Project title:	Brassicas, leafy salads, oilseed rape and legumes: Developing and evaluating management strategies to mitigate woodpigeon *Columba palumbus* damage to crops.
Project number:	FV 426a
Project leader:	Dr Dave Parrott, National Wildlife Management Centre, Animal and Plant Health Agency
Report:	Annual report, April 2016 (year 1 of 3)
Previous report:	NA
Key staff:	Dr Dave Parrott (APHA), Nigel MacDonald (Austin Consultancy), Rebecca Jones (APHA), Carly Peggie (APHA), Ray Ridley (APHA), David Fouracre (APHA)
Location of project:	Lincolnshire (Year 1, 2015/16)
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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Senior Wildlife Ecologist

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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 FV 426.

Summary

- The effectiveness of selected deterrents to reduce woodpigeon grazing activity, and by association crop damage, was investigated in trials on fields of Brassica crops, during autumn/winter 2015/16 in south Lincolnshire.
- Two treatments were investigated: (i) gas cannons and life-like mannequins/scarecrows reinforced periodically with a human shooter (seven fields), (ii) hand-held laser and replica woodpigeon wing-markings (one field).
- Numbers of woodpigeons feeding or perched in the trial fields were compared between pre-treatment, treatment (4-12 weeks) and post-treatment periods.
- Assessments of crop damage were made immediately prior to initial deployment of the deterrents, mid-way through the treatment period and at the end of the treatment period.
- The effectiveness of treatment 1 (mannequins/cannons/shooter) varied markedly between fields, from very effective to largely ineffective. Differences are likely due to field-specific features, such as area and proximity to perching opportunities (e.g. tree lines) and/or woodpigeon roost sites.
- The estimated cost of the reinforced mannequin strategy ranged from approximately £18-145 per ha over the individual trial periods; equivalent to approximately £3-29 per ha per week.
- A previous consultation with Brassica growers revealed their own estimates of economic loss due to woodpigeon grazing of £330-£1,250/ha (FV 426a).
- Treatment 2 (laser and wing-markings) appeared to be largely ineffective. Although the laser was consistently successful in lifting woodpigeons off the trial field, this was short-lived with birds (original and/or new arrivals) often repeatedly re-landing in the field. Numbers of woodpigeons recorded on the field remained largely unchanged throughout the treatment period. It cannot be ruled out that there was some cumulative longer-term effect of the lasers.
- Treatment 2 involved the application of two different lasers: a smaller ‘laser-pointer’ type and a larger, commercial ‘bird-scaring’ laser. Both lasers consistently lifted woodpigeon flocks off the field from up to a distance of 300m away.
- On a control field (no deterrents) woodpigeon presence and numbers increased throughout the ‘treatment’ period.
- Attempts to monitor the movements of a sample of woodpigeons, using radio-tracking, were unsuccessful. Woodpigeons proved very difficult to capture with only six birds trapped and tagged. Only a very few re-locations were achieved in the study area, most

likely as a result of birds either leaving the area or shedding the tags.

- Alternative analysis of woodpigeon movements in relation to trial fields, using GIS mapping of visual records of birds is ongoing.
- Year 2 deterrent trials (on OSR) will involve modification of the treatments with, for example, reinforced shooting and laser application more widely dispersed throughout the week.

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 key 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 incorporates four main research elements:

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

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:

- 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: FV 426).
- To undertake an evaluation of population management, using shooting, to reduce woodpigeon grazing activity.
- To undertake preliminary investigations of woodpigeon capture and tagging/marking and its potential for monitoring woodpigeon movements and habitat use in response to crop protection measures.
- To undertake preliminary evaluation of the potential for the application of unmanned aerial vehicles (drones) in the monitoring and management of woodpigeon grazing activity.

This annual report details work undertaken in the first year of project FV 426a (1st April 2015 - 31st March 2016) in which the use of selected traditional and novel bird deterrents was investigated on winter Brassicas: (i) gas cannons and life-like mannequins/scarecrows reinforced periodically with a human shooter, (ii) hand-held laser and replica woodpigeon wing-markings.

The deterrents investigated in this project were previously identified in a review of avian deterrents and other management measures (FV 426) as those having greatest potential; these deterrents also possess inherent beneficial practical characteristics, in that they are:

- Relatively low labour-intensive with respect to maintenance
- Not weather dependent (e.g. damaged/displaced by strong winds)
- Relatively prolonged woodpigeon habituation period
- Does not require specialist training/expertise

Preliminary analysis of the effectiveness of deterrents is presented; analysis of woodpigeon movements (using GIS mapping) is ongoing. Further trials of these deterrents will be undertaken on OSR (2016) and spring Brassicas (2017). Preliminary findings from year 1 will inform modifications to the application of the deterrents in order to improve effectiveness.

Materials and methods

Study area and trial fields

The field trials on winter Brassicas were undertaken in an area of approximately 5km^2 near the South Holland District of south Lincolnshire (Figure 1). Preliminary surveys encompassed a larger area, extending further east, of approximately 10km^2. Following the selection of trial fields the overall survey area was reduced to 5km^2 as a consequence of a complete lack of trial fields in the eastern side of the original area. Field crops (and hence available food resources for woodpigeons) within the study area changed over time due to planting and harvesting regimes.

