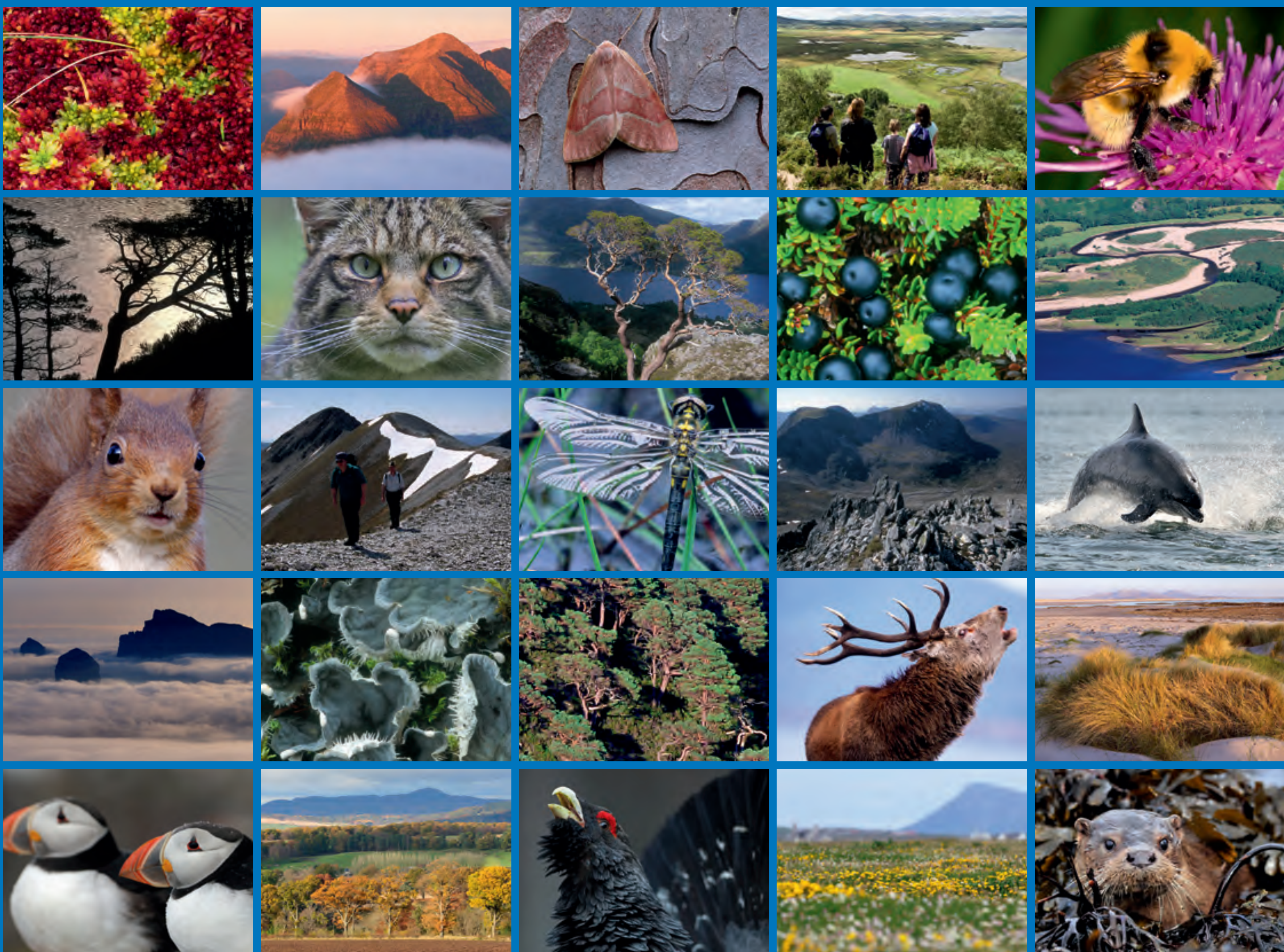
Scottish Natural Heritage
Commissioned Report No. 932

Assessing the nature and use of corvid cage traps in Scotland: Part 2 of 4

Field survey of trap use in Scotland 2014-15



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COMMISSIONED REPORT

Summary

Assessing the nature and use of corvid cage traps in Scotland: Part 2 of 4 – Field survey of trap use in Scotland 2014-15

Commissioned Report No. 932
Project No: 13747
Contractor: Gill Hartley, SASA
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Keywords

General licences; corvid traps; crow family; trap operators; trapping performance.

Background

This survey was commissioned by SNH to inform their regular review and consultation of four General Licences, which allow the control of corvid birds for various purposes. It aimed to improve understanding of current corvid trapping practices by trap operators, including information on the effectiveness of traps and incidents of non-target captures. It also provided an opportunity to obtain information on the use and welfare of decoy birds.

Main findings

- As a result of data arising from part 1 in this series of reports, 410 registered trap users in Scotland were approached to ask if they would be willing to take part in this field survey of trap use.
- 271 (66%) trap operators were willing to participate by taking records, of which 129 (32%) provided usable records, representing approximately 10% of the Scottish trapping population.
- As part of the data validation process of trap records, trap operators were asked if they would be willing to have field cameras placed near their traps, of which 151 (56% of participants) agreed, although usable records suitable for validation were supplied by only 27 trap operators (10% of participants) by the end of the study. Trap operators without cameras were significantly more likely to catch target species than trap operators with cameras. However, trap operators with cameras were significantly more likely to catch raptors as a proportion of their total bird catch, than the non-camera trap operators.
- Over 16,000 trap days were recorded, during which over 4,500 target birds (6 species), 119 non-target birds (11 species), and 9 non-target mammals (8 species) were caught.
- Carrion crows and magpies were the most common target species caught, pheasants were the commonest non-target bird caught and domestic cats the commonest mammal caught.
- Trap operators were located mainly in eastern, southern and in the central belt of Scotland. These areas coincide with key agricultural, game management and high human population density areas, and reflect the purposes for which General Licences are used.

