

# The proportion of common pheasants shot using lead shotgun ammunition in Britain has barely changed over five years of voluntary efforts to switch from lead to non-lead ammunition

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## SUMMARY

Since 2020, the SHOT-SWITCH research project has monitored the proportion of wild-shot common pheasants *Phasianus colchicus* in Great Britain that were killed using lead and non-lead shot. This was set up in response to UK shooting and rural organisations' announcement that game shooters should make a full voluntary transition from lead to non-lead shotgun ammunition by 2025 and initiatives by retailers and wholesalers of game meat products. In the study's fifth and final season (2024/2025), 99% of pheasants obtained from businesses other than Waitrose & Partners had been killed using lead ammunition. There has only been a slight, non-significant downward trend in the proportion of pheasants killed using lead shot over the five-year transition period. Although some food retailers have stated their intention to cease selling game meat products from animals killed using lead ammunition, our study indicates that these initiatives have made limited progress so far. It appears that voluntary efforts to encourage shooters to switch from lead to non-lead shotgun ammunition for game shooting have been unsuccessful and have been diminishing as the deadline for complete transition approached.

## BACKGROUND

Lead is used to make most of the shotgun and rifle ammunition used to shoot game animals in the United Kingdom and most European Union (EU) countries. It is currently lawful to use lead shotgun ammunition for live quarry shooting in both jurisdictions, except in wetlands and in all habitats in Denmark, the Netherlands, and Flanders (Belgium). In the UK, the Royal Commission on Environmental Pollution proposed replacement of lead shot with non-toxic alternatives more than 40 years ago (Royal Commission on Environmental Pollution 1983). However, governmental advisory bodies in Britain and the EU have only recently followed up on this by recommending bans on the use of lead shotgun cartridges and rifle bullets for most types of game shooting in all habitats because of the negative impacts of lead on wild animals (mainly birds) and on human health (European Chemicals Agency 2023; UK Health and Safety Executive 2024). The appropriate authorities have yet to decide on whether and how to act upon these recommendations. Since 2010, UK governments

have preferred voluntary controls in several environment and food policy areas and have suggested that regulation should only be used as a last resort (National Audit Office, 2014). We do not know whether the current government will take a different view, so it is uncertain whether the ban on live quarry shooting with lead ammunition recommended by the UK Health & Safety Executive will be implemented.

The 2024/2025 shooting season is the fifth and final season of an intended complete voluntary transition proposed in 2020 by the leading UK shooting and rural organisations from the use of lead to non-lead shotgun ammunition for shooting game animals in all habitats (BASC 2020). Had this been successful, it might have removed any suggested need for additional regulation of the use of lead ammunition of this type. Separately from this initiative, some food retailers, game meat producers and game dealers have announced that they would voluntarily cease supplying game meat products from animals killed using any type of lead ammunition (Barkham 2019; Marks & Spencer 2019; Wild Justice

2022). If successful, these changes might have provided a further stimulus for a change in practice with regard to the use of lead ammunition and its effects on wild species. Specialist organisations have also been established by shooting and rural non-governmental organisations to promote the consumption of game meat as healthy and sustainable food. As part of this promotional effort, registers of game shoots where no lead ammunition is used were established for the purpose of identifying shoots from which food suppliers could be assured of obtaining lead-free game meat.

In this paper, we report on progress with these voluntary initiatives by measuring the overall change in the proportions of dissected carcasses of the most frequently shot and consumed small game species, the common pheasant (*Phasianus colchicus*) from which lead and non-lead shotgun pellets were recovered at the end of the transition period.