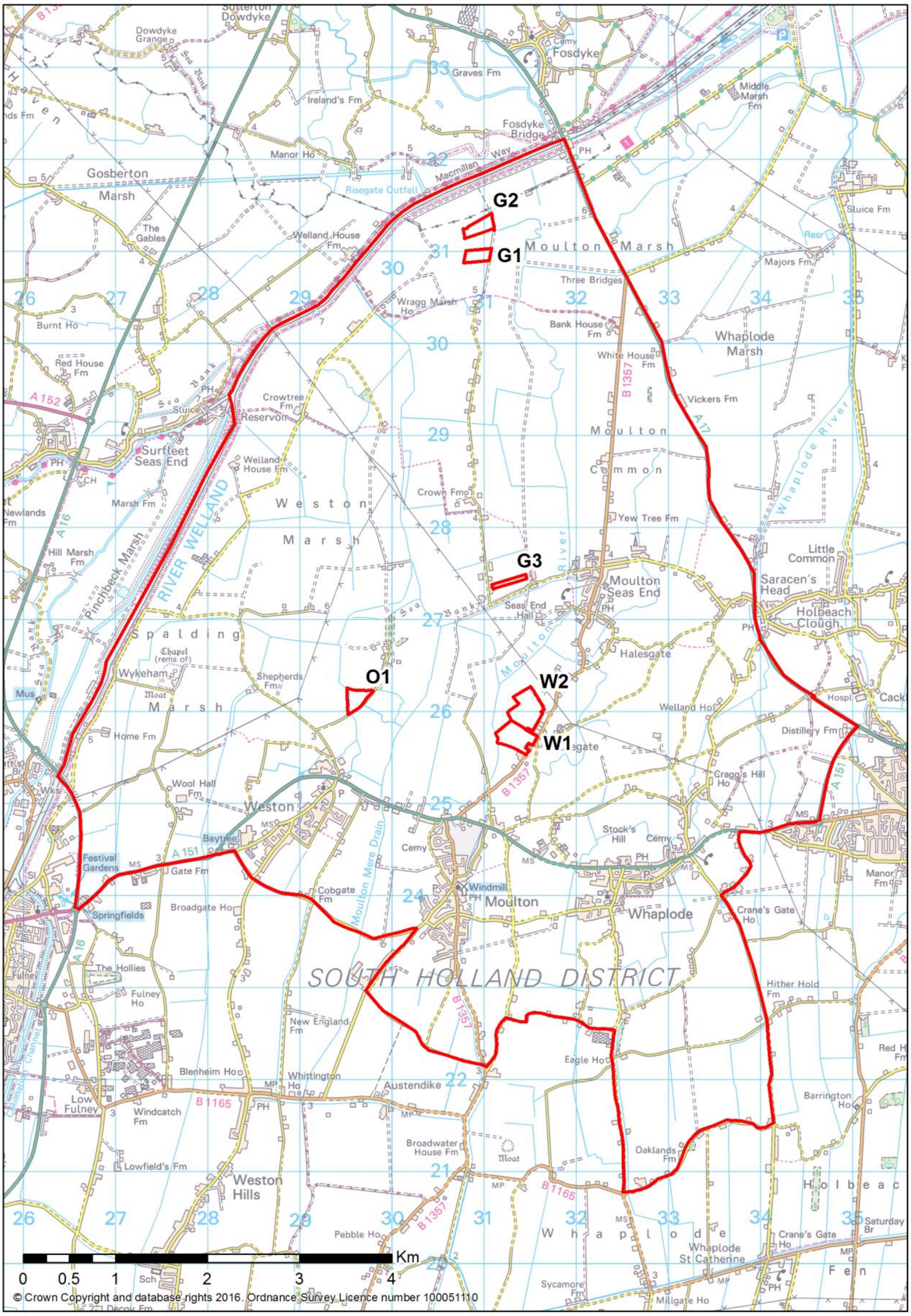
Selection of fields for inclusion in the deterrent trials encountered a number of unforeseen challenges. Firstly, due to the mild weather, movement of woodpigeons onto Brassica crops was later than normal. Second, early in the season, it transpired that a number of suitable fields that had started to receive woodpigeon grazing were not available for inclusion in the trials, due to either imminent cutting of the crop or sheep being put out to graze.

Over the 2015/16 winter, 8 fields were selected for deployment of deterrents (Table 1). Fields were selected either from direct observation of woodpigeon grazing or from reports of grazing activity from landowners/growers (validated by visual assessment of crop damage). A further field with woodpigeon activity (not suitable for deterrents) was closely monitored as a control field. Two trial fields (RG1 and RG2) were outside the main study area ~11km to the north-west.

Table 1. Details of deterrent trial fields – treatment, crop and trial duration.

Field	Ha	Treatment	Crop	Duration (weeks)	Period
G1	3.6	Reinforced mannequins	Spring cabbage	12	Dec-March
G2	4.4	Reinforced mannequins	Spring cabbage	12	Dec-March
W1	9.1	Reinforced mannequins	Winter cauliflower	12	Dec-March
G3	1.9	Reinforced mannequins	Savoy cabbage	9	Dec-March
O1	4.5	Reinforced mannequins	Sprouts	10	Dec-March
RG1	1.1	Reinforced mannequins	Spring cabbage	5	Jan-March
RG2	5.4	Laser + wings	Spring cabbage	5	Jan-March
W2	11.2	Reinforced mannequins	Winter cauliflower	4	Feb-March

Reinforced mannequins = mannequins + gas cannon + periodically reinforced by live marksman.
Laser + wings = periodic scaring with hand-held laser + life-size images of spread woodpigeon wing


G1
G2
G3
O1
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W2
SOUTH HOLLAND DISTRICT
Km
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Woodpigeon numbers
Between October 2015 and March 2016, weekly driven transect surveys were undertaken through the overall study area to record woodpigeon activity. 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. 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.

Crop damage
Measurements of crop damage were undertaken on all fields in which deterrents were deployed. Damage assessments were completed immediately prior to deployment of deterrents, repeated after a period of around 5 weeks and finally at the end of the trial when deterrents were removed.

Crop damage assessment involved scoring the percentage of overall leaf cover that was missing (as a result of grazing) from a stratified random sample of plants. Plants were scored on a scale from 1 to 4, where 1 = 0% leaf loss (zero damage), 2 = <10% of leaf loss (minor loss), 3 = 10-50% leaf loss (moderate loss) and 4 = >50 leaf loss (severe loss). Examples of the damage score for are presented in appendix 1.

The crop damage scoring system was derived in order to facilitate the detection of changes in the magnitude of crop damage imposed on the crop (associated with changes in woodpigeon activity); the assessments were not designed to permit an evaluation of the economic cost of the damage.

Mannequins/gas cannons/reinforced shooting
At the onset of a trial, following the initial crop damage assessment, life-like mannequins were placed in the trial field along with a gas cannon (Figure 2). Mannequins were dressed in white boiler suits and orange hi-visibility waistcoat. Mannequins also held a wooden, replica firearm. Gas cannons were covered with camouflage netting (Figure 2) to minimise visual information on the source of the sound to woodpigeons; the cannons were set to fire a double-bang at 50 minute intervals

Figure 2. Mannequin and camouflaged gas cannon.

Mannequins were positioned in the trial field where there was evidence of woodpigeon grazing damage; the number of mannequins initially deployed was subjectively assessed in respect to the existing areas of damage, likely adjacent roosting sites and overall size of the field (2-4 mannequins). Mannequins and where possible gas cannons were re-positioned at weekly intervals. On some fields, the scope for moving gas cannons was very limited due to the proximity of nearby residential properties. On fields where continued woodpigeon grazing was observed (ascertained either from observations of woodpigeons and/or crop damage assessments) mannequins were re-sited accordingly and/or additional mannequins deployed.

