Project title:	Brassicas, leafy salads, oilseed rape and legumes: Developing and evaluating management strategies to mitigate woodpigeon *Columba palumbus* damage to crops.
Project number:	FV426A
Project leader:	Dr Dave Parrott, National Wildlife Management Centre, Animal and Plant Health Agency
Report:	Annual report, April 2017 (year 2 of 3)
Previous report:	Annual 2016
Key staff:	Dr Dave Parrott (APHA), Rebecca Jones (APHA), David Fouracre (APHA), Nigel MacDonald (Austin Consultancy)
Location of project:	Lincolnshire (Year 2, 2016/17)
Industry Representative:	Andy Richardson (Allium and Brassica Centre), Stephen Francis (Fen Peas Ltd), Dermot Tobin (PDM Produce UK Ltd.)
Date project commenced:	01/05/2015
Date project completed (or expected completion date):	31/03/2018

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AUTHENTICATION

We declare that this work was done under our supervision according to the procedures described herein and that the report represents a true and accurate record of the results obtained.

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CONTENTS

GROWER SUMMARY

Headline

The key message from research findings will not be evident until the project is completed in 2018. Then, a successful outcome will provide best-practice guidance in respect to an integrated woodpigeon management strategy aimed at reducing woodpigeon grazing and associated crop damage to levels acceptable to growers.

Background

The woodpigeon is recognised as a major agricultural pest in the UK, feeding on a range of arable crops including horticultural brassicas, leafy salads, oilseed rape and legumes. Existing woodpigeon management practices, across all crops, are frequently ineffective and often costly, particularly for high value horticultural brassicas and lettuce. The current research project focusses on developing and evaluating management strategies that integrate the most promising deterrent techniques (current and novel) and other measures (e.g. shooting) – taking forward the current knowledge on woodpigeon management reviewed in FV426.

Summary

Population management (shooting)

- The effectiveness of shooting and impact on woodpigeon abundance within an 8,200ha area in Lincolnshire was evaluated over a 10-week period April to mid-June 2016.
- There were four categories of land with: (i) shooting undertaken by APHA staff only, (ii) shooting undertaken by APHA staff and landowner appointees, (iii) shooting undertaken only by landowner appointees, and (iv) no shooting. Landowners/growers provided shooting returns - this included a number of returns from land outside the study area.
- Over the 10-week trial, 2137 woodpigeons were reported shot in total, 1575 within the study area.
- Of the 2137 woodpigeons reported shot, APHA marksmen accounted for 955 (45%) (60% of the 1575 shot within the study area). Of the 955 woodpigeons shot by APHA marksmen 57% involved shotguns and 43% air rifles. Four landowners/growers reported total bags of: (i) 639 (30%), (ii) 251 (12%), (iii) 134 (6%) and (iv) 158 (7%); all involved shotguns only. No other landowners/growers reported shooting returns.
- Within the study area, apart from weeks three and ten, in each of which over 300 woodpigeons were shot, weekly bags averaged 117 birds (72-182).
- Numbers of woodpigeons observed in the study area decreased from a mean of 1661 in the first two weeks of April, thence remaining relatively steady over the following 8 weeks fluctuating around a mean of 728 (387-1386), i.e. there was not a continuous decline in

woodpigeon numbers over the trial.

- The landowner/grower returns reflected a number of different approaches to shooting woodpigeons: (i) full-time pest control: exhibited consistent effort to shoot woodpigeons across the 10-week treatment period; (ii) early period shooting: shot woodpigeons during each of the first four weeks only. A lack of vulnerable crops during the latter half of the trial, removing the impetus to undertake further control; (iii) sporadic shooting (keepering): generally every second week during the first six weeks of the trial; again ceasing in the latter period of the study, and (iv) sporadic shooting (sport shooting) – generally one day every second week throughout the 10-week trial.
- There was little, or no, apparent cooperation between neighbouring growers, with individual growers restricting shooting effort on their land to vulnerable periods in the growing cycle of their own crops.
- For sport shooting, the spatial and temporal distribution of hunting appears to be dictated by the convenience and protectionism of shooters' 'patches', with the onus on ensuring good days' bags for those with shooting rights; access to hunt by others being denied. An effect of sport shooting is that during the period between successive shoots, woodpigeons have access to holdings that serve as safe havens.
- Sport shooters were also resistant to what they perceived as overly intense shooting management, seeking to retain healthy populations for sport.
- There are similar issues associated with landowners/growers shooting independently of neighbours.
- The current approach to shooting woodpigeons in the study area is not consistent with maximising either population management or overall crop protection. Effort focussed at the scale of the needs of individual holdings and the aspirations of sport shooters constrains the overall impacts of wider control. A more effective approach to population management would require greater cooperation between growers, a strategic approach focussed at the landscape-scale and removal of the 'protectionism' of shooters 'patches'.

Roost management (hand-held laser)

- A small-scale investigation (January 2017) tested whether a low-powered, hand-held laser could disperse woodpigeons from a habitual winter night time roost.
- The trial involved three sequential one week phases (pre-treatment, treatment, post-treatment) with a laser deployed at a roost at dusk on each of five consecutive evenings during the treatment period. A second untreated roost 6km away was simultaneously monitored for comparison.

- At the laser treatment roost, the median number of woodpigeons declined by 78% at dusk counts and 98% at dawn counts during the treatment period compared to the pre-treatment period. At the control roost; numbers increased by 68% and decreased by 6% respectively.
- By the end of the 5-day post-treatment period numbers of woodpigeons at the laser roost recovered to pre-treatment levels.
- During the treatment phase, numbers of woodpigeons observed during the day in a $1km^2$ area surrounding the roost increased by 25% at the laser roost and by 83% at the control roost.
- Low-powered, hand-held lasers have a potential use in disrupting woodpigeon roosts but indications are that repeated applications are required.

Financial Benefits

The financial benefits of the research will not be evident until the project is completed in 2018.

Action Points

Action points derived from the research findings will not be evident until the project is completed in 2018.

SCIENCE SECTION

Introduction

The woodpigeon is recognised as a major agricultural pest in the UK, feeding on a range of arable crops including horticultural brassicas, leafy salads, oilseed rape and legumes. The UK population has been estimated to have increased by 40% over the short-term (1995-2011) (Risely *et al*. 2013) and by 134% over the longer-term (1970-2011) (Eaton *et al.* 2013) and was last estimated formally in 2009 at 5.4 million pairs (Musgrove *et al*. 2013). The rate of population increase over this period has varied between different regions.

Current costs of woodpigeon damage to the individual grower sectors are not known. A recent estimate of woodpigeon damage to the overall UK oilseed rape crop was approximately £2 million for a 'low impact' year (2% of national crop severely damaged) and approximately £5 million for a 'high impact' year (5% of national crop severely damaged) – based on an average loss of £131 per ha for severely damaged crop (figures presented at a National Farmers Union Bird Deterrent Event, Dec 2014).

The current project (FV 426A) takes forward the findings of an APHA (2014) review (FV 426: A review of the woodpigeon costs to brassicas, salad crops and oilseed rape and the effectiveness of management activities) in order to address gaps in practical woodpigeon management to mitigate crop damage. The project aims to develop and evaluate different control measures to reduce woodpigeon grazing activity, and by association crop damage, to acceptable levels and provide growers with best practice advice.

The study will last a period of three years and at the outset incorporated four main research elements:

i. Field trials of deterrents (traditional and novel)
ii. Population management (shooting)
iii. Woodpigeon movement patterns in response to management
iv. Preliminary evaluation of the application of drones in monitoring and management.