## ACTIONS

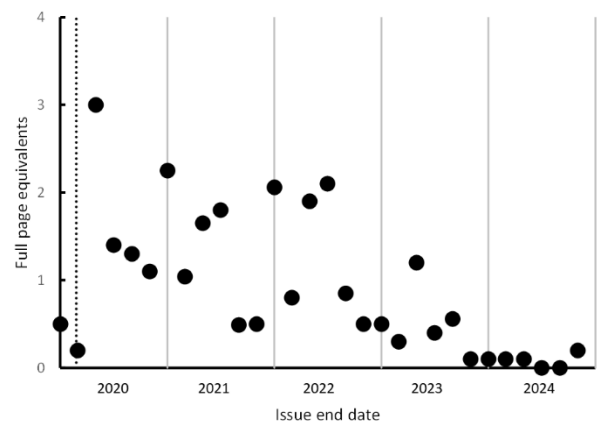
### Proposed five-year voluntary transition from lead to non-lead shotgun ammunition and efforts by shooting and rural organisations to promote its adoption by game shooters

In February 2020, nine of the UK's leading shooting and rural organisations called for a complete voluntary transition from the use of lead to non-lead shotgun ammunition for live quarry shooting within five years 'in consideration of wildlife, the environment and to ensure a market for the healthiest game products at home and abroad' (BASC 2020). Some of these organisations followed up on this announcement with substantial efforts to publicise and promote its adoption by their members and other shooters. The British Association for Shooting and Conservation (BASC) has provided opportunities for thousands of game shooters to try shooting with non-lead ammunition at various events throughout the UK, such as game fairs. Detailed practical advice about making the transition has been made freely available through guides on the websites of BASC and the Game and Wildlife Conservation Trust (GWCT) (BASC 2022; GWCT 2022). Magazine articles and social media posts informing and encouraging the transition were published by these organisations. They have also encouraged the ammunition manufacturing industry to produce a wider range of types of non-lead shotgun ammunition and informed them about perceived shortcomings, identified by feedback from their members, of previously existing products.

A major source of up-to-date information for shooters on the transition has been the bi-monthly magazine *Shooting and Conservation*, which is distributed by BASC to its 150,000 members (BASC 2024a). We read all 30 of the issues for the period November 2019–October 2024 and found 116 items that mentioned the transition. These included articles, readers' letters, readers' queries with responses from BASC staff, news items, assessments of the performance of non-lead shotgun ammunition, experiences of

shooters in Denmark and announcements about training and advisory events concerning the transition. We excluded items about draft proposals by the European Union and the UK Health & Safety Executive to introduce statutory regulation of lead ammunition, except for any parts that mentioned the role of the voluntary transition. For each item, we judged the length, by eye, of those parts of the item that referred directly to the transition. We expressed the length of the text covering this content as the proportion of a full page of text of standard font size, estimated to the nearest 10%. We did not include images and large-font headlines in this assessment.

As expected, the number of full-page equivalents of text about shooters voluntarily switching to non-lead shotgun ammunition was low in the two issues of the magazine compiled just before publication of the transition on 24th February 2020, although the possibility of such a change was mentioned in both (Figure 1). In the 28 issues published after the declaration (March-April 2020 issue onwards), there was substantial coverage of the proposal for about three years and it was overwhelmingly positive regarding both the potential value of the change and its practicality. However, there was a marked and statistically significant decline in coverage of the transition during the time since it was announced (Spearman rank correlation coefficient  $r_s = -0.798$ ,  $p < 0.001$ ), with few mentions of the transition from mid-2023 onwards (Figure 1).



**Figure 1.** Change over time in the number of full-page equivalents per magazine issue covered by text in items about shooters voluntarily switching from lead to non-lead shotgun ammunition published in the BASC members' magazine *Shooting and Conservation*. Each symbol refers to coverage of the topic in one issue, with values plotted against the end date of the two-month period covered by each issue. The vertical dotted line shows the date of publication of the joint declaration calling for a complete voluntary transition from lead to non-lead shotgun ammunition for live quarry shooting within five years.

### **Voluntary transition by food wholesalers and retailers to game meat products from animals killed using non-lead ammunition**

In 2019, food retailers Waitrose & Partners and Marks & Spencer both announced their intentions to stop selling game meat products from animals killed using lead ammunition (Barkham 2019; Waitrose 2020; John Lewis Partnership 2023; Marks & Spencer 2019; 2022). However, we found few, if any, oven-ready pheasants available for purchase in their stores in the first three of our previously published surveys (Green *et al.* 2021; 2022; 2023a). Waitrose began selling this product again in quantity in January 2024 and we reported on the outcomes separately from those for carcasses obtained from other sources in Green *et al.* (2024). Waitrose also sold oven-ready pheasants in the most recent 2024/2025 shooting season and we report the outcomes later in this paper. We did not find oven-ready pheasants in Marks & Spencer stores in October-December 2024.