- Trapping occurred mainly between April and June, although it did take place throughout the year.
- The majority of trap operators did not specify a time of day when they checked traps, but of those that did, most checked their traps between 0600 and 1000 each day.
- Larsen traps were the commonest trap used, and were set on more days than small single compartment and multi-catch traps together.
- Of all birds caught, magpies were caught equally by agricultural, game management and suburban trap users. Trappers associated with game management caught the majority of carrion and hooded crows, jackdaws and jays, while trappers more closely associated with agriculture tended to catch most rooks.
- Live decoys tended to be the most effective attractant used in traps to catch conspecific territorial species (crow species and magpies). Food baits tended to be more successful at capturing flocking species (rooks and jackdaws). Relative success of baits and decoys however, could vary for carrion crows and rooks depending on the time of year.
- Small, single compartment cage traps appeared to be more effective when catching territorial species when run alongside Larsen traps, than when run alone.
- Plastic decoys were generally ineffective, although the sample size for this variable was small.
- Capture rates of carrion crows and magpies were highest in single compartment or Larsen traps, while capture rates of jackdaws and rooks were highest in multi-capture traps.
- Multi-capture traps in particular, were capable of catching many tens of birds in a single trapping day.
- Capture rates for carrion crows were higher in the period February to July than between August to January. However, for magpies and hooded crows, capture rates peaked in September and October, although both these latter species exhibited a small increase in capture rates in the spring. Rooks and jackdaw capture rates peaked in July. Reasons for these differences probably relate to differences in social behaviour (crows and magpies are territorial) and timing of the availability of large numbers of naïve offspring later in the year.
- The majority of traps were not placed under any type of vegetative or other cover. Nonetheless, trap rates for most target species were highest when traps were placed under cover or within 10 metres of cover.
- Visits to trap sites conducted by the field worker provided an opportunity to assess decoy bird condition and welfare. Of the 35 birds seen, the majority were in 'very good' or 'good' condition, and the majority of traps were 'clean' and in 'good' condition
- Nineteen incidents of decoy fatality were recorded, nine of which were attributable to predation events.
- Trap users gave feedback on difficulties associated with the General Licences.

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1. BACKGROUND

This is the second report in a series describing research commissioned by SNH to investigate the use and impacts of corvid cage traps in Scotland. It follows up on the results of a questionnaire survey of trap users in Scotland conducted in 2013 and detailed in ‘part 1’ of this study (Reynolds, 2016).

During the questionnaire survey all trap operators were able to provide their responses anonymously but were given the option to provide their contact details on the basis that they may be asked to participate in field trials. Those who did were later contacted and asked to take part in this study.

The questionnaire (Reynolds, 2016) focussed on trap users and general trapping trends, and gave a useful overview of who is trapping and the reasons why they were doing so. It also provided information on the variation in approach amongst trap users and gave a general picture of their success.

This study is a field-based survey designed to examine the day to day efficacy of corvid traps as used by practitioners across Scotland. The aim was to provide a detailed snapshot of trap operation by practitioners across a calendar year, and relate their activities to the capture of both target and non-target species. The opportunity was also taken to examine the condition of both the decoy birds encountered, and of the traps in which they were kept. The results could then be used to reassure SNH that trap practices followed perceived knowledge on their use, or alert SNH to particular issues should they arise.

2. METHODS

2.1 Trapping records

Respondents who provided contact details on return of the Phase 1 questionnaire were re-contacted according to when they stated they began trapping. Individuals were invited to participate by a letter, which was followed up by a phone call to confirm. All those willing to participate were issued with record books, or spreadsheets, or given access to a mobile phone 'app' (Trapper) designed by the Game & Wildlife Conservation Trust (GWCT), and were issued with instructions.

The first books were issued on the 8th of September 2014 with 339 books being sent out by the 15th of October 2015. Throughout the recording period, an attempt was made to keep in regular contact with all participants and issue new books as required.

2.2 Information recorded

Books and spreadsheets allowed trap operators to record information on specific traps and provided information on the trap type, habitat in which it was used and how the trap was operated. An example of a trap booklet supplied to a volunteer recording data on three traps is provided in annex 1. Table 2.1 lists information collected on each trap, this information was collected once for each trap and only required updating when the trap was relocated. Further information on the trap's operation was recorded in week by week sheets, giving space for daily records. This provided information regarding when and how the trap was used, and the resulting captures (table 2.2).

Table 2.1 Information recorded in the trap record booklets and multiple choice options.

Factor	Response options
Trap type	*Larsen; Larsen mate; Larsen pod; multi-catch ladder trap; multi-catch roof funnel; multi-catch other.*
Land Category	*Lowland Agriculture (LA); Lowland Other (LO); Upland (Up); Forestry (Fo); Urban, semi-urban or recreational (Ur)*
Cover	*Open, Under cover*
Distance from cover	(In metres)

'Lowland agriculture' (LA) encompassed crops and grassland; 'Lowland other' (LO), mire, bog, scrub and coastal heath; 'upland' (Up) consisted of upland grass and moorland; 'forestry' (Fo) included deciduous, coniferous or mixed woodland, and 'suburban' (SU) included gardens, industrial estates, airfields and amenity land.

Cover included any natural environmental shelter into which the trap was placed, and may have included trees, shrubs or bushes. Trap operators were only asked to provide information on the distance any trap was placed from cover. For traps placed in cover, trap operators were not asked to provide information as to how far into cover they placed their traps.

Table 2.2 Information recorded daily when a trap was in use

Factor	Explanation
Date and time	Allows comparisons of traps operated at different times of the year, and time of day most commonly used for trap checking.
Trap set	Allowed differentiation between days the trap was closed and days that it was set but did not catch anything.
Captures (all species)	Operators were asked to record all species caught by the trap, not just target species.
Species of decoy	The species of decoys used may influence the species of birds likely to interact with the trap.
Type of bait	Different baits may attract different species so operators were asked to record bait type and some of the food categories were then combined.
Notes	This category allowed for other additional information to be provided by the operator, such as the moving of the trap.

2.3 Definition of 'trap success' and 'capture rate'

Throughout this report, results are often considered in terms of trap success or capture rate. Trap success is calculated by determining the number of days on which a trap successfully caught a target species over the total trap days for that particular variable, i.e. the proportion of days when a trap was successful, expressed either as decimal fraction or a percentage, e.g. 0.10 or 10%. Capture rate is the total number of a particular species caught over the total trap days for that variable. Capture rate allows for the possibility that multiple captures may take place in a given trap on a given day. Figures may also be presented as decimal fractions or percentages. For example, if *all* traps catch a single bird *every day* over a given period of time then the capture rate over that time period will be exactly the same as the trap success and will equal 1.0 or 100%. If *all* traps catch two birds *every day* over a given period of time, then the capture rate over that time period will be 2.0 or 200%, and the trap success will be 1.0 or 100%.

2.4 Geographic region

Each trap operator was assigned to a geographic region. Post code or Local Authority areas were too numerous to allow easy dissemination and were amalgamated into fewer larger areas. 'Visit Scotland' provided an easily accessible and comprehensive amalgamation of Local Authority areas (figure 2.1). The named areas were Aberdeen City and Shire; Argyll and The Isles; Ayrshire and Arran; Dumfries and Galloway; Edinburgh and The Lothians; Dundee and Angus; Greater Glasgow and the Clyde Valley; Loch Lomond, the Trossachs, Stirling and Forth Valley; Perthshire; The Highlands; the Kingdom of Fife and the Scottish Borders (figure 2.1). Trap operators were contacted in Orkney and Shetland, but unfortunately did not run any corvid traps during the study period, and were not therefore included in the data collection (figure 3.3).