Proposals for re-focusing project elements, in light of findings from the first year's trials and subsequent steering group discussions, formulated five work elements to be undertaken in years 2 and 3 of the project:

i. Deterrents to deter woodpigeons at field-level (Year 3)
ii. Aerial drone to deter woodpigeons at field level (Year 3)
iii. Roost management with low-powered hand-held lasers (Year 2)
iv. Field-level management with an automated laser (Year 3)
v. Investigate the use of taste repellent treatments (work being done by Stephen Francis with PGRO during Year 2, but will be reported in Final report).

Project aim:

The overarching project aim is:

- To develop and evaluate the effectiveness of management measures to mitigate the impact of woodpigeon damage to horticultural brassicas, leafy salads, oilseed rape and legumes.

Project objectives (years 2 and 3):

- To undertake field trials to evaluate the effectiveness of deterrents deployed in an integrated management strategy (IMS) on the crops of interest. The techniques and approaches to be evaluated will include those that have been identified in a previous Animal and Plant Health Agency (APHA) review of management options (Parrott *et al*. 2014: FV426).
- To undertake a small-scale investigation to evaluate whether low-powered, hand-held lasers can disperse or relocate woodpigeons from a habitual night roost.
- To undertake preliminary evaluation of the potential for the application of an automated laser to reduce woodpigeon grazing at field-level.
- To undertake preliminary evaluation of the potential for the application of an unmanned aerial vehicle (drone) in deterring woodpigeon grazing at field-level.
- To carry out a field trial using commercially available taste repellent products (GRAZERS) in a replicated field trial (work ongoing in 2017, to be reported in final report).

This annual report details work undertaken in the second year of project FV 426A (1st April 2016 - 31st March 2017) which involved: (i) an evaluation of the effectiveness of shooting and its impact on woodpigeon abundance within a delineated study area; (ii) a small-scale investigation to evaluate whether low-powered, hand-held lasers can disperse woodpigeons from a habitual night roost.

Materials and methods

Shooting

The effect of shooting on the numbers of woodpigeons within a defined area was undertaken over a 10-week period April to mid-June 2016. The trial took place in an area of approximately 8,200ha in Lincolnshire (Figure 1) with cooperation from 20 landowners representing around 66% of that land area. On these holdings, landowners either allowed access to APHA marksmen to undertake shooting and/or undertook the shooting of woodpigeons themselves.

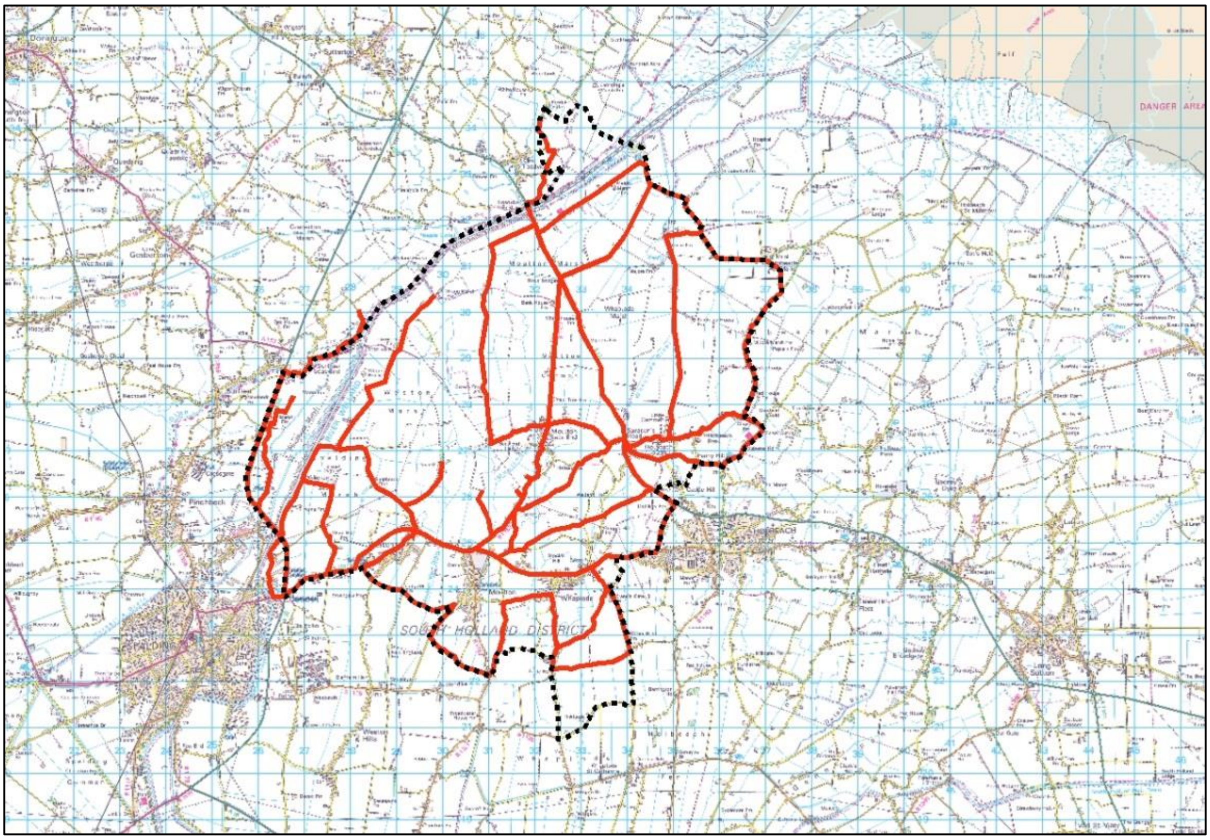

Figure 1. Study area (8200ha) for woodpigeon shooting trial. Dotted line = boundary, red line = transect route for monitoring woodpigeon numbers.

Thus, within the overall 8,200ha study area, there were four categories of land:

- Shooting undertaken by APHA staff only
- Shooting undertaken by APHA staff and landowner appointees
- Shooting undertaken only by landowner appointees
- No shooting undertaken by landowner appointees, nor APHA staff

Shooting by APHA staff commenced during the week of 4th April and ended during the week commencing 5th June (10 weeks). The APHA shooting team involved two marksmen who conducted a total of 380 gun-hours over the 10-week period; representing 66% of the combined total reported 575 gun-hours.

All landowners were supplied with a data sheet for recording the details of any woodpigeon shooting sessions that were conducted by their own appointed shooters during the 10-week trial. Returns of data were requested regularly during the trial.

During the shooting period, weekly surveys of woodpigeon abundance across the study area were undertaken. Individual surveys involved following a pre-determined driven transect (112km), using roads and farm tracks, through the study area to record woodpigeon activity (Figure 1). Transects were completed twice per week, being followed in opposite directions on consecutive days. For all woodpigeons encountered, the number, location, habitat (e.g. field, trees, hedge) and activity (grazing, loafing, perched) were annotated onto large scale OS maps. The largest number of woodpigeons recorded on any one of the two consecutive survey days was taken as the maximum for that week. These counts represent an index of abundance and not a census of absolute numbers. However, as the observer effort (route and time taken) was comparable between surveys, the counts facilitated detection of changes in relative abundance and areas of activity across the study area.

The total numbers of woodpigeons observed in the study area was compared to the total numbers of woodpigeons reported shot per week over the 10-week period.

Laser disturbance at night roost

A trial of the control of a selected traditional night roost using a low-powered, hand-held laser was undertaken in January 2016. Data on woodpigeon numbers within study roosts (treatment and control) and on neighbouring fields utilised by woodpigeons was compared before (pre-treatment), during (treatment) and after (post-treatment) disturbance with a laser.