The National Game Dealers Association (NGDA) made a commitment to obtain all game meat from birds and mammals killed without using lead ammunition with effect from 1<sup>st</sup> July 2022. Although this commitment was posted on the NGDA's website until 6<sup>th</sup> January 2023, it was removed soon afterwards. A screenshot of the NGDA's original announcement can be viewed at Wild Justice (2022). In our previous survey of pheasant carcasses in the 2022/2023 shooting season (Green *et al.* 2023), we recovered shotgun pellets from 57 carcasses obtained from 11 NGDA member businesses and found that they were all principally composed of lead. Although we therefore conclude that the NGDA's commitment to non-lead ammunition has lapsed, we report results from pheasants obtained for NGDA member businesses in the 2024/2025 shooting season later in this paper.

#### **Registers of lead-free shoots**

The idea of a register of lead-free shoots was initiated by British Game Assurance (BGA; previously British Game Alliance). Its stated purpose was to allow retailers of game meat products to find sources of meat from game animals shot using non-lead ammunition. Shoots that elected to join the BGA Lead-Free Register (Peters 2021) were obliged only to use non-lead shot. In 2023, we requested information from BGA on the number of lead-free gamebird shoots on this register but no information was provided, except that insufficient lead-free gamebird meat was available at that time to conduct a previously proposed trial intended to increase its use as a healthy food (Bonner 2022). When BGA ceased to operate in 2023, its activities were transferred to two other organisations Aim to Sustain (A2S) and Eat Wild. A2S decided not to operate a lead-free register, but Eat Wild, through its partner Back British Game, still advertises a lead-free register as being open to shoots (Back British Game 2024). We asked Eat Wild and Back British Game in 2024 how many shoots had joined the lead-free register and

were informed that the scheme is now defunct. These are the only UK lead-free registers we found any publicity about in 2023 and 2024 in online searches using variants of the terms 'lead free game' and 'lead free register'. Responses from 39 retailers of foods based upon game meat products to a questionnaire survey conducted in 2023 indicated that three of them (8%) sold any gamebird meat products labelled as lead-free and one respondent (3%) had ever found the lead-free register useful (Green 2023).

Some lead-free pheasant shoots exist. A shoot at Warter Priory in East Yorkshire stopped allowing lead shot to be used at the beginning of the 2022/2023 shooting season (ShootHub 2023). The GWCT's demonstration shoot at Loddington in Leicestershire (part of the Allerton Project) has been lead free since the beginning of the 2023/2024 shooting season. Both shoots appear to have effective methods for ensuring compliance with their policy (ShootHub 2023; GWCT 2024). In 2024, we asked the GWCT if the Loddington shoot would be joining a lead-free register. A director replied that this was a desirable outcome but was not possible because there were no such registers operating (R. Draycott, GWCT Director of Advisory and Education, pers. comm., 2 January 2025). We conclude that we know of no evidence of any lead-free registers for gamebird shoots operating in the UK.

## **CONSEQUENCES**

### **Obtaining pheasant carcasses**

In November – December 2024, we obtained 255 whole or oven-ready prepared pheasant carcasses from shoots and retailers of game meat (57 from Waitrose and 198 from other retailers).