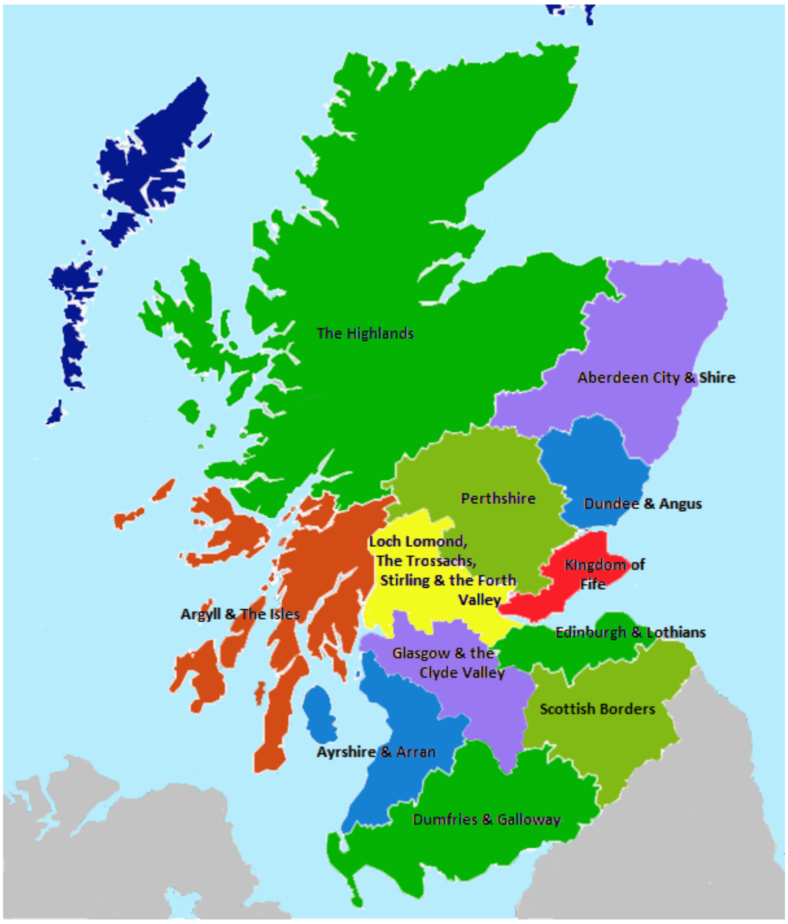

Figure 2.1 Geographic areas of mainland Scotland used for recording location of trap users based on amalgamation of Local Authority areas used by Visit Scotland. Map generated by SASA.

2.5 Data validation

Where possible, data derived from members of the public should be cross-checked and validated. This was undertaken by monitoring the traps of a sub-set of trap operators using field cameras to corroborate their trap records, and then by comparing their records with the main sample. Installation of automatic trail cameras at the sub-set of trap sites was undertaken with the complete cooperation and knowledge of the trap operator, who gave permission for the field worker to access the site.

2.5.1 Camera volunteers

All trap operators who agreed to keep trapping records for the study were asked if they would also be prepared to accept a trail camera to monitor their trap for a period of 3-4 weeks at some point during the study. Ideally every participant collecting trap records would also have volunteered to permit cameras to monitor their traps, and a random stratified sample selected for analysis. However, shortly after the trial began, a high profile court case took place (Cramb, 2015), involving illegal use of these traps, and evidence that had been collected using trail cameras by a third party, without the knowledge of the trap operator. As a consequence, a number of volunteers withdrew their support entirely for the trial, while a large proportion withdrew their support for the use of a camera on their traps.

The majority of people who were willing to take cameras were contacted at regular intervals to try and arrange camera installation as soon as possible after trapping began, to ensure that data were collected on traps that were operated for just a short period. Due to the spread of participants, difficulty in contacting participants and the logistics of installing and collecting cameras, it was not always possible to set up cameras on traps, particularly when estimated start dates could change depending on the weather, personal circumstances and for some, the availability of live decoy birds. Some practitioners would close traps quickly if the rate of capture or observation of target birds was low. Where the setting up of a camera could take an entire day of travelling, operators were grouped as much as possible to ensure camera installation and collections were logistically efficient.

2.5.2 Camera set-up

Twenty Ltl-Acorn 6210MC trail cameras were used, which were equipped with an MMS capability, using Vodafone SIM cards and SMTP2GO (www.smtp2go.com), and an e-mail delivery service. Where cameras were in an area with a mobile phone signal, all photographs were sent to a secure email address, which ensured data were not lost should the camera be lost or stolen. Cameras were set on a 1hr time lapse to give continuous regular coverage of the trap throughout each day. Although the cameras were fitted with passive infra-red (PIR) sensor triggers, this option was not used due to concerns over the risk of false negatives (Newey *et al*., 2015), and given that detecting the IR profile of a bird might be problematic against some potential background temperatures (Campbell, pers. comm.). There was also a risk that cameras could take large numbers of photographs if a bird was present and continually moving in a trap. Using a one hour time lapse struck a balance between detecting the vast majority of birds caught (only birds that were in the trap for less than one hour would be missed), and having a manageable number of photographs to examine each day when all 20 cameras were active.

Trail cameras were, when possible, attached to a solid object in the vicinity of a trap such that they had an uninterrupted view of the trap (or as good a view as possible). This normally took the form of a tree or fencepost to which the camera was attached by placing in a lockable metal security box and securing to the feature using a bicycle lock. A number of angle-iron stakes were also prepared, to which the lockable security boxes could be attached. In the absence of suitable camera mounting point, these stakes could be hammered into the ground near a trap if necessary and a trail camera placed inside the box.

2.5.3 Comparison of record books and photographs

Once cameras and record books were collected, the data were compared to allow validation of the record books submitted by trap operators. Where discrepancies were found, efforts were made to explain them. Occasionally a bird was recorded in the record books but not photographed by the camera, which was probably due to the trap operator removing the bird before the camera took a photograph. Occasionally the camera identified a bird that was not recorded in the trapping record. These records were from multi-catch traps, and it was assumed the bird had escaped the trap (see part 3 of this series of reports: Campbell *et al*. 2016a).

2.6 Trap assessments

When trail cameras were installed, a short visual inspection of traps was undertaken and several details noted, shown in table 2.3. This included an opportunistic inspection of the decoy bird’s condition and circumstances in which it was held.

Table 2.3 Details of information collected during visual inspection of traps.