The investigation involved a single trial involving one treatment roost (laser) and one control roost (no treatment); roosts were approximately 6km apart. The trial involved three sequential one week phases (pre-treatment, treatment, post-treatment) with a laser deployed at dusk on each of five consecutive evenings during the treatment period. Woodpigeons were disturbed both when attempting to land in the roost and within the roost. During the first evening's deployment of the laser, in the first instance a small pen-type laser was deployed; but due to limitations in its strength and range it was replaced by a larger commercially marketed hand-held laser (Portek Laserstrike). Only the latter laser was deployed on the subsequent four evenings. During all three phases, counts were undertaken of woodpigeons at the roost each evening and following dawn (treatment and control roosts).

Prior to the treatment phase, a suitable location was identified from which the laser could be safely deployed onto the treatment roost (e.g. avoiding the laser engaging roads or habitation). The location was at a distance of approximately 180m from the roost (rather than within/under the roost trees), in order to mimic how roost disturbance would be undertaken in practice. During the treatment phase, at each dusk deployment of the laser, the fieldworker undertaking the treatment took up position in the pre-identified location. The laser was deployed on any woodpigeons perched in the roost and on birds attempting to land in the roost. The laser was deployed in short bursts to minimise the risk of burning out components; a risk if the laser is engaged continuously for extended periods. Laser deployment repeatedly targeted birds until it was too dark to see. A second fieldworker continuously monitored numbers of woodpigeons present in the roost and movements to and from the roost.

During each of the experimental periods an area with a radius of 1km around each of the roosts was surveyed for woodpigeons twice daily, once in the morning and once in the afternoon. The larger of the two daily counts was taken as the maximum number of woodpigeons using that area for that day. The predominant land cover in each of the areas was ploughed earth (laser roost: 42%, control roost 56%).

Counts of woodpigeons during the pre-treatment, treatment and post-treatment periods were compared between the treatment and control roost. Likewise, counts of woodpigeons during the three periods were compared between the 1km radius areas surrounding the roosts.

Results

Shooting returns

Landowner/grower returns included some shooting sites outside the study area. The data, therefore, is analysed in two ways. First, all shooting data is used to evaluate the effectiveness of different shooting techniques and strategies between and within shooting groups. Second, data only from shooting sites within the study area is used to investigate woodpigeon abundance in relation to shooting activity.

Over the 10-week period, a total of 2,137 woodpigeons were shot (Table 1). APHA marksmen accounted for 955 (45%) of these woodpigeons.

Of the 20 landowners/growers cooperating with the study, only four provided shooting returns; the remainder either traditionally never undertook shooting, or traditionally did undertake some shooting but reported not do so during the 10-week trial. Reasons for not shooting included an absence of vulnerable crops during the trial and hence no woodpigeon problems and being fully occupied on other tasks.

Table 1. Summary of shooting returns (inside and outside the 8200ha study area)

Organisation	Sessions (days)	Gun-hours	WPs killed	WPs killed (%)	Kills/gun-hour
APHA	32	381	955	44.7	2.5
Grower 1	13	86	639	29.9	7.5
Grower 2	11	65	251	11.7	3.9
Grower 3	9	31	134	6.3	4.4
Grower 4	4	12	158	7.4	13.2
Grower 5-20	0	0	0	0	0
Total		575	2137	100.0	3.7

The shooting activity and returns illustrated a number of different approaches to shooting woodpigeons (Figure 2).

APHA (full-time pest control): consistent effort to control woodpigeons across permissible land.

Grower 1 (full-time pest control): exhibited generally consistent effort to control woodpigeons throughout the 10-week treatment period. This grower also shot woodpigeons during four of the five weeks (March) preceding the 10-week trial period (killing a further 355 woodpigeons; a total of 994 over a 15-week period).

Grower 2 (grower appointee): shot woodpigeons each week during the first four weeks only. This was due to a lack of vulnerable crops during the latter half of the trial, removing the impetus to undertake further control.

Grower 3 (gamekeeper): shooting sessions were sporadic during the first six weeks of the trial; again ceasing in the latter half. This was again consistent with limiting shooting to periods when vulnerable crops were available.

Grower 4 (grower appointee): shot on only four occasions spread through the 10-week period, generally fortnightly. This approach was consistent with shooting woodpigeons for sport.

Over the 10-week period, the numbers of woodpigeons shot was generally in the order of 100-200 birds per week with some peaks of over 300 birds (Figure 2).

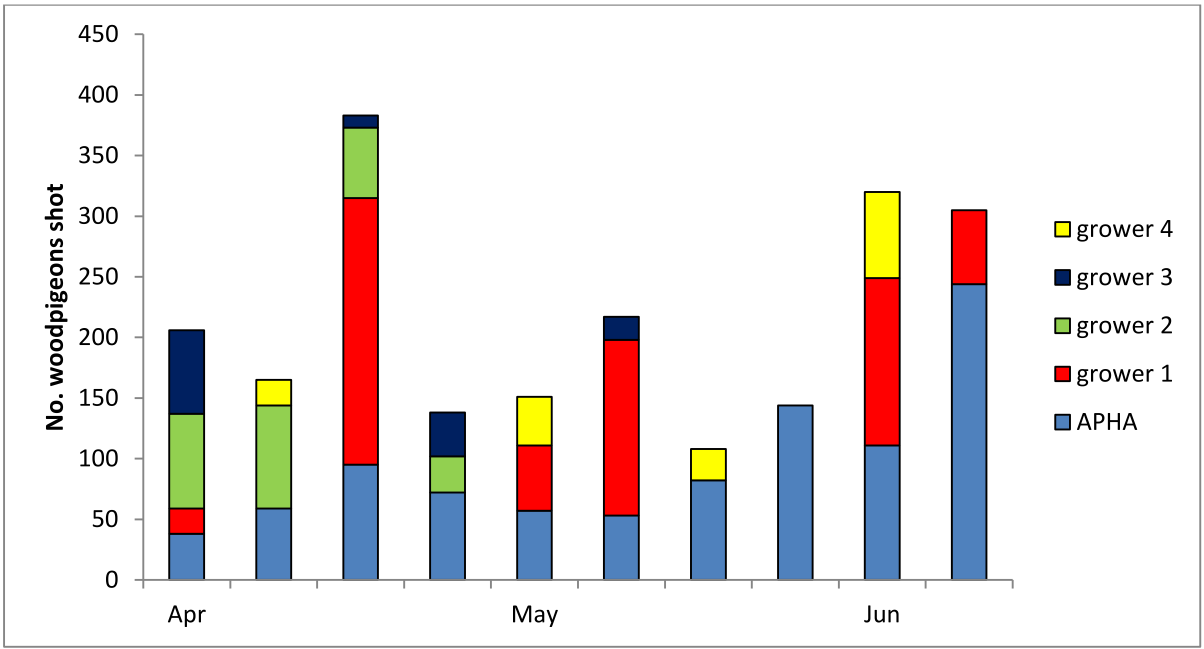

Figure 2. Total numbers of woodpigeons reported shot per week (inside and outside 8200ha study area) during the 10-week trial period.

Inside the study area only, a total of 1575 woodpigeons were shot (Table 2). APHA marksmen accounted for 942 woodpigeons, representing 60% of all woodpigeons reported shot.

Table 2. Summary of shooting returns from inside the study area.