### **Extracting shotgun pellets**

We dissected the carcasses and examined soft tissues and broken bones to search for embedded shotgun pellets using methods described elsewhere (Green *et al.* 2021; 2022; 2023a; Environmental Research Institute 2024). We recovered 350 shot (between one and 12 shot per carcass with shot) and/or large shot fragments from 171 carcasses (67% of those processed) from sources other than Waitrose and 47 shot (between one and four shot per carcass with shot) from 33 carcasses (58% of those processed) from Waitrose stores. The proportions of carcasses from which no pellets were recovered are similar to those from previous studies (Pain *et al.* 2010; Green *et al.* 2021; 2022; 2023a; 2024). The reasons for no pellets being recovered from a substantial proportion of the birds examined, despite the presence of wounds from shotgun pellets, are discussed elsewhere (Pain *et al.* 2010; Green *et al.* 2024).

Carcasses from which at least one shotgun pellet was recovered, obtained from businesses other than Waitrose, came from 48 businesses located in eight of the ten NUTS (nomenclature of territorial units for statistics) Level 1 regions in Great Britain (Office for National Statistics 2024). Based upon information

obtained from suppliers, the NUTS region in which the pheasant was probably shot was known for 90% of these carcasses, which were from seven of the NUTS regions. The types of businesses, other than Waitrose stores, from which the carcasses were obtained were butcher's shops ( $n = 125$  carcasses), farm shops (22), game dealers (13), online retailers (7) and shoots (4). Carcasses from which at least one shotgun pellet was recovered were obtained from 13 Waitrose stores located in six NUTS regions.

#### Chemical analysis of pellets

Qualitative examination and chemical analysis of the recovered shotgun pellets was conducted at the Environmental Research Institute, University of the Highlands and Islands, Thurso, UK. Methods used were as described previously (Green *et al.* 2021; 2022; 2023a). In cases where more than one pellet was recovered from a carcass, we carried out qualitative tests to assess whether they were likely to be of the same or different metallic compositions. Multiple pellets from the same carcass were all found to be of the same type, except for two carcasses from which both magnetic and non-magnetic pellets were recovered. We selected a single pellet of each type from each carcass to determine its principal metal composition. We dissolved each pellet in acids 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; 2023a). We considered a pellet to be principally composed of an element if that element was estimated to comprise 50% or more of its initial mass.

#### Chemical composition of pellets

The principal element in 170 of the 171 shotgun pellets analysed from carcasses obtained from businesses other than Waitrose was lead. One pellet was composed principally of iron. None of the pellets was composed principally of bismuth, copper, tungsten, tin or zinc, which the ICP-OES assays also measure. The percentage of carcasses with at least one lead shot recovered, as a proportion of carcasses obtained from non-Waitrose businesses with shot of any type recovered, was 99% (Clopper-Pearson 95% binomial confidence limits 97 – 100%). We recovered shotgun pellets from 13 carcasses obtained from three businesses that are members of the National Game Dealers Association, and which undertook not to sell meat from any game killed using lead ammunition from 2022 onwards. All of the shot recovered from these carcasses was composed principally of lead.

The principal element in 19 of the 35 shotgun pellets analysed from carcasses obtained from Waitrose stores was lead. Nine pellets were composed principally of iron and seven of bismuth. None of the pellets were composed principally of copper, tungsten, tin or zinc. Both lead and iron shot were recovered from two

carcasses. The percentage of carcasses obtained from Waitrose stores with at least one lead shot recovered, as a proportion of carcasses with shot of any type recovered, was 58% (Clopper-Pearson 95% binomial confidence limits 39 – 75%). The proportion of carcasses from which lead shot were recovered was significantly lower for carcasses obtained from Waitrose stores than for those from other sources (58% cf. 99%; Fisher exact test, two-tailed  $p < 0.001$ ).