Factor	Example Responses	Explanation
Grid Reference	*NY 15### 30###*	Allows easy collection of cameras.
Surrounding habitat	*Land categories as listed in the record books.*	Description of trap location.
Land use	*Livestock, private garden, shooting estate*	Description of trap location.
Vegetation	*Tree line 100m South; grazed grass 150m in all directions*	Recorded using Grid References, using Grid Reference Finder prominent features were noted.
Features close to trap	*House 15m East, Main road 45m West*	Recorded using Grid References, using Grid Reference Finder prominent features were noted.
Overhead cover	*50% (tree overhead); 0%*	Describes trap location.
Substrate under trap	*Grazed grass, concrete*	Describes trap location.
Exposure	*Low, medium, high*	Describes trap location.
Visibility	*Low, medium, high*	Describes trap location.
Live decoy	*Magpie; Carrion crow; none*	Shows if a live decoy was present when the camera was placed.
Water	*Water supply identified; degree of soiling*	To assess compliance with General Licence requirements.
Food	*Fresh dog food, carrion*	Collected information on decoy bird husbandry while in captivity.
Shelter	*Roof, 2 walls*	A measure of the shelter provided for decoy birds.
Feather condition	*Very good (clean feathers); Good, OK, Poor (frayed tail and wing feathers, some soiling)*	An indication of the condition of the bird, and possibly length of time in use as decoy bird.
General condition	*Very good (alert, active, not stressed), Good, OK, Poor (listless and unresponsive/ panicked/ panting etc.)*	An indication of the bird's general well-being.
Trap Cleanliness	*Very good (clean, no soiling, fresh food), Good, OK, Poor (obvious soiling, moulding food, very dirty water)*	Indication of the cleanliness of the trap.

3. RESULTS

3.1 Return rate

There were 410 people available to contact, who were either participants in part 1 of this series of reports (Reynolds, 2016) and had volunteered their details, or were trap operators who had heard about the project via press releases or friends. Of the 410 people, 271 (66%) were willing to participate by taking records. The remainder either could not be contacted, declined to participate, or were unable to participate due to personal circumstances.

Uptake of the ‘Trapper App’, developed by the GWCT, was poor. Technical issues meant very little data were collected using this method, and ultimately no data from the ‘Trapper App’ has been presented.

Although record books were sent to 271 participants, only 129 returned usable trapping records. Almost one quarter of participants did not return books. Of returned records, some did not use the books/spreadsheet as intended and returned data summarised by month or year, which was of limited use, and some returned empty books as they had not trapped during the study period (see table 3.1). In total there were over 16000 trap days’ data recorded, with over 3000 days resulting in the capture of target species (table 3.2).

Table 3.1 Breakdown of participation

Trap operators	Number contacted or participating	Percentage of participants
Willing to participate	271	100%
Willing to take cameras	151	56%
Did not return books	65	24%
Record books returned	206	76%
Returned usable records	129	48%
Usable camera records	27	10%

Table 3.2 Breakdown of data provided by participants taking records. Unique trap refers to the individual trap in a given location. When the trap was moved it was no longer subject to the same environmental and location dependent factors and is therefore counted as a separate trap for purposes of the analysis.

Summary of data used for analysis	Count
Trap days data recorded	16184
Days target species were caught	3008
Days non-target species were caught	121
Number of unique traps	1398

3.2 Data validation using cameras

In order to establish if trappers with cameras were representative of all trappers, all trappers with usable trapping records were divided into two groups on the basis of whether or not a camera had ever been used to monitor a trap operated by an individual trapper. Thus, even though a camera may have been used to monitor a single trap for just a short period of time, all traps operated by that individual, irrespective of number of traps they used and the length of time records were kept, were assigned to the ‘camera’ trap operator group (table 3.3). For a full list of species caught see table 3.8. Note that number of trappers catching species in table 3.3 does not equate with numbers of trappers shown in table 3.8 since multiple species captures could take place in the same trap in a 24 hour period.

Table 3.3 Target and non-target bird trapping statistics for trap operators who agreed to have traps monitored with cameras and trap operators who did not. Raptors included birds of prey, owls and raven.

Bird catch (% of 'All birds caught')	**Camera group**	**Non-camera group**	**Camera data as percentage of non-camera data**
All birds	853	3787	23%
Target species	795 (93.2%)	3726 (98.4%)	21%
Non-target, non-raptor birds	40 (4.7%)	48 (1.3%)	83%
Raptors	18 (2.1%)	13 (0.3%)	138%
Buzzard	17 (2.0%)	8 (0.2%)	213%
Tawny owl	1	3	33%
Sparrowhawk	0	1	0%
Raven	0	1	0%
Trap operators			
Total trap operators	27	102	26%
Trappers that caught target species	26	94	28%
Trappers that caught non-target, non-raptor birds	6	11	55%
Trappers that caught raptors	4	10	40%
Trappers that caught buzzards	4	5	80%
Proportion of trap operators that caught buzzards who caught more than one buzzard	100%	20%	

Every volunteer in the entire study was self-selected rather than randomly selected, although this is unavoidable for this type of volunteer survey. However, if certain types of trapper were more likely to volunteer than others, then this may result in some bias. The trap operators that accepted cameras were a sub-sample of these self-selected volunteers, and could coincidentally have been better or worse trappers than the non-camera group, which may have caused appreciable differences. Thus, differences in the probabilities of capturing a target bird species were compared across the two groups by fitting a GLM with a logit link function, and a binomial error structure, to assess whether the proportion of trap days on which at least one target species was caught differed between the two groups of trappers. In this case trap success was modelled either as 'yes' or 'no' per trapper per day, rather than total numbers of birds caught. This allowed for differences between the two groups in terms of types of traps used, since some traps, in particular multi-catch traps, are capable of catching large numbers of birds in a day, and if multi-catch trappers were disproportionately represented by a one group or the other, this could skew catch rates of target species in the model. Those trap operators who agreed to have traps monitored with cameras were found to have a statistically smaller chance of catching at least one target bird in an individual trap on an individual day than trap operators who did not agree to the use of cameras ($p=0.025$).