During each week of the treatment phase, a human marksman dressed identically to the mannequins, stood in the field along with the mannequins. Any woodpigeons that landed or attempted to land in the field were shot at, using either live shotgun rounds or bird-scaring cartridges. Fields were visited 2-3 times per week. During individual treatment visits, the marksman spent one hour in each field and then moved onto the next trial field and repeated the reinforcing shooting. Over the treatment period, the order in which fields were visited was alternated so that each field received reinforced shooting during different periods of the day. In addition, however, reinforced shooting sessions were tailored to respond to observed woodpigeon visitation patterns on each field. The frequency and/or duration of reinforced shooting sessions were increased on fields where woodpigeons were more resistant to scaring or where habituation began to occur; sessions were decreased on fields where woodpigeon activity was reduced.

Lasers and woodpigeon wing-markings

Two different low-powered, hand-held green lasers: a smaller, cheaper ‘laser-pointer’ type and a larger, commercial ‘bird-scaring’ laser were deployed. The smaller laser had a narrower beam. Lasers were deployed from a vehicle parked at the edge of the trial field. When targeting a woodpigeon flock, the laser was pointed at the ground and moved toward the flock; the laser was moved across birds in the flock until they took flight (lifted). In addition to lifting flocks the laser was also run along the ground below a flock attempting to land, often the same flock that had just been lifted. Flocks were persistently exposed to the laser until they left the field and the immediate neighbouring fields. In most instances, the smaller laser was initially deployed, switching to the larger laser if there was failure to lift the flock. The trial field was visited 2-3 times per week at different times of the day, but focussing around early morning and late evening when the laser was most visible. Individual treatment sessions persisted until no woodpigeons persisted on the trial field or immediate neighbouring fields.

Life-size images of woodpigeon wing-markings were produced by having a photo of the wing of a shot specimen professionally printed onto weatherproof dibond signage (Figure 3). Sixty ‘wing-signs’ were produced, thirty each of left wing and right wing. Wings were deployed by affixing each to the top of a T-shaped wooden stake set into the ground. Groups of wings were arranged in a grid (approximately 1-2m between adjacent wings); wings were approximately 50 cm above the ground.

Figure 3. Image of woodpigeon wing-markings on dibond signage.

Analysis

Crop damage was compared between the pre-treatment period (i.e. immediately prior to deployment of deterrents) and the treatment period. In general, two crop damage assessments were undertaken during the treatment period at around 5 weeks and 12 weeks following initial deployment of deterrents. The analysis compared the proportion of sampled plants that scored either a 3 (moderate) or 4 (severe) on the damage scale between the different periods, using a Chi square test.

Woodpigeon numbers: due to the large number of zero counts and significant difference in variance in numbers of woodpigeons on trial fields between treatment phases, meaningful statistical analysis was not possible. Interpretation of changes in woodpigeon numbers between treatment phases was therefore limited to qualitative description.

Woodpigeon movements

Attempts to monitor the movements of a sample of woodpigeons, using radio-tracking, throughout the trial period were unsuccessful. Woodpigeons were very difficult to capture (due to a high level of wariness as a consequence of historical harassment and shooting in the study area) with only six birds trapped (mist net) and tagged. Only a very few re-locations were achieved in the study area, most likely as a result of birds either leaving the area or shedding the tags. Alternative analysis of woodpigeon movements in relation to trial fields, using GIS mapping of visual records of birds is ongoing.

Results

G1 – reinforced mannequins/spring cabbage

Woodpigeons were almost never observed by APHA staff, either on the trial field or perched on its perimeter, during either pre-treatment, treatment or post-treatment periods. During the pre-treatment period, reports of woodpigeon grazing by the grower were confirmed by visual assessment of crop damage. During the pre-treatment phase a day roost, located approximately 450m away, was regularly occupied by up to 170 woodpigeons.

Crop damage (scores 3 and 4) increased from 5% to 8% (6 weeks) to 12% (12 weeks) over the duration of the trial (Table 2). The increase in damage was not statistically significant between successive phases but was significant between the start (0 weeks) and end (12 weeks) of the trial (Chi square = 10.36, p=0.0013).

Table 2: Crop damage scores on field G1 assessed at pre-treatment, mid-treatment and post-treatment.

		Crop damage score (% plants)			
Date	**Plants**	1	2	3	4
09.12.15	370	42.4	52.4	4.3	0.8
19.01.16	365	39.7	52.3	7.1	0.8
02.03.16	367	27.2	61.0	10.9	0.8

During the trial no shots were taken and no woodpigeons killed.

Feedback from the grower indicated that the deterrent strategy was considered to be effective, with no further damage observed following deployment of mannequins.

G2 – reinforced mannequins/spring cabbage

Woodpigeons were almost never observed by APHA staff, either on the trial field or perched on its perimeter, during either pre-treatment, treatment or post-treatment periods. During the pre-treatment period, reports of woodpigeon grazing by the grower were confirmed by assessment of crop damage. During the pre-treatment phase a day roost, located approximately 450m away, was regularly occupied by up to 170 woodpigeons.

Crop damage decreased from 56% to 48% (6 weeks) to 47% (12 weeks) over the duration of the trial (Table 3). The decrease in damage was statistically significant between the start (0 weeks) and middle (6 weeks) of the trial (Chi square 5.29, p=0.022) and between the start and end (12 weeks) of the trial (Chi square = 8.40, p = 0.004).

This decrease in % damage appeared largely to be due to fresh growth in the plants reducing the overall area of leaf lost and corresponding reduction in damage score for some plants.

Table 3: Crop damage scores on field G2 assessed at pre-treatment, mid-treatment and post-treatment.

Date	Plants	Crop damage score (% plants)			
		1	2	3	4
09.12.15	436	7.8	36.0	42.0	14.2
19.01.16	408	3.7	48.0	33.1	15.2
02.03.16	367	4.9	48.5	38.1	8.4

During the trial no shots were taken and no woodpigeons killed.

Feedback from the grower indicated that the deterrent strategy was considered to be effective, with no further damage observed following deployment of mannequins.

G3 – reinforced mannequins/savoy

During the pre-treatment period, a large feeding flock (~125 birds) was observed on the trial field. Reports from the grower indicated that similar numbers of birds had been feeding for up to two weeks earlier.

Following deployment of the deterrent treatment (16.12.15), woodpigeon numbers decreased markedly and were observed only intermittently over the 9 week trial (Figure 4).