#### Changes across shooting seasons from sampling of businesses other than Waitrose

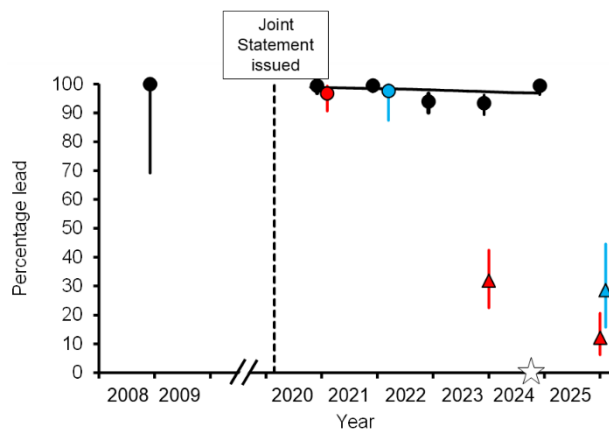
We compared our results with those from earlier SHOT-SWITCH monitoring (Green *et al.* 2021; 2022; 2023a; 2024) and an earlier study of pheasant carcasses collected in the 2008/2009 season reported by Pain *et al.* (2010) (Table 1, Figure 2). In 2024/2025, 99% of pheasants with any shot recovered contained lead shot. This proportion was higher than in the preceding season, when it was 93%. We fitted a logistic regression model to the data in Table 1, including data from 2008/2009, which is well before the beginning of the transition period. We treated the number of years elapsed since the 2008/2009 season as the independent variable in the regression. We detected no evidence of a significant trend ( $\text{logit}(P_{Pb}) = 7.177 - 0.2629 \cdot \text{YEAR}$ ,  $t_4 = 1.93$ , two-tailed  $p = 0.126$ ). In this analysis, we used the proportion of carcasses with shot recovered in which at least one lead shot was found as the dependent variable. Ellis & Miller (2023) proposed an alternative measure, which is the proportion of all carcasses dissected in which at least one lead shot was found. This measure is also shown in Table 1. Based upon four independent lines of evidence presented by Green *et al.* (2024), we do not consider that the measure proposed by Ellis & Miller (2023) is an accurate alternative to the one we have used. However, even if it is adopted, the results shown in Table 1 indicate no evidence for a downward trend over time in the proportion of pheasants killed using lead shotgun ammunition. Indeed, the trend estimate for this alternative measure is marginally positive rather than negative ( $\text{logit}(P_{Pb}) = 0.2769 + 0.0244 \cdot \text{YEAR}$ ,  $t_4 = 0.85$ , two-tailed  $p = 0.442$ ).

#### Change from sampling from Waitrose stores since the 2023/2024 season

The estimate of the proportion of Waitrose carcasses from which lead shot were recovered in 2024/2025 was significantly lower than for 2023/2024 (58% in 2024/2025 cf. 91% in 2023/2024; Fisher exact test, two-tailed  $p = 0.014$ ). We could only estimate this proportion separately for Waitrose stores and other businesses in the two most recent seasons since they implemented their intended change to only selling game killed without the use of lead ammunition because we did not find oven-ready pheasants on sale in Waitrose stores in the 2021/2022 and 2022/2023 shooting seasons.

**Table 1.** Numbers of pheasant carcasses obtained from businesses other than Waitrose and numbers with lead, iron, bismuth, zinc and shot of all kinds recovered in each of the five seasons of the SHOT-SWITCH project (2020/2021 to 2024/2025) and from an earlier study in 2008/2009 (Pain *et al.* 2010). 95% Clopper-Pearson confidence limits of percentages are given. \*one carcass contained lead and iron pellets. +one carcass contained zinc and iron pellets.

Number of carcasses examined	Shooting seasons					
	2008/09	2020/21	2021/22	2022/23	2023/24	2024/25
Total	22	276	336	356	340	255
with shot recovered	12	180	215	235	229	171
with no shot recovered	10	96	121	121	111	84
with lead shot recovered	12	179*	214	221	214	170
with iron shot recovered	0	2*	1	10	9+	1
with bismuth shot recovered	0	0	0	4	3	0
with zinc shot recovered	0	0	0	0	4+	0
Percentage with lead of those with any shot	100	99	100	94	93	99
95% C.L.	74 – 100	97 – 100	97 – 100	90 – 97	89 – 96	97 – 100
Percentage with lead of all carcasses	55	65	64	62	63	67
95% C.L.	32 – 76	59 – 70	58 – 69	57 – 67	58 – 68	61 – 72