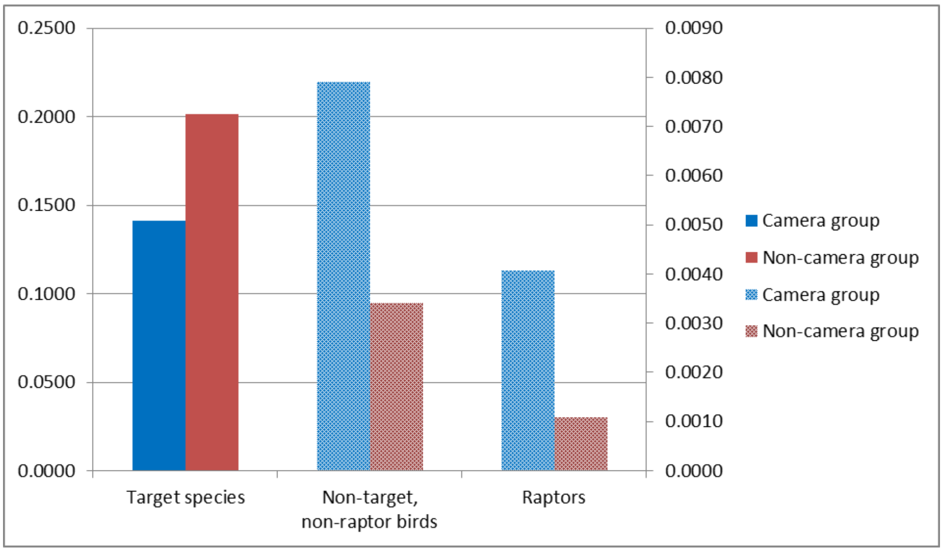

Figure 3.1 Proportion trap success of different bird species groups for trap operators who agreed to have traps monitored with cameras and trap operators who did not. Trap success is calculated from the number of trap days when the species group was caught divided by the total number of trap days for each trap operator group. Raptors included birds of prey, owls and ravens. Solid bars refer to the axis scale on the left; hatched bars to the axis scale on the right.

Trappers with cameras operated traps for 155 days on average during the study, while trap operators without cameras operated traps for approximately 118 days on average, which equates to approximately 28% more trap days on average in the camera operator group.

Figure 3.1 indicates that 'camera' trap operators trapped target species less often, but trapped both non-target (non-raptor) bird species and raptors more often than 'non-camera' trappers. Over 70% of non-target (non-raptor) birds were made up of pheasants (see table 3.8; section 3.4), and the majority of these pheasants were caught by just a single trapper, and were rarely caught by the majority of trap operators, so these data are highly influenced by just a single trapper, who also permitted the use of a camera on his traps.

For raptors however, the vast majority of birds were buzzards (see table 3.3). Observations from this project and part 3 of this series of reports (Campbell *et al*., 2016a), found that buzzards were only caught in traps with meat baits and/or decoys (a possible source of meat bait for some raptors) (figure 3.2).

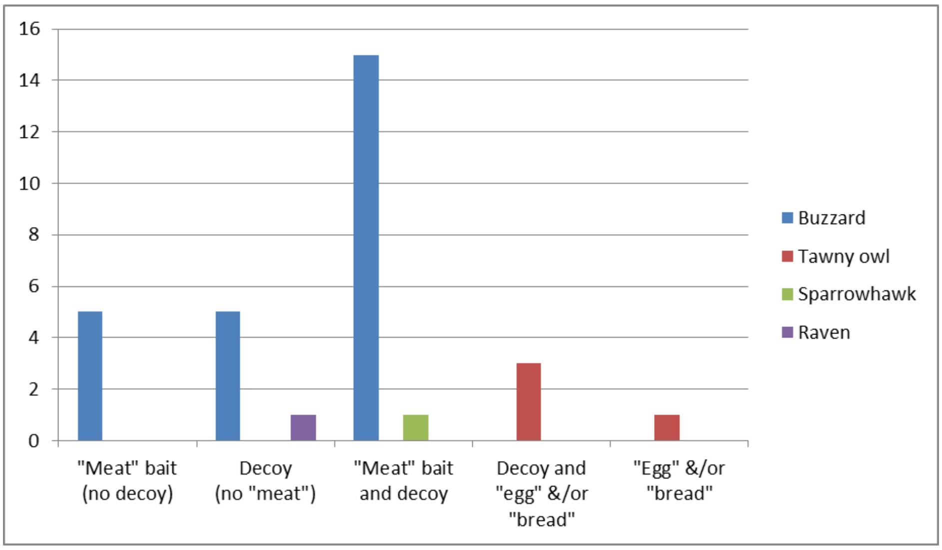

Figure 3.2 Numbers of different raptor species caught using different attractants.

Under the terms of the current General Licences, small single compartment cage traps (Larsen-mates and Larsen-pods) cannot be used with meat baits, and it was possible that trappers without cameras used single compartment traps more often than trap operators with cameras, and were therefore less likely to catch raptors species. Therefore, for statistical purposes, captures arising from the single compartment traps were excluded, and to remain consistent with the hypothesis of disproportionate use of meat baits, owls were also removed from the raptor analyses since they were the only ‘raptor’ species that entered traps set with bread or eggs, almost certainly in an attempt to capture small mammals attracted to these bait items. Despite this adjustment, trap operators with cameras were significantly more likely to catch raptor species ($p<0.001$) when they caught raptor or target birds than operators without cameras.

Cameras were not being used to monitor traps during all trap days of the camera trap operator group. Nonetheless, their records indicate that buzzards were caught on seven occasions when cameras were present, and on 10 occasions when cameras were not actually present, suggesting no influence of the presence of a camera on raptor catches.

The differences observed between the two camera groups may have been due to differences in the trap operator ‘user groups’ (see section 3.3 for a full explanation of terms), with trap operators being assigned to a group associated with agricultural protection, game protection or protection of certain bird species (e.g. songbirds) by urban/suburban users. Within the group of trappers who permitted the use of cameras, the proportion of trap days associated with ‘agriculture’ were lower, but trap days associated with game management or from the suburban group were higher when compared with the group of trappers who did not permit the use of cameras (table 3.4). The proportion of raptor catch by game managers was clearly higher than for agricultural or suburban trappers regardless of whether a camera was deployed or not, but the greater proportion of game managers in the camera group may partly explain differences in the raptor catch between the camera vs non-camera group. Raptor catch might be explained by the proportional use of meat as bait, since meat bait was used by agricultural trappers on 21% of trap days, by game managers on 33% of trap days, and by suburban trappers on just 3% of trap days. Furthermore, since game management trappers were slightly less efficient at capturing target species than the other trap user groups (table 3.7), this disproportionate use of game managers in the camera group may partly explain why the camera group is significantly less likely to catch target species, but more likely to catch raptors. Comparison of the ratio of the proportion of raptor catch by the proportion of the trap days for each user group, showed very similar results regardless of whether the trappers were from the camera or non-camera group. Nonetheless, statistical reanalysis of the data, taking into account the different user groups, did not have an impact on the results, suggesting that the differences between the camera and non-camera groups in terms of target and raptor catch, could not be explained by the differences in the proportion of the user groups.

Table 3.4 Percentage of trap days, and number and proportion of raptors caught according to assigned 'user groups' for those who agreed to have traps monitored with cameras and trap operators who did not. Also the ratio of the proportion of raptors caught over the proportion of trap days within each group.