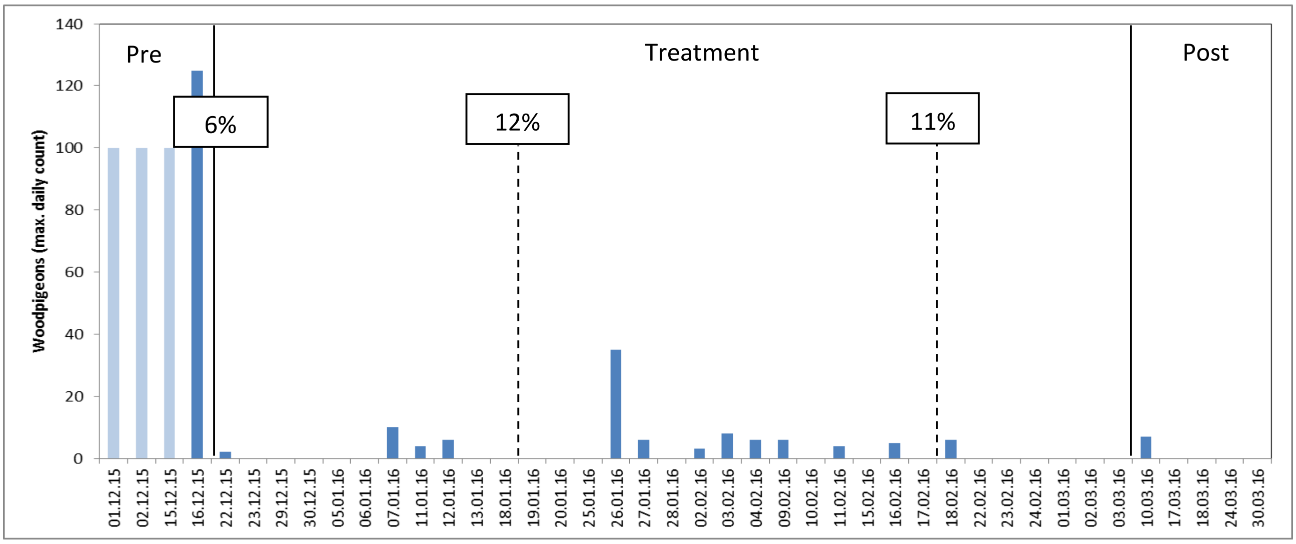

Figure 4. Numbers of woodpigeons on field G3 during pre-treatment, treatment and post-treatment phases. Values in boxes indicate the crop damage scores.

Crop damage increased from 6% to 12% (5 weeks) to 11% (9 weeks) over the duration of the trial. The increase in damage was statistically significant between the start (0 weeks) and middle of (5 weeks) of the trial (Chi square=12.32, p=0.0005) and between the start and latter period (9 weeks) of the trial (Chi square=7.61, p=0.006). There was no statistically significant change between the middle and end of the trial.

Table 4: Crop damage scores on field G3 assessed at pre-treatment, mid-treatment and post-treatment.

Date	Plants	Crop damage score (% plants)			
		1	2	3	4
16.12.15	419	49.2	45.3	3.1	2.4
19.01.16	428	40.5	47.1	8.4	4.0
18.02.16	411	39.9	49.4	6.3	4.4

During the trial 10 shots were taken and 2 woodpigeons killed.

Feedback from the grower indicated that the deterrent strategy was considered to be partially effective, with damage lowest in areas of the field in proximity to mannequins.

W1 – reinforced mannequins/cauliflower

Following deployment of the deterrent treatment (11.12.15), woodpigeon numbers decreased markedly for a period of approximately 8 weeks; from up to 200 woodpigeons to a maximum of 25 present at any one count (Figure 5). After 8 weeks, numbers recovered toward that observed in the pre-treatment period; with up to 150 birds at any one count. Following cessation of the trial (04.03.16) and removal of the deterrents at 12 weeks, woodpigeon numbers increased markedly with 250 or more birds present. Therefore, although habituation to the deterrents appeared to commence from 8 weeks, the marked increase in woodpigeon numbers post-treatment suggests that the deterrents still retained some aversive effect during the latter part of the treatment period.

There was no significant increase in crop damage over the first 6 weeks of the trial (0 weeks = 42%; week 6 = 41%) (Table 5). During the latter half of the trial, however, crop damage increased significantly from 41% (week 6) to 59% (week 12) (marked increase in plants with moderate damage -3) (Chi square=53.65 p=0.0000).

Table 5: Crop damage scores on field W1 assessed at pre-treatment, mid-treatment and post-treatment.

Date	Plants	Crop damage score (% plants)			
		1	2	3	4
11.12.2015	357	29.7	28.6	11.8	30.0
19.01.2016	377	27.3	31.8	13.0	27.9
04.03.2016	569	0.5	14.1	33.4	25.8

During the trial 28 shots were taken and 4 woodpigeons killed.

The grower could not provide feedback on perceptions of crop damage or effectiveness of the deterrent as the crop was not harvested due to lack of retailer demand.

W2 – reinforced mannequins/cauliflower

Following deployment of deterrents (03.02.16), a consistent reduction in woodpigeon activity was less clear cut than on trial field W1. However, woodpigeon numbers during the four weeks following deployment (median = 70) was lower than during the three weeks immediately preceding deployment (median = 20). Post-treatment, woodpigeon numbers (median = 170) increased compared to the pre-treatment period.

There was no significant increase in moderate-severe crop damage over the 4-week trial (0 weeks 29%; 6 weeks 31%). However, there was a significant increase in damage when also including plants with minor damage (score 2) (60% and 76% respectively); there was a corresponding decrease in plants completely ungrazed (score 1) (Chi square, p=0.0000).

Table 6: Crop damage scores on field W2 assessed at pre-treatment and post-treatment.

		Crop damage score (% plants)			
Date	**Plants**	1	2	3	4
03.02.2016	439	40.5	30.1	20.3	9.1
04.03.2016	436	24.1	45.4	22.7	7.8

During the trial 16 shots were taken and 4 woodpigeons killed.

The grower could not provide feedback on perceptions of crop damage or effectiveness of the deterrent as the crop was not harvested due to lack of retailer demand.