Organisation	Sessions (days)	Gun-hours	WPs killed	WPs killed (%)	Kills/gun-hour
APHA	30	372	942	59.8	2.5
Grower 1	5	86	256	16.3	3.0
Grower 2	3	21	85	5.4	4.0
Grower 3	9	31	134	8.5	4.4
Grower 4	4	12	158	10.0	13.2
Grower 5-20	0	0	0	0	0
Total		522	1575	100.0	3.0

Shooting techniques

A number of different shooting techniques were deployed (Table 3). The majority (70%) of the 2137 woodpigeons were shot using the traditional method of shotguns over decoys on crops. APHA marksmen also shot 410 (19%) woodpigeons using air rifles; the majority (399) of these also using night vision.

Table 3. Summary of woodpigeon numbers shot using different techniques (all marksmen).

		Night roost					Day roost	
Shooter	Decoys/ shotgun	Decoys/ shotgun	Shotgun	Shotgun/ sub sonic	AR[1]/NV[2]		Shotgun	AR
APHA	528			11	399		6	11
Grower 1	639							
Grower 2	94	89	68					
Grower 3	79		55					
Grower 4	158							

[1] AR =Air rifle, [2] NV = night vision

Considering techniques used by APHA marksmen only, the highest returns were from shotguns over decoys on fields (55% of all woodpigeons shot by APHA) and air rifle with night vision at night roosts (42% of all woodpigeons shot by APHA) (Table 4).

Table 4. Comparison of the numbers of woodpigeons shot by APHA marksmen using different shooting techniques.

Site	Technique	Woodpigeons	Gun-hours	Woodpigeons per gun-hour
Night roost	AR/NV	399	199.3	2.0
	Shotgun/subsonic	11	8	1.4
Day roost	AR	11	16.2	0.7
	Shotgun	6	10.9	0.6
Fields	Shotgun/decoys	528	145.5	3.6
Total		955	379.9	2.5

Across all marksmen, the majority of woodpigeons (70%) were shot in fields using shotguns over decoys. The number of woodpigeons killed per gun-hour was fairly consistent between three of the shooting groups (3.5-3.9) (Figure 3). The highest returns per gun-hour was achieved by grower 1 (experienced local pest controller) and grower 4 (sports shooter).

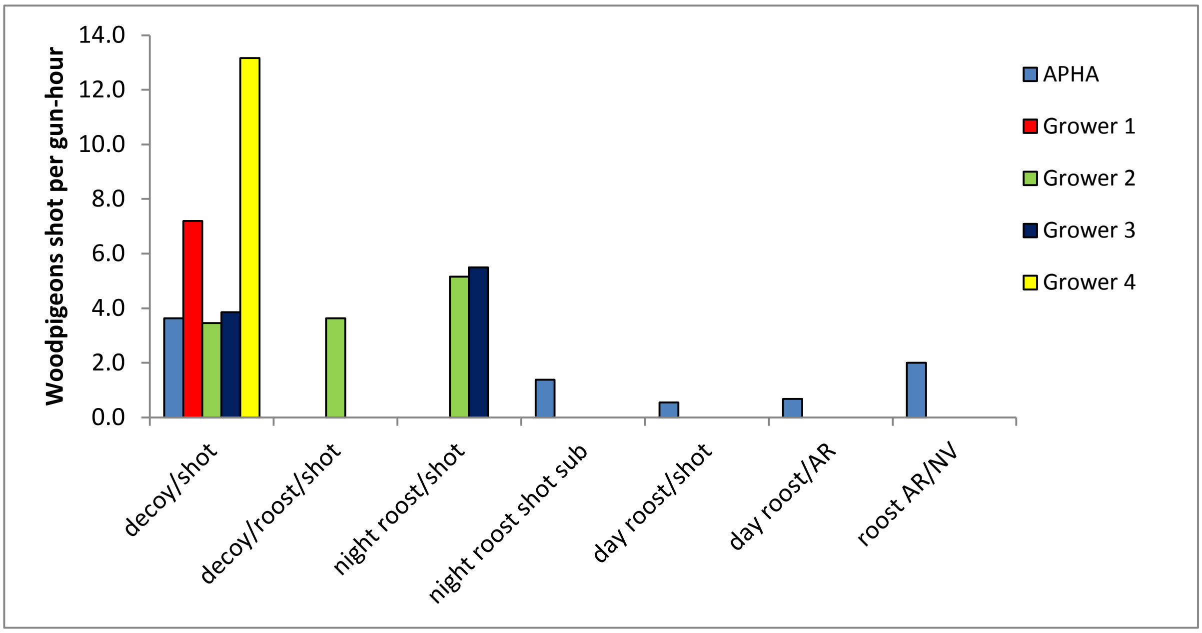

Figure 3. Comparison of the numbers of woodpigeons shot per gun-hour by different shooting techniques (AR = air rifle; NV = night vision).

Pest control versus sport shooting

A comparison between the shooting returns of growers engaged in full-time pest control (APHA and grower 1) and sports shooting (grower 4) are instructive with respect to overall woodpigeon management. In terms of the number of woodpigeons killed per gun-hour using decoying (the only technique used by the sports shooter), grower 4 achieved higher returns than either of the two pest control groups on each of the four occasions that grower 4 undertook shooting (Figure 4).

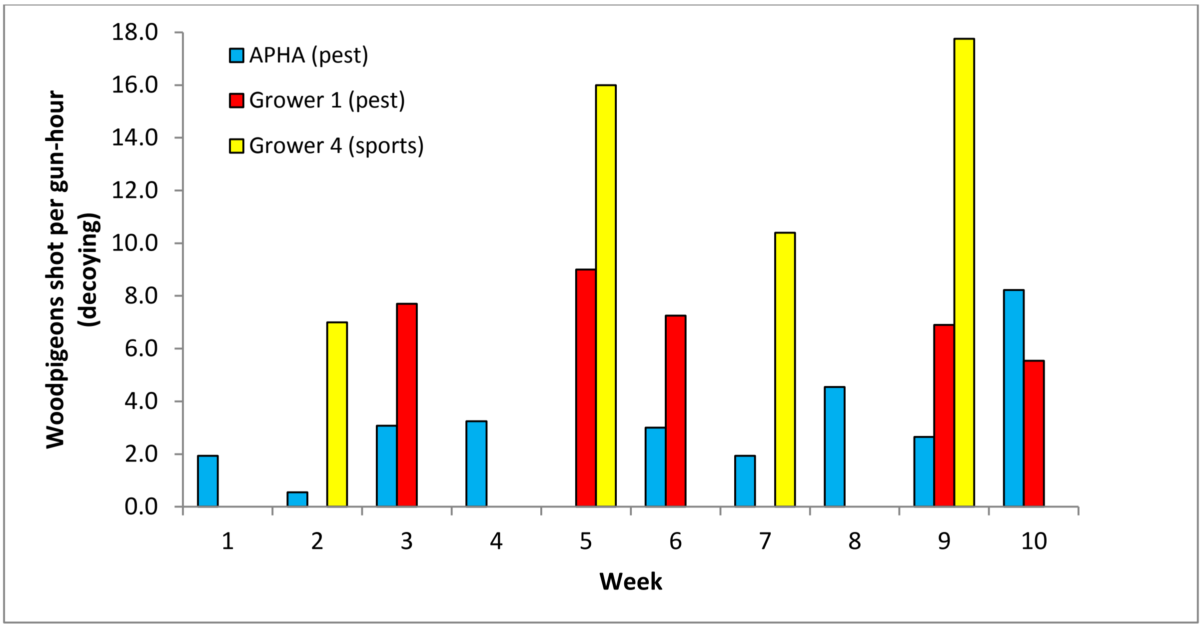

Figure 4. Comparison of the number of woodpigeons shot over decoys per gun-hour each week between shooting for pest control and sport.