		Agriculture	**Game management**	**Suburban**
Camera group (n = 27)	Proportion of trap days	27%	57%	16%
	Raptor number caught (proportion)	4 (22%)	14 (78%)	0 (0%)
	Ratio of proportion of raptors over proportion of trap days	0.8	1.4	0.0
Non-camera group (n = 102)	Proportion of trap days	39%	50%	11%
	Raptor number caught (proportion)	4 (31%)	8 (62%)	1 (8%)
	Ratio of proportion of raptors over proportion of trap days	0.8	1.2	0.7

There were also differences in the proportion of camera and non-camera trappers in terms of geographical location, but given the relatively small number camera trappers (27), and the relatively large number of geographical areas (13 in total), this is not surprising (table 3.5). Looking more closely at which regions raptors were caught in, there appears to be a considerable amount of overlap, suggesting that Aberdeenshire, Argyll and the Highlands may have higher than average buzzard densities within them (this is also partly supported by the BTO Breeding Atlas; Balmer *et al*., 2013). While two of the regions both caught multiple raptors, the number of raptors caught was clearly higher in the camera group (table 3.5).

Table 3.5 Proportional regional distribution, and number of trap operators catching raptors (number of raptors caught) of trap operators who agreed to have traps monitored with cameras and trap operators who did not.

	Proportion of trappers		**Number of trappers catching raptors (number of raptors)**	
	Camera group	**Non-camera group**	**Camera group**	**Non-camera group**
Aberdeen City and Shire	15%	30%	1 (3)	4 (4)
Argyll and The Isles	4%	4%	1 (8)	1 (1)
Ayrshire and Arran	0%	7%		
Dumfries and Galloway	7%	10%		1 (1)
Dundee and Angus	0%	3%		
Edinburgh and The Lothians	4%	10%		1 (1)
Greater Glasgow and the Clyde Valley	15%	6%		
Kingdom of Fife	7%	5%		
Loch Lomond, the Trossachs	7%	6%	1 (4)	
Perthshire	15%	9%		1 (1)
Scottish Borders	4%	5%		1 (1)
Stirling and Forth Valley	0%	0%		
The Highlands	22%	6%	1 (3)	1 (4)

Close examination of the buzzard capture data shows several instances of repeated buzzard captures at the same trap over a relatively short period of time. While these birds were not marked (ringed or wing-tagged) to allow confirmation, the data perhaps suggest that individual buzzards may have been recaptured repeatedly creating distortions in the actual numbers of buzzards caught if recaptures are taken into account. All four of the 27 camera trappers who caught buzzards caught them multiple times. One trapper caught three buzzards in same trap on 11, 15 and 28 March; another caught four buzzards on 18, 23, 24 November and 1 December in the same trap; a third trapper caught buzzards twice, on 17 and 18 May in the same trap, but on the second day, two buzzards were caught in the trap together. Finally, the fourth camera trapper who caught buzzards, caught seven in total; one was trapped on 18 March in one trap, but in another trap, an individual buzzard was caught on 31 March, 1, 2, 3, 4 and 5 April. Only one of the non-camera trappers caught buzzards repeatedly: a buzzard was caught on 17 and 19 March in the same trap. This trapper also caught another two buzzards on 11 and 13 April but in different traps in different habitats. Identifiable buzzards were caught repeatedly in part 3 of this series of reports (Campbell *et al.*, 2016a) (one tagged buzzard three times; another with distinct markings likely to have been caught twice), confirming that re-captures of individual birds can occur. Overall therefore, it would seem possible that in many cases, the actual number of individual buzzards caught was much lower than the data suggests, particularly amongst the camera trappers, which would reduce the disproportionally high rate of individual buzzard catch seen in this sub-group.

3.3 Trap use by different trap operator user groups

Trap operators were assigned to one of three possible groups based on the analysis performed in part 1 of this series of reports (Reynolds, 2016; section 3.8). The groups included ‘Agricultural’, ‘Game management’ or ‘Suburban’ trap operators, depending upon the occupation of the trapper, their reason for trapping and the General Licence under which they undertook trapping, the principle land use over which trapping was undertaken, their location with respect to human population density, and the main corvid species caught. Altogether, 124 trap operators were assigned to a group; 113 were designated based on results from Reynolds 2016, and a further 14, who were not part of original survey, were assigned a trap-user group based on the same factors used in the original analysis.

3.3.1 Location of trappers

Figure 3.3 shows the location of the trap operators in relation to their assigned user group, and includes the majority of individuals for whom the data are presented in the rest of this report. Trap operators involved in this study were concentrated across southern, central and eastern Scotland. Their locations coincide with the main areas of agronomic and intensive agricultural production,[1] the main areas associated with game bird production[2] and the main urban conurbation of the central belt. Given the purposes of the General Licences, and the relative density of farmers, game bird managers and suburban users, this distribution is unsurprising. Efforts were made to include trap operators from the west and north of Scotland (section 2.3), but the likely density of trap operators in these areas is perhaps indicative of the frequency with which they were involved.

[1] see http://www.macaulay.ac.uk/explorescotland/lca_map.pdf
[2] see http://www.gwct.org.uk/research/species/birds/red-grouse/grouse-moor-survey/; https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/314715/pub-avian-gbpr13.pdf (figure 2: reared game bird density)
http://www.gwct.org.uk/research/species/birds/common-pheasant/lowland-shoot-survey/