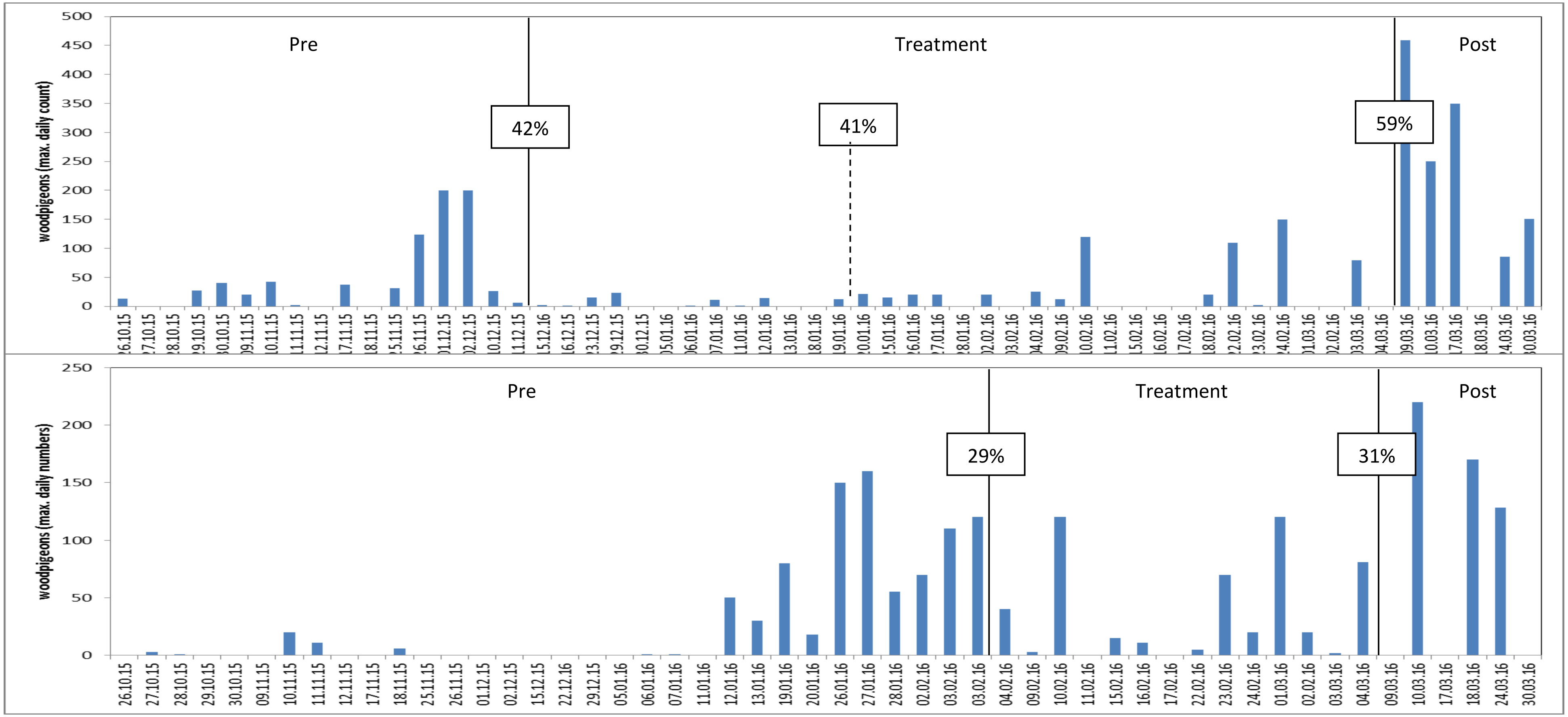

Figure 5. Numbers of woodpigeons on fields W1 and W2 during pre-treatment, treatment and post-treatment phases. Values in boxes indicate the crop damage scores.

O1 - reinforced mannequins/sprouts

Following deployment of deterrents (10.12.15), woodpigeon numbers fluctuated in a series of peaks and troughs. Immediately following deployment, woodpigeon attendance was markedly lower for around three weeks, then recovered, waned and recovered again. Troughs in woodpigeon numbers corresponded to periods when reinforcement of the scarecrows was intensified, with the marksmen attending the field for longer periods and/or more frequently.

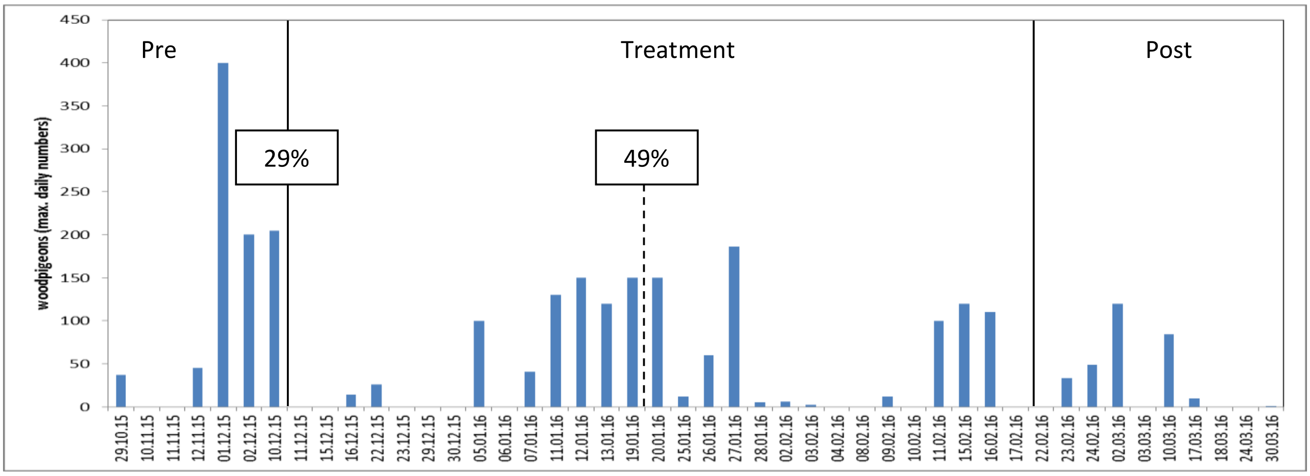

Figure 6. Numbers of woodpigeons on field O1 during pre-treatment, treatment and post-treatment phases. Values in boxes indicate the crop damage scores.

Crop damage increased significantly from 29% to 49% over the first 6 weeks of the trial (Chi square=37.82, p=0.0005). Further crop damage assessments were prevented by harvesting of the crop. Continued grazing by woodpigeons indicated that crop damage would likely have increased further.

Table 7. Crop damage scores on field O1 assessed at pre-treatment and mid-treatment.

		Crop damage score (% plants)			
Date	**Plants**	1	2	3	4
10.12.2015	446	14.8	56.1	20.6	8.5
18.01.2016	458	14.8	36.0	16.8	32.3

Grazing damage was limited to the leafy tops of the sprout plants.