When comparing the overall numbers of woodpigeons killed using all shooting techniques, pest control achieved consistently higher weekly returns than sports shooting (Figure 5).

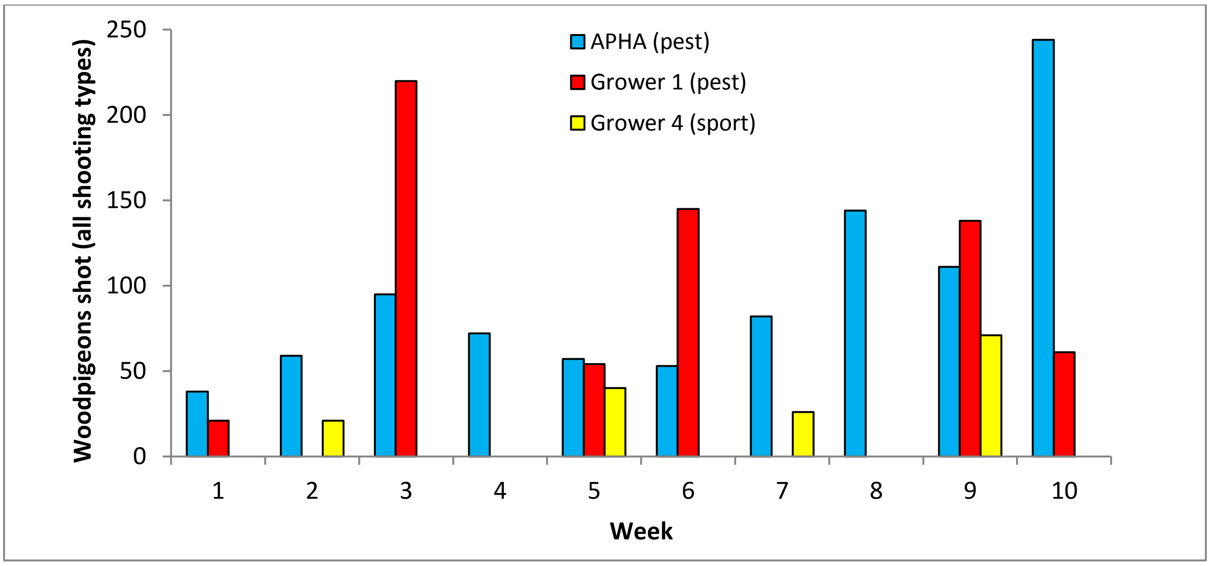

Figure 5. Comparison of the number of woodpigeons shot overall each week between shooting for pest control (all shooting techniques) and sport.

This observation in itself is to be expected as the pest controllers undertook a number of shooting sessions per week compared to the sports shooter's single session. In addition, the pest control groups generally used two marksmen during each shooting session (APHA 100%

of sessions; grower 1 69% of sessions) compared to the single sport shooter. However, in terms of returns per marksman over the 10-week period, pest controllers out-performed Grower 4, by shooting 2.4 to 3 times as many woodpigeons (APHA = 478, Grower 1 = 378, Grower 4 = 158). This highlights the constraints placed on overall removal rates by sports shooters who are only able to hunt during their leisure time (e.g. weekends).

Sports shooters typically leave woodpigeons undisturbed at a site for a period between hunting sessions (here generally two-week intervals). The rationale is that the birds lose their increased wariness resulting from the previous shooting session and allow numbers at that site to build up again, maximising the likelihood of a good bag on the next shoot day. When looking at the decoying returns of pest control groups, however, it can be seen that bags did not decrease over the 10-week trial, despite more frequent shooting sessions compared to the sport shooter; indeed APHA shooters achieved their markedly highest return in the last week of the trial (Figure 6). APHA marksmen (and the local pest controller), however, were able to switch between a number of different sites dependent on current woodpigeon activity.

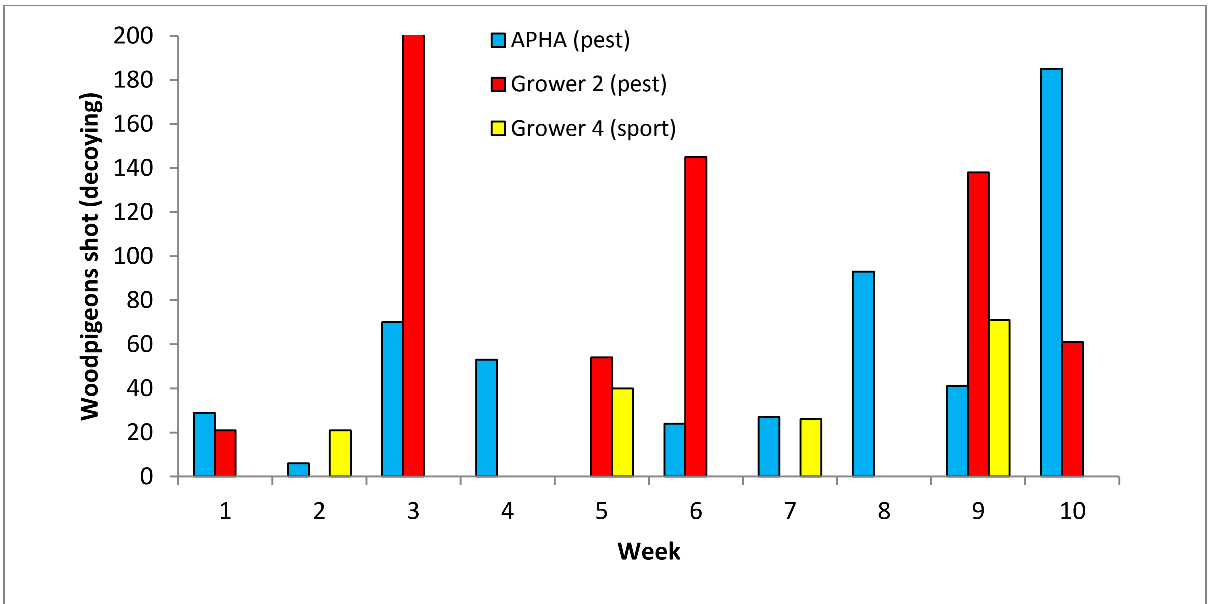

Figure 6. Comparison of total woodpigeons shot per week using decoy shooting only by pest controllers and sports shooters.

Woodpigeon abundance

During the 10-week trial period, the numbers of woodpigeons observed during the transect survey of the study area ranged from 387 to 2,018. Numbers decreased from a mean of 1,661 during the first two week period to fluctuate around a mean of 728 for the remainder of the trial period (Figure 7).

Over the same period, the total numbers of woodpigeons reported shot within the study area was 1575, with a mean of 118 woodpigeons shot per week during the first two weeks and a mean of 167 woodpigeons shot per week during weeks 3-10.

If shooting was conducted at sufficient intensity to have an impact at the level of the local population, the numbers of woodpigeons in the study area would be expected to show a consistent decrease over the 10-week shooting period. However, there was no clear relationship between the abundance of woodpigeons in the study area and the number of woodpigeons shot. For example, although an incremental increase in woodpigeons shot during weeks 7-10 was associated with an incremental decrease in woodpigeons observed in the study area over the same period, this pattern no longer holds when considering the respectively relatively low and high woodpigeon numbers in the weeks immediately preceding (week 5: 387 woodpigeons) and following this period (week 11: 1091 woodpigeons). The overall pattern of the relationship is suggestive of reactive shooting, whereby peaks in abundance of woodpigeons (week 2 and week 7) presented increased opportunities to target and kill woodpigeons, i.e. shooting tracked rather than caused population fluctuations.