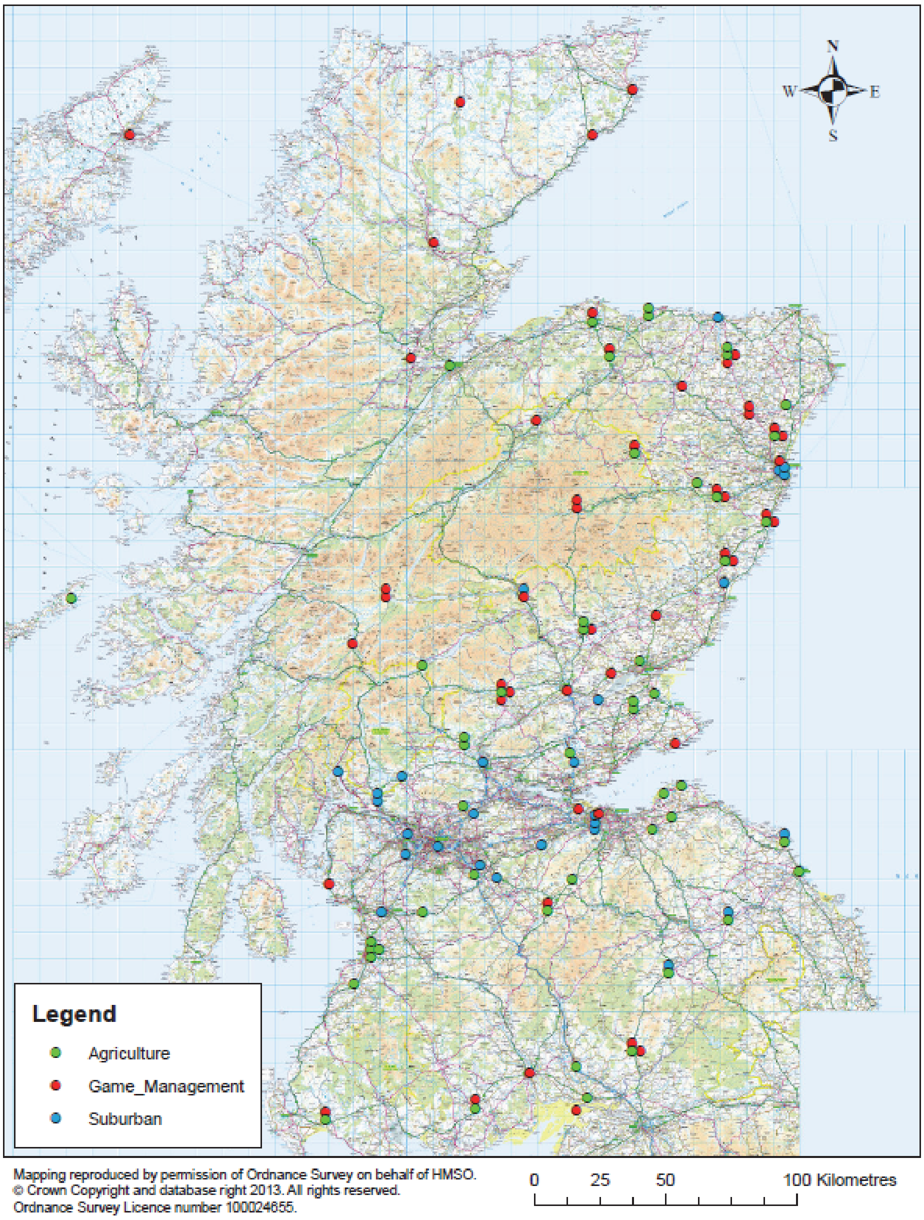

Figure 3.3 Location of trap operators by category of user group. Trappers associated with 'agriculture' are represented by green circles, 'game management' by red and 'suburban' by blue.

3.3.2 Time of year when traps were deployed

There was a distinct seasonal usage of traps, which broadly followed the same pattern regardless of trap user group (figure 3.4). The peak of trapping took place in April for those trappers assigned the game management group, but was a month later in May for those trappers assigned the agriculture and suburban group. Despite the peak in trapping, suburban users generally operated traps more continuously throughout the year, while game managers tended to vary their trapping intensity across the year. Agricultural trap operators focussed more rigidly on trapping from April to May. The peak trapping period coincides with recommended guidelines on trapping (GWCT, 2015), although this is heavily influenced by game management, and may not always reflect peak periods of damage, at least not always for the agricultural sector, where corvid damage can occur for instance, to mature, pre-harvest crops, and newly sown crops in the autumn.

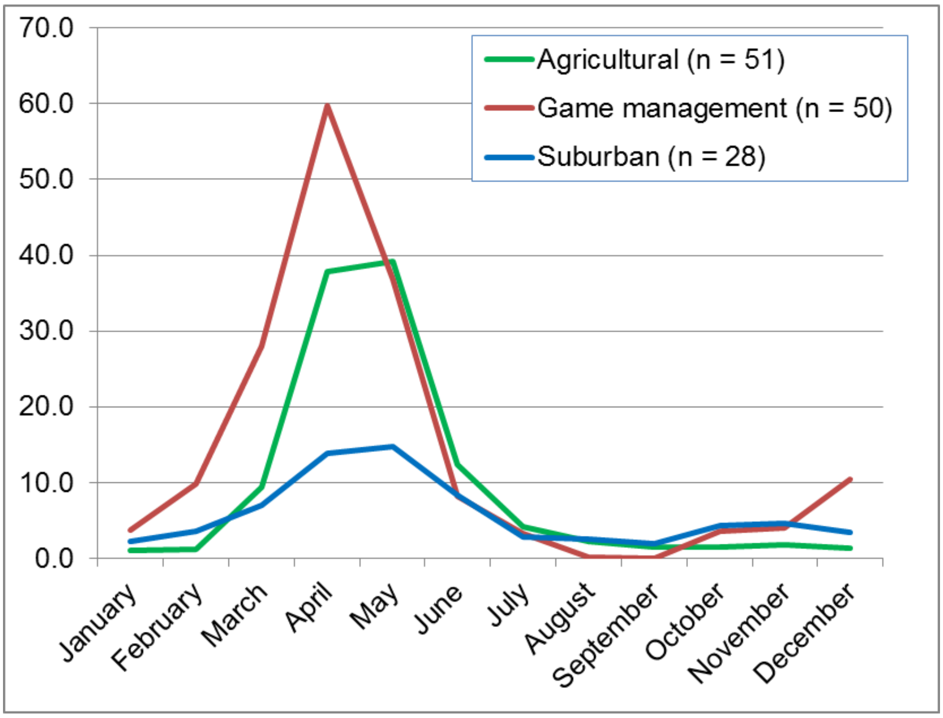

Figure 3.4 Seasonal use of traps (trap days per month per operator) by the three trap user groups.

3.3.3 Time of day traps checked

Trap record books sent to participants included a single box to allow operators to record the time of day traps were checked. Returns indicated that some trap operators checked traps more frequently than once a day, but without a second 'time' box in which to record the data, the time that further checks were undertaken were only occasionally recorded under 'notes'. In some cases, traps were checked so many times in one day, particularly those close to occupied buildings (suburban trap group and farmers), that times were not provided at all (38%, 34% and 61% of trap days provided by agricultural, game management and suburban trap operators respectively). A small number of volunteers recorded only 'am' or 'pm', and it is possible that some of these trap operators may have occasionally exceeded the 24 hour time limit on consecutive checks of traps.

Evidence for operators checking traps more often than once a day however, can be found in section 3.5.2, figure 3.7, which provides information on capture success for different trap types based on absolute numbers of birds caught each day, relative to trap success, based on whether or not a trap caught anything that day. Differences between the height of the solid and hatched bars for a given trap type demonstrates the capacity of that trap to make multiple captures each day. Blue data bars represent the small, single compartment traps, and the height difference seen can only be achieved by emptying and resetting the trap multiple times in a single day when multiple birds are caught.

Figure 3.5 shows that most trap operators checked their traps between 06:00 and 10:00 in the morning. There was some evidence of an afternoon check by all three user groups, although by relatively few trap operators.