During the trial 18 shots were taken and 5 woodpigeons killed.

Feedback from the grower indicated that the sprouts matured rapidly becoming over-mature before fully harvested; there was no information on yield/damage.

RG1 - reinforced mannequins/spring cabbage

This field of spring cabbage had been very heavily grazed by the time its existence became known to APHA; crop damage was 100% (moderate = 3%; severe = 97%).

Deterrents were deployed (28.01.16) with the aim of keeping woodpigeons away and allowing the crop to recover.

Woodpigeons were almost never observed by APHA staff, either on the trial field or perched on its perimeter, during either pre-treatment, treatment or post-treatment periods.
After a five week period crop damage was 99% (moderate = 0.7%; severe = 99%).

Due to the severity of the grazing (prior to deterrent deployment), the crop was unable to recover to a measurable extent before the trial ended.

Treatment cost

The estimated cost of the reinforced mannequin strategy ranged from approximately £18-145 per ha per over the trial period; equivalent to approximately £3-29 per ha per week (Table 9). The key elements of the treatment were: gunman, mannequins and gas cannon. The cost of the gunman was based on the number of hours on the field at standard agricultural worker rate of £7.05 per hour. The cost of the mannequins was based on a mean cost of £45 per mannequin discounted over 5 years. The cost of a gas cannon was based on a price of £445 per gas cannon discounted over 5 years. The total treatment cost was expressed as £/ha over the trial period and as £/ha/week. These estimated costs are indicative as the price of individual elements may vary locally.

Table 9. Estimated costs for reinforced mannequin treatment.

			Gunman		Mannequin		Gas gun		Total	
Field	**Ha**	**Weeks**	**Gun Hrs**	**£/ha**	**No.**	**£/ha**	**No.**	**£/ha**	**£/ha**	**£/ha/week**
G1	3.6	12	12.91	25.28	2	5.00	1	24.72	55.00	4.56
G2	4.4	12	12.91	20.69	3	6.14	1	20.23	47.05	3.92
W1	9.1	12	26.83	20.79	4	3.96	1	9.78	34.53	2.88
G3	1.9	9	18.87	70.02	3	14.21	1	46.84	131.07	14.56
O1	4.5	10	17.81	27.90	3	6.00	1	19.78	53.68	5.37
RG1	1.1	5	6.17	39.54	3	24.55	1	80.91	144.99	29.00
W2	11.2	4	11.99	7.55	3	2.41	1	7.95	17.91	4.48

Gunman; Standard worker rate of £7.05 per hour (https://www.daera-ni.gov.uk/articles/awb-agricultural-rates-pay-orders-and-reports).
Mannequin: £45 each discounted over 5 years.
Gas gun: £445 each discounted over 5 years.

RG2 – laser and wing flashes/spring cabbage

Numbers of woodpigeons recorded on the field remained largely unchanged throughout the treatment period; deployment of the lasers occurred on all days during the treatment phase on which woodpigeons were observed on the field (Figure 7). Individual sessions deploying the laser ranged from 5 minutes to 140 minutes, with flocks exposed to the lasers ranging from 9 to 300 birds. It is of note that the treatment session on 17th February was exceptionally long (140 minutes) compared to all previous sessions (5 minutes to 49 minutes), due to persistent woodpigeon attendance. During this longer session, flocks ranging in size from 9 birds to 220 birds repeatedly landed in the field and were repeatedly lifted off by the laser. Individual flocks comprised birds that had been exposed to the laser and other newly arriving birds that had not been exposed. The turn-over of birds probably resulted in more birds being exposed to the laser than the single largest count of birds seen at any one time. It is not known whether the absence of woodpigeons post-24th February (4-weeks treatment) was due to any cumulative longer-term deterrent effect of the lasers over the treatment period or to an alternative factor.

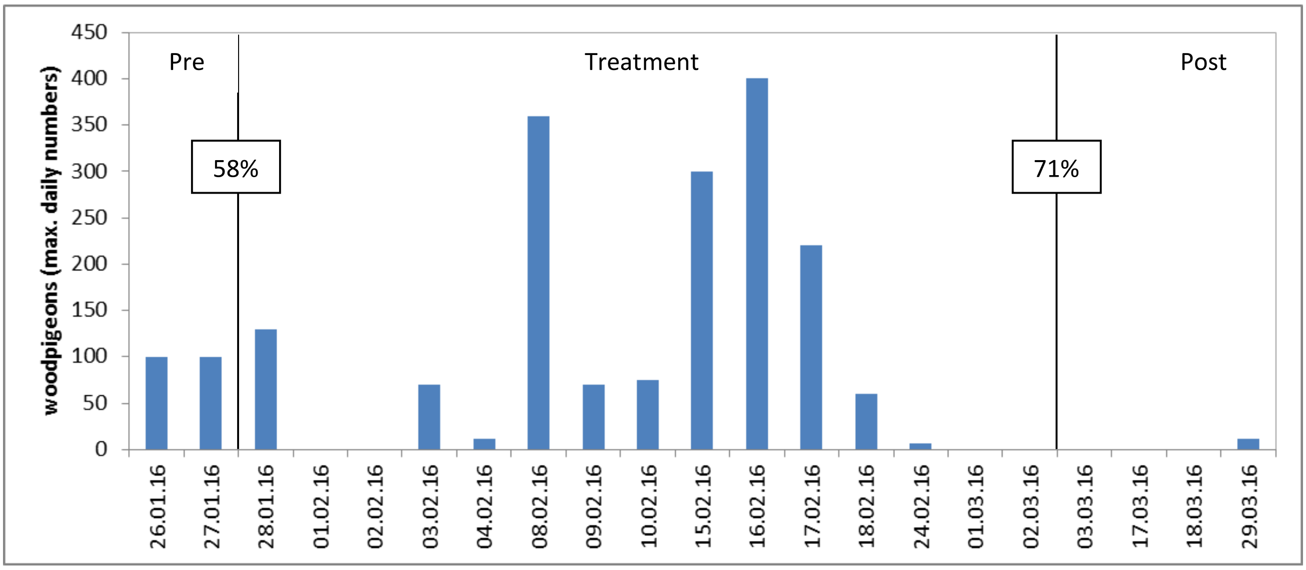

Figure 7. Numbers of woodpigeons on field RG2 during pre-treatment, treatment and post-treatment phases. Values in boxes indicate the crop damage scores.

Crop damage increased significantly from 58% to 71% over the 5 weeks of the trial (Chi square=18.18, p=0.0000).