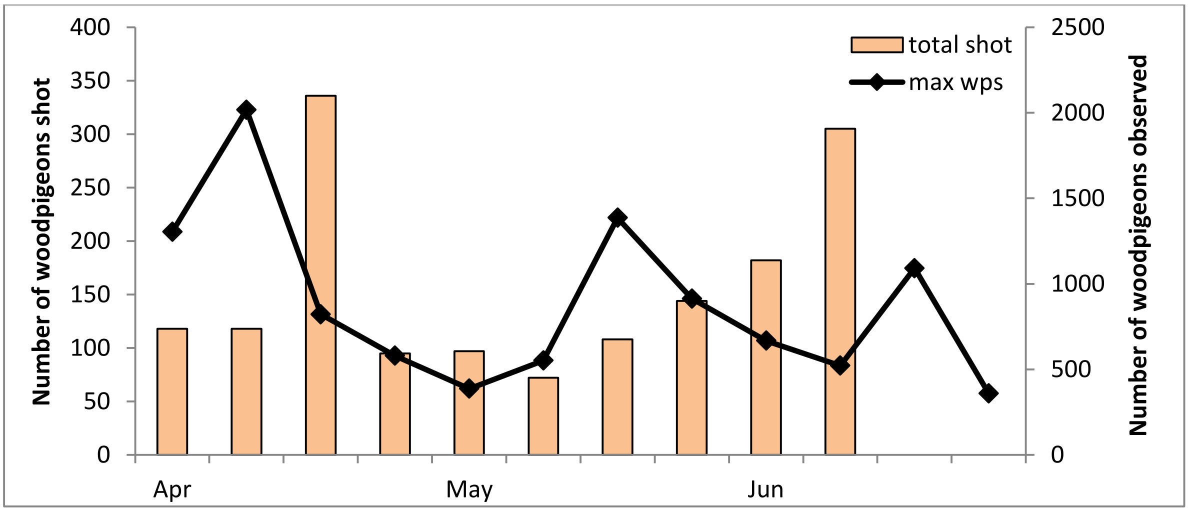

Figure 7. Numbers of woodpigeons observed and the total numbers shot each week in study area during the 10-week shooting trial. Post APHA-shooting woodpigeon counts were undertaken in weeks 3 and 4 of June.

Laser disturbance at night roost

Roost counts

The median number of woodpigeons recorded during dusk counts in the laser-treated roost decreased by 78% between the pre-treatment and treatment periods (Table 5); whilst numbers in the control roost increased by 68% between the same periods. For dawn counts, the median number of woodpigeons in the laser-treated roost decreased by 98% and decreased by 6% in the control roost.

Table 5. Median number of woodpigeons in treatment and control roosts during the trial.

Time	Roost	Pre-treatment	Treatment	Post-treatment
Dusk	Treatment	231	52	258
	Control	222	373	340
Dawn	Treatment	298	7	214
	Control	346	326	254

Individual dusk counts indicated that numbers of woodpigeons in the laser-treated roost decreased incrementally over the five day treatment period, until no woodpigeons were recorded in the roost on the evenings of days 3 and 4 (Figure 8).

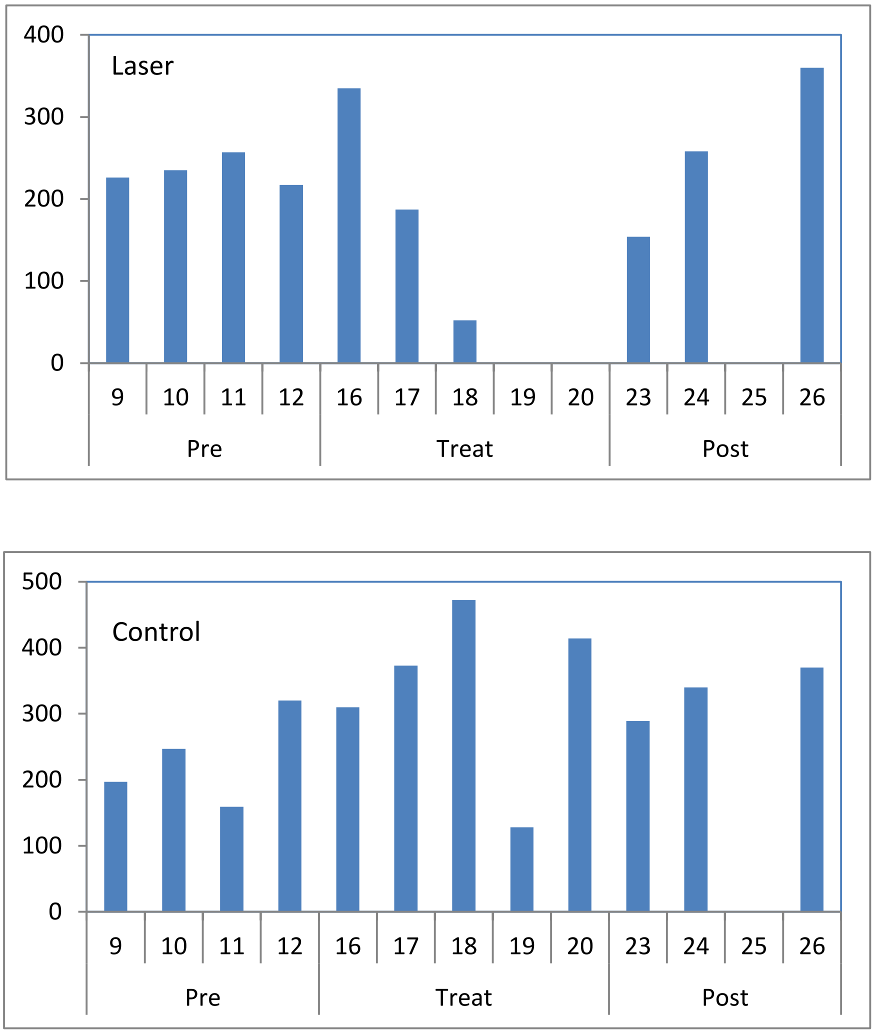

Figure 8. Numbers of woodpigeons in laser and control roosts at dusk counts during pre-treatment, treatment and post-treatment periods.

Dawn counts support the dusk observations of zero (or near zero) woodpigeons in the laser-treated roost by the end of the treatment period (Figure 9). Although there was a general correlation between dusk and dawn counts, there were instances of noticeable disparity between individual sequential dusk/dawn counts. The principal reason for this was due to poor visibility (fog, rain etc.) affecting accuracy of one of the successive counts.