**Figure 2.** 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 five recent SHOT-SWITCH studies (Green *et al.* 2021; 2022; 2023a; 2024; and the present study). The vertical lines associated with the black circles are 95% confidence intervals. The curve is from a logistic regression model fitted to the data from the six surveys. The white star represents the intended endpoint of the voluntary complete transition to the use of non-lead shotgun ammunition advocated by nine shooting and rural organisations in February 2020. Red and blue circles represent reported proportions of large gamebird shoots continuing to use lead shot, with their 95% confidence intervals shown by vertical lines, based upon questionnaire surveys by Savills (2021: red) and Savills (2023: blue). Red and blue triangles are proportions of shoots stating their intention at the future time shown to still be using lead shot, as reported at the time of the two Savills surveys.

## DISCUSSION

Our results from monitoring the types of shotgun pellets recovered from pheasants obtained from businesses other than Waitrose in all five years of the intended voluntary transition from lead to non-lead shotgun ammunition show no significant downward trend in the proportion of carcasses with lead shot recovered. The proportion of birds killed using lead shot has remained well over 90% (Green *et al.* 2021, 2022, 2023a, 2024) in all five seasons.

The findings from our previous surveys were reasonably consistent with those from questionnaire surveys of the self-reported practice of a sample of large gamebird shooting estates up to the 2021/2022 shooting season (Savills 2021; 2023). The surveys of shooting estates in those years indicated that over 95% of them were continuing to permit the use of lead shotgun ammunition in the 2020/2021 and 2021/2022 shooting seasons. However, the respondent estates reported that most intended to have phased out lead shot progressively by the 2024/2025 season (Savills 2021; 2023; Figure 1). Despite this, the proportion of pheasants killed using lead in recent seasons has been much greater than the proportion of estates that had earlier expected that they would still be allowing the use of lead shot (Figure 1).

The undertaking by the National Game Dealers Association (NGDA) that member businesses would not sell any game killed with lead ammunition from the beginning of the 2022/2023 season appears not to have been implemented in any season (Wild Justice 2022; Green *et al.* 2023a). Waitrose announced its intention to sell only game meat products from animals killed using non-lead ammunition in 2019 (Barkham 2019), however, there were supply issues (Green *et al.* 2023a). A high proportion of the pheasant carcasses from Waitrose stores sampled for this study also contained lead shot (58%), but there had been a significant decline

from 91% reported in 2024 (Green *et al.* 2024). Marks & Spencer also stated its intention to sell only game meat products from animals killed using non-lead ammunition in 2019, but we have found it difficult to source adequate samples of oven-ready pheasant products from Marks & Spencer stores. Hence, voluntary changes by food wholesalers and retailers towards selling only gamebird meat products from birds killed using non-lead ammunition have achieved only limited success and therefore seem unlikely to have had a substantial effect on the exposure of wild species to ammunition-derived lead.

We conclude that the efforts made by shooting and rural organisations during the five years since their announcement of a voluntary transition have had little or no effect on the types of ammunition used by hunters to shoot pheasants intended for the retail trade. In a response to the publication of the Opinion of the Health & Safety Executive that the use of lead ammunition should be banned, BASC suggested (BASC 2024b) that an achievement of the transition period they had proposed five years previously was that it 'gave the ammunition manufacturers time to .... deliver a range of viable alternatives to lead'. However, the shooting organisations considered in 2020 that the complete switch from lead to non-lead shotgun ammunition was achievable with ammunition types existing at that time. As far as we are aware, none of the shooting and rural organisations gave regular quantitative feedback to their members and other gamebird shooters, based upon results from our monitoring project or any other source, on the progress being made towards the objective of the transition. We conclude that at the end of the intended complete voluntary transition from the use of lead to non-lead shotgun ammunition for hunting pheasants, little progress had been made in delivering its objective.

The appropriate authorities will decide in March 2025 whether or not to introduce regulations to restrict the use of lead ammunition for shooting game animals. Regardless of that decision, our results suggest that continued studies to monitor future responses by game shooters to interventions intended to achieve changes in shooting practice, either by regulation or by voluntary means, would be both useful and feasible.

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This paper is the fifth 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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