Table 8. Crop damage scores on field RG1 assessed at pre-treatment and post-treatment.

		Crop damage score (% plants)			
Date	**Plants**	1	2	3	4
27.01.2016	360	9.4	32.8	39.7	18.1
04.03.2016	358	5.6	23.2	41.3	29.9

Control field - BCS 1

BCS1 was a field of over-winter cauliflower, located approximately 1km from the nearest trial field (W1); deterrents were deployed on W1 between 15.12.15 and 04.03.16. Field BCS1 served as a control field on which numbers of woodpigeons were monitored over this same period.

Woodpigeon presence and numbers increased throughout the ‘treatment’ period, from a mean of 6 woodpigeons during the pre-treatment period to a mean of 43 woodpigeons during the latter half of the treatment period (Figure 8, Table 9).

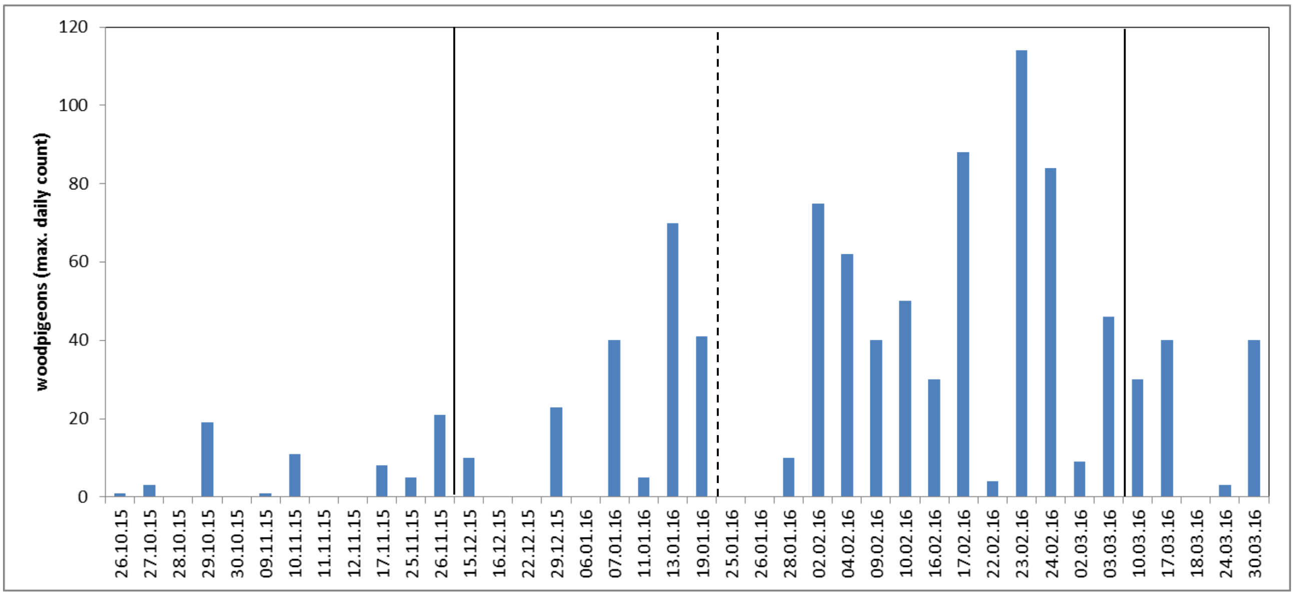

Figure 8. Numbers of woodpigeons on control field BCS1 during the period when deterrents were deployed on trial fields. Solid lines indicate the start and end of the 'treatment' period; dashed line denotes the early and later phases of the treatment period (six weeks each).

Table 9. Comparison of woodpigeon numbers and frequency of flock (>50 woodpigeons) presence on control field BCS1, during periods corresponding to pre-treatment, early treatment and late treatment periods on trial fields.

Phase	Mean woodpigeon nos.	% Counts >50 woodpigeons [a]
Pre-treatment	5.8	0
Treatment (early)	21.0	17
Treatment (late)	43.7	50

[a] when woodpigeons present

Discussion

Reinforced mannequins

The effectiveness of the treatment 'mannequins/gas cannons/reinforced shooting' varied markedly between different trial fields, from very effective through partially effective to largely ineffective. Differences are likely due to field-specific features, such as area and proximity to perching opportunities and/or a woodpigeon roost. For example, field O1 was located only 200m away from woodland that served as a traditional woodpigeon night roost. This proximity likely facilitated observation of the field by woodpigeons, and hence information, on the mannequins and shooter which was not available to woodpigeons at other trial fields not as closely associated with roost sites.

On trial fields where numbers of woodpigeons were observed to markedly decrease following deployment of deterrents (G3, W1), this decrease in woodpigeon numbers was associated with either an arresting of the crop damage or only a relatively small increase. Where the effectiveness of the deterrents broke down during the latter part of the treatment period and woodpigeon numbers increased again, crop damage also increased (e.g. W1). Indeed, on all trial fields where woodpigeons were observed the deployment of the deterrent was followed by a reduction in woodpigeon attendance for at least part of the treatment period.

In contrast, on the one control field woodpigeon numbers consistently increased throughout the 'treatment' period; it can reasonably be assumed that crop damage also consistently increased over this period.

For a woodpigeon management strategy to be deemed cost-effective, the costs of implementing the strategy must be exceeded by the value of the crop saved from woodpigeon grazing that would have occurred in the absence of the deterrents. In the present study, the estimated cost of the reinforced mannequin strategy ranged from approximately £18-145 per ha over the individual trial periods; equivalent to approximately £3-29 per ha per week.

Although it is not known what level of damage might have been incurred on trial fields in the absence of the deterrent treatment, previous consultation with Brassica growers revealed their own estimates of economic loss due to woodpigeon grazing of £330-£1,250/ha (FV 426a). These grower estimates are significantly in excess of the costs of the reinforced mannequin treatment.

The one grower (three fields) who was able to provide feedback on his perceptions of effectiveness of the deterrents viewed the deployment of the deterrents as a positive measure and stated that he would like to see them used again on his fields.

In year 2 deterrent trials, deployment of 'reinforced mannequins" can be modified in a number of different ways, for example, by dispersing the application of reinforced shooting more widely through each treatment week, increasing the rate of firing of gas cannons, moving mannequins more frequently or increasing the density of mannequins on the field.