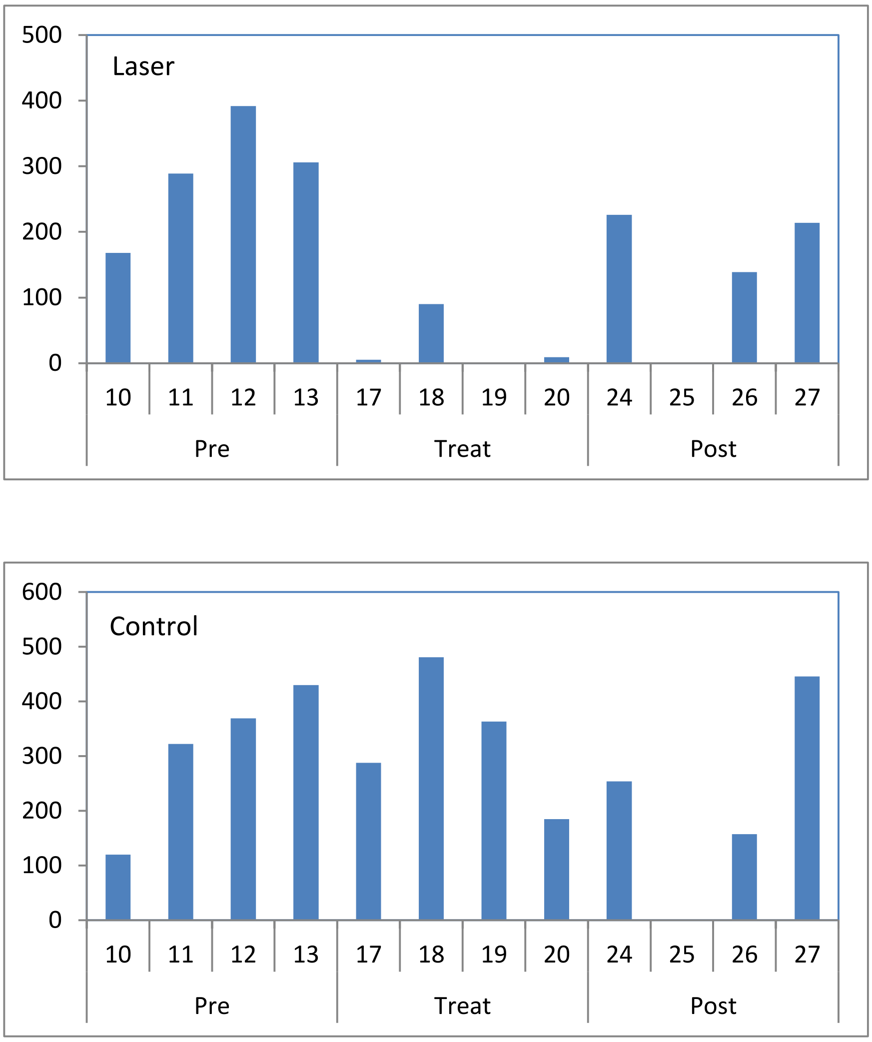

Figure 9. Numbers of woodpigeons in laser and control roosts at dawn counts during pre-treatment, treatment and post-treatment periods.

Area counts

Median numbers of woodpigeons recorded in the 1km radius area around the laser-treated roost increased by 25% between pre-treatment and treatment periods (Table 6); whilst numbers in the area around the control roost increased by 87% between the same periods.

Table 6. Median number of woodpigeons present in 1km radius area of the treatment and control roosts during the trial.

Roost	Pre-treatment	Treatment	Post-treatment
Treatment	144	180	329
Control	278	508	684

Individual maximum daily counts showed that numbers of woodpigeons in the area around the control roost increased incrementally over the treatment period and remained high during the post-treatment period (Figure 10). Around the laser roost, numbers remained relatively constant during the treatment period (except for a large increase on the final day) and remained high during the post-treatment period. That is, there was a slower rate of increase in daytime woodpigeon abundance around the laser-treated roost during the trial period.

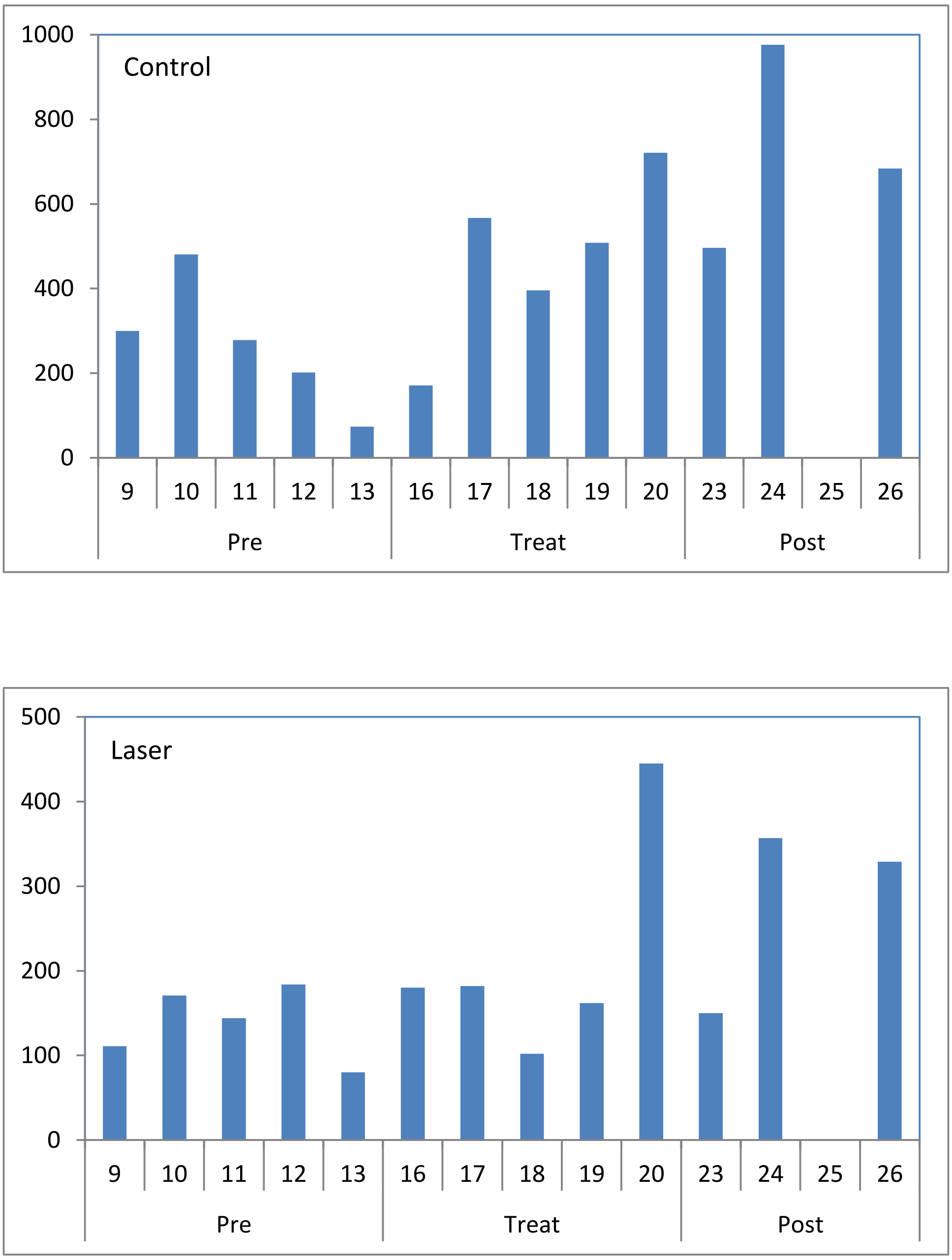

Figure 10. Maximum daily numbers of woodpigeons in 1km radius area around control and laser roosts during pre-treatment, treatment and post-treatment periods.

Discussion

Population management (shooting)

Woodpigeons can be shot throughout the year under a Natural England General Licence for the purpose of preventing serious damage to livestock and their foodstuffs, crops, vegetables, fruit, growing timber; and for preventing the spread of disease; and for the purpose of preserving public health or safety. Woodpigeons are killed during three types of shooting: decoying/flighting, roost shooting and ‘other’ shooting (rough shooting, game shooting and wildfowling) (Reynolds and Harradine 1996; Harradine and Reynolds 1997).

In 1994, the NFU (in association with BASC) undertook a questionnaire survey of its membership to obtain an account of the problems caused by woodpigeons (Smith *et al*. 1995). The survey encompassed nearly 1,000 farmers throughout England, Scotland and Wales with 964 returns (1.1% of the NFU/SNFU farming membership). Shooting was the most frequent control method used being undertaken by 97% of respondents. Seventy-five percent rated the effectiveness of shooting as moderate to high. Shooting over decoys accounts for the majority of woodpigeons killed (BASC 2001).

In the present study, it is apparent that woodpigeon shooting is not conducted in a manner that is consistent with maximising effective population management. In order to be an effective management technique at the landscape-scale (the scale at which woodpigeons are active) shooting needs to involve sustained effort, be cooperative and coordinated between neighbouring landowners, and focused on crop protection rather than sporting purposes. Presently, however, population management is largely constrained through inefficiency in each of these factors.

There exists disconnect between shooting for crop protection and sports shooting. Discussions with shooters in the study area (and elsewhere) revealed attitudes inconsistent with maximising crop protection. For example, shooters considered the opportunity to shoot woodpigeons as a perk of working on the associated holding and were resistant to allowing access to others for pest control. In the present study, occasions occurred when APHA marksmen were having limited success on land for which they had access permission but at the same time could see large numbers of targetable woodpigeons on an adjacent holding (shooters patch) to which access to shoot had been denied. Further, there was opposition to intensive shooting regimes (e.g. persistent use of air guns and night vision at roosts) in order to maintain a healthy flock for sporting purposes (i.e. shotguns over decoys). In the current study APHA marksmen used air rifles and night vision to good effect, accounting for 42% of all woodpigeons they shot.

The respective overall return rates (total woodpigeons shot) and kills per gun-hour emphasise the different rationales between pest shooting and sports shooting. The overarching aim of sports shooting is to enjoy a ‘good day’s shoot’ which is inevitably associated with achieving a good day’s bag. In order to ensure a good bag over a limited period of a hunting trip, however, the sports shooter will leave woodpigeons undisturbed at favourite hunting site/s for a period prior to a planned shooting session (in the current study the sport shooter hunted on one day every other weekend). In contrast, pest controllers will maintain a constant pressure on the woodpigeon population and shift the focus of their shooting between different sites depending on current crop protection needs and woodpigeon activity; continually removing birds irrespective of the kills per gun-hour. In the present study, the two pest control groups (APHA and grower 1) achieved consistent removal rates over the 10-week trial.

Another factor that limits the overall effectiveness of shooting is a general lack of cooperation and coordination between neighbouring growers in terms of pest management. In the present study, a number of growers undertook shooting that was limited to periods when crops in vulnerable growth stages were present on their own land. Once crops were no longer vulnerable (e.g. matured) or harvested, shooting activity ceased. This focus on individual holding-level control means that woodpigeons have access to ‘safe havens’ after having grazed on vulnerable crops on neighbouring land.

Shooting for pest control involves a sustained effort and hence cost. It is understandable, therefore, why growers are content to accept sport shooting as a means of pest management, with sport shooting either undertaken for free or shooting rights sold. However, a hidden cost to the grower of sport shooting is the failure of sport shooting to maximise crop protection. There is inevitably a ‘conflict’ between growers and shooters in regard to their respective commercial and sporting interests. Shooters, for example, may prefer to limit shooting to weekends and/or at times and locations most favourable to their convenience and desire to achieve a day’s good bag. Growers have reported shooters turning down payment to manage woodpigeons so that they can retain their independence and shoot to their own preferred schedule. Whereas, in order to maximise crop protection more regular, sustained and wide-ranging shooting is more appropriate.

A potential approach to address the costs associated with full-time woodpigeon shooting is for a number of growers to pool resources in order to pay for a full-time pest controller. The controller will then be able to shoot woodpigeons at the landscape-scale over a number of neighbouring holdings, removing the availability of ‘safe havens’ for woodpigeons associated with the current sporadic and vested interest shooting. The use of air rifles and night vision at night roosts provides an additional effective technique. If this approach is replicated across neighbouring consortiums of growers, each with its own full-time woodpigeon controller, landscape-scale control will be further enhanced. Sport shooting would be additive, rather than alternative, to this approach to woodpigeon management.

In respect to changes in woodpigeon abundance, although numbers of woodpigeons recorded in the study area decreased after the first two weeks of the trial (mean of 1661 during first two weeks), numbers did not show any persistent further decrease but fluctuated around a mean of 728 birds. The absence of any sustained reduction in numbers is likely due to the removal rate of woodpigeons being too low in respect to recruitment of young birds and to the movements of woodpigeons into the study area from the wider landscape.

Roost management (hand-held laser)

The low-powered hand-held laser was effective at dispersing woodpigeons from a traditional night roost. Complete (or near complete) dispersal was achieved by the end of five consecutive evenings of deployment of the laser; the effect of the laser appeared to increase incrementally over the five evenings. Effectiveness was dependent on the laser-operator persistently targeting the same woodpigeons, as the initial response of birds put to flight was to circle the roost and repeatedly attempt to land again. Only after several repeated exposures to the laser did woodpigeons disperse permanently from the roost. On consecutive evenings fewer birds attempted to enter the roost. It is presumed that dispersed birds relocated to a neighbouring alternative roost.

The effect of the roost dispersal was short-term, however, with numbers in the roost showing full recovery over the five day post-treatment period. This highlights the need for subsequent periodic reinforcement of the deterrent through further deployment following successful roost dispersal.

The effect of roost dispersal on woodpigeon abundance and crop grazing in the area immediately surrounding the roost is unclear. On the one hand, the numbers of woodpigeons present in the area around the treated roost increased during the treatment period (+25%). On the other hand, however, this increase was markedly lower than the increase recorded in a similar area around the control roost (+87%). It is possible, therefore, that dispersal of the woodpigeons to alternative roost sites, delayed the build-up of birds grazing on fields in the immediate area (compared to the control roost). Alternatively, the difference in relative increase in woodpigeon abundance around the two roosts may have been due to variation in crop cover and land management. Although the predominant land cover in each area was ploughed earth (laser 42%, control 56%), the areas differed in crop cover (laser: cereal 28%, beet 6%; control: brassicas 15%, cereal 4%); with harvested beet and sprouts attracting woodpigeons in the respective areas.

Future work (year 3 2017/18)

Deterrents

Field trials investigating the integrated deployment of lifelike mannequins, gas cannons, rope bangers and reinforced shooting are scheduled for the spring/summer 2017 in Lincolnshire.

Agrilaser

An 8-week trial investigating the effectiveness of an Agrilaser in deterring woodpigeons from grazing at the level of the individual field is scheduled for spring/early-summer 2017 in the East Riding of Yorkshire on spring planted Brussels sprouts.

Aerial drone

Preparations for a preliminary exploration of the potential for using an unmanned aerial drone to deter woodpigeons from grazing crops at the level of the individual field are ongoing and currently scheduled for late-summer early-autumn 2017 in the East Riding of Yorkshire.

Conclusions

The current approach to shooting woodpigeons in the study area is not consistent with maximising either population management or crop protection. Effort focussed at the scale of the needs of individual holdings and the aspirations of sport shooters constrains the overall impacts of control. Greater cooperation between growers, a strategic approach focussed at the landscape-scale and removal of the ‘protectionism’ of shooters ‘patches’ will facilitate more effective population management.

Low-powered hand-held lasers have the potential to disperse woodpigeons from traditional night roosts. A rapid recovery of woodpigeon numbers following cessation of laser deployment indicates the need for additional subsequent laser deployment to reinforce the deterrent effect.

Knowledge and Technology Transfer

In year 2 (2016/17) of the project no technology transfers were planned or carried out.

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