It should be emphasised that the reinforced mannequin strategy that utilises a highly-visible marksman is designed to achieve a different outcome compared to the activities of concealed marksmen. The rationale of deploying a marksman who is visually similar to the mannequins is to attempt to condition woodpigeons into avoiding any areas containing mannequins. Following exposure to shooting by the marksman, flocks of woodpigeons will be wary of similar 'mannequins' and intuitively will find the area less attractive for feeding. In contrast, decoying by concealed marksmen seeks to attract woodpigeons into an area to be killed; this approach provides no visual cues to subsequently deter surviving birds. In examining the economics of woodpigeon damage to Brassicae, Murton and Jones (1973) noted that although a gunman roving around fields was the least effective method of killing woodpigeons it was the most effective way of keeping birds off the crops. In an integrated woodpigeon management plan shooting by both visible and concealed marksmen have a role.

Lasers/wing-markings

The hand-held lasers and woodpigeon wing-markings appeared to be largely ineffective. Although the laser was consistently successful in lifting woodpigeons off the trial field, this was short-lived with birds often repeatedly re-landing in the field. Birds that re-landed included birds that had just been deterred by the laser and/or additional woodpigeons that had recently arrived and had not yet been exposed to the laser.

On exposure to the laser, woodpigeons typically lifted and re-landed in the trial field but progressively more distant to the source of the laser; after several exposures relocating to neighbouring fields, or leaving the area completely.

It cannot be ruled out that there was some cumulative effect of the lasers over the treatment period; the decline in numbers during the latter two weeks of the treatment period followed an exceptionally long deployment session of the lasers.

Although the smaller laser had a narrower ‘pencil’ beam compared to the larger laser it was still consistently effective in lifting woodpigeon flocks up to 300m away. The larger laser retained a disruptive effect at longer distances (up to 350m) and in brighter ambient light.

In year 2 deterrent trials deployment of the lasers can be modified in a number of ways, for example, through more prolonged deployment sessions early in the treatment phase, dispersing application of the treatment more widely, or more frequently, through each treatment week.

Bird counts and crop damage assessments
On some fields there was generally good agreement between counts of woodpigeons and crop damage assessments. On W1, for example, the reduction in woodpigeon attendance over the first six weeks of treatment was supported by no change in crop damage score. The continued relatively very low woodpigeon numbers for the following 2-3 weeks suggests that the deterrent effect likely persisted for around 8-9 weeks before habituation led to an increase in woodpigeon numbers visiting the field.

In contrast, for example, woodpigeons were almost never observed on field G1 yet crop damage showed some increase over the treatment period. There are likely two factors at play here: first woodpigeons potentially visited at times of day when observers were absent; and other species potentially contributed to the damage. In the latter case, rabbits, hares and partridge were known to be present on and around G1.

Future work (year 2 2016/17)

Population management
The first-year of population management is ongoing in an area of Lincolnshire that largely overlaps that used for deterrent trials in 2015/16. The trial is taking place in an area of approximately 8,200ha with cooperation from about 20 landowners representing around 66% of that land area. Landowners are either allowing access to APHA marksmen to undertake shooting and/or are undertaking the shooting of woodpigeons themselves.

Shooting commenced on 4th April and is scheduled to last 10 weeks ending 10th June. Weekly surveys of woodpigeon abundance and distribution across the study area are being undertaken during this 10-week period. Analysis will involve mapping woodpigeon numbers and locations over the treatment period in respect to the time and location of reported shooting activity.

Deterrents
Selection of trial fields for investigating deterrents on OSR is ongoing, with discussions with growers in the Beverly area of East Yorkshire. Trials are scheduled to commence in late-summer/early-autumn 2016. Trials will involve modifications to the manner in which the reinforced mannequin strategy is deployed.

Drone
Preparations for a preliminary exploration of the potential for using an unmanned aerial drone to monitor and/or deter woodpigeons from fields of crops are ongoing (scheduled for autumn 2016).

Roost management (lasers)
Preparations for a small-scale investigation to evaluate whether hand-held lasers can disperse or relocate woodpigeons from habitual roost sites are ongoing (scheduled for winter 2016/17).

Conclusions

The first year field trials have shown that the deterrent treatment 'cannons/ mannequins/ reinforced shooting' reduced woodpigeon activity on fields but the magnitude and duration of this effect varied markedly between individual fields. Differences are likely due to field-specific features, such as proximity to a woodpigeon roost. The deterrent treatment 'hand-held lasers and woodpigeon wing-markings' appeared to be largely ineffective in the longer-term, although the lasers were successful in the immediate-term by consistently lifting flocks off of a crop. A potential longer-term cumulative effect cannot be ruled out. Results from this first year of deterrent field trials will inform modifications to the deployment of these deterrents in order to try to improve effectiveness and consistency between trial fields

Knowledge and Technology Transfer

In year 1 (2015/16) of the project no technology transfers were planned or carried out.

References

Eaton, M.A., Balmer, D.E., Bright, J., Cuthbert, R., Grice, P.V., Hall, C., Haywow, D.B., Heran, R.D., Holt, C.A., Knipe, A., Mavor, R., Noble, D.G., Oppel, S., Risely, K., Stroud, D.A. and Wotton, S. (2013). The State of the UK's Birds 2013. RSPB, BTO, WWT, NRW, JNCC, NIEA and SNH, Sandy, Bedfordshire.

Murton, R.K. and Jones, B.E. (1973). The ecology and economics of damage to Brassicae by woodpigeons *Columba palumbus*. Ann. app. Biol. 75: 107-122.

Musgrove, A.J., Aebischer, N.J., Eaton, M.A., Hearn, R.D., Newson, S.E., Noble, D.G., Parson, M., Risely, K. and Stroud, D.A. (2013). Population estimates of birds in Great Britain and the United Kingdom. British Birds 106: 64-100.

Parrott D., Roy S., Bellamy F. and Daniel, B. (2014). A review of the woodpigeon costs to Brassicas, salad crops and oilseed rape and the effectiveness of management activities. Project (FV 426) report to the Agriculture and Horticulture Development Board.

Risely, K, Massimino, D., Newson, S.E., Eaton, M.A., Musgrove, A.J., Noble, D.G., Procter, D., Baillie, S.R. (2013). The Breeding Bird Survey 2012. BTO Research Report 645, British Trust for Ornithology, Thetford.

Appendices

Example of crop damage assessment on spring cabbage. A stratified random sample of plants were scored on a scale from 1 to 4, where 1 = 0% leaf loss (zero damage), 2 = <10% of leaf loss (minor loss), 3 = 10-50% leaf loss (moderate loss) and 4 = >50 leaf loss (severe loss).