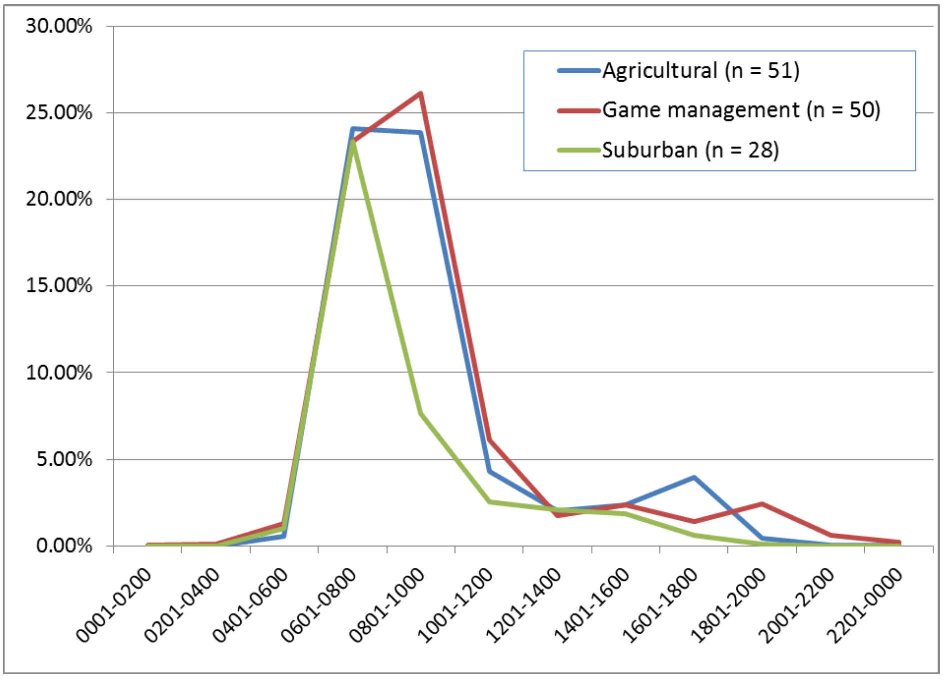

Figure 3.5 Time of day given for trap checking (percentage of total trap days) by three trap user groups

3.3.4 Trap types

Larsen traps were consistently the most commonly used trap type by all trap user groups, followed by any type of multi-catch trap (table 3.6). Small single compartment traps (Larsen-mates and Larsen pods) were the least often used trap, although given their relatively recent inclusion on the General Licence (since 2013), this may be a reflection of habit, and the resources required to manufacture or purchase such traps. Suburban trap operators in this study only set Larsen-mate traps in conjunction with a Larsen trap. Only game managers used Larsen pod traps. These data do not indicate trap efficacy, only frequency of use or popularity.

Table 3.6 Trap types used by different trap operator groups. Data are average number of trap days per trap operator in each user group.

	Total trap days	**Agricultural (n = 51)**	**Game management (n = 50)**	**Suburban (n = 28)**
Small single compartment traps*	704	5	8	2
Larsen	11856	88	112	62
Multi-catch (all types)	3623	21	47	7

*Includes traps s*et al*ongside Larsen traps

3.3.5 Capture rates

Table 3.7 provides information on the trap success rate of target species (number of days a trap successfully caught a target species) in relation to the three trap operator user groups. Percentages in brackets indicate their comparative impact in terms of the proportion of all target species caught. By species, carrion and hooded crows, jackdaws and jays were caught mostly by game managers, although capture of hooded crows was probably determined largely by the distribution of this species and land use across its geographical range. The proportion of magpies caught by the three trap user groups was virtually identical, although the capture rate by suburban trappers was over twice that of the other groups, which may indicate that magpies are found more often, and at higher densities, in urban areas compared with rural situations. They may also be targeting magpies more often than other users if using magpie decoy birds. Suburban users and game managers caught similar numbers of rooks, but the catch rate was higher amongst the suburban trappers, which may be related to the proximity of a rookery. Agricultural based trappers had a similar trap rate to game managers of carrion crows, catching almost half of all carrion crows caught. Game managers were most likely to trap jays, which were caught at very low rates.

Game managers were slightly less efficient than other trap operators but this could be due to a number of factors, not least the fact that most shot as well as trapped (91%; 69% of agricultural trappers and 26% of suburban trappers shot as well as trapped; part 1 of this series of reports (Reynolds, 2016), and thereby potentially lowered the availability of corvids for trapping. They also ran more traps on average, and were possibly laying traps in suboptimal as well as optimal habitats.

Table 3.7 Trap success in relation to target species (proportion of target species caught in brackets), average number of trap days and average number of traps used by different trap operator groups. Trap success is based on whether or not a trap successfully caught a bird for each day a trap was set. 'n' denotes the number of trap operators in each group.

	Total caught	**Agricultural (n = 51)**	**Game management (n = 50)**	**Suburban (n = 28)**
Carrion crow	2144	12.0% (45%)	10.8% (52%)	2% (2%)
Hooded crow	281	0.7% (15%)	2.4% (85%)	0.0% (0%)
Magpie	1076	4.7% (34%)	3.4% (34%)	13.7% (32%)
Rook	353	0.3% (6%)	0.6% (46%)	1.6% (48%)
Jackdaw	667	1.9% (28%)	0.9% (41%)	2.3% (31%)
Jay	18	0.03% (11%)	0.1% (83%)	0.05% (6%)
Overall trap success		20%	18%	20%
Average number days traps set		114	167	71
Average number traps set per trap operator		9	17	3

3.4 Species caught

Across 16197 trap days' data, 4539 target individuals (six species) and 120 non-target individuals (19 species) were caught (table 3.8). This gives overall trap rates of 28.1% target captures per day and 0.7% non-target captures per day. Recorded capture rates of target species were 38 times higher than the capture rates of non-target species.

Table 3.8 Total species caught (common and scientific names) and numbers of trap operators catching them. Target species are the corvids which can be legally controlled using corvid traps under General Licences GL01, 02, 03 and 04.

Common name	Scientific name	Number caught	Number of trappers catching the species
Target birds			
Carrion crow	*Corvus corone*	2144	88
Magpie	*Pica pica*	1076	67
Jackdaw	*Corvus monedula*	667	28
Rook	*Corvus frugilegus*	353	19
Hooded crow	*Corvus cornix*	281	23
Eurasian jay	*Garrulus glandarius*	18	6
Non-target birds			
Common pheasant	*Phasianus colchicus*	50	7
Common buzzard	*Buteo buteo*	25	9
Wood pigeon	*Columba palumbus*	6	2
Common starling	*Sturnus vulgaris*	5	3
Common blackbird	*Turdus merula*	4	3
Tawny owl	*Strix aluco*	4	4
Duck (no species given)	*Anatidae spp*	2	1
Gull (no species given)	*Laridae spp*	2	1
European robin	*Erithacus rubecula*	1	1
Eurasian sparrowhawk	*Accipter nisus*	1	1
Raven	*Corvus corax*	1	1
Mammals			
Domestic cat	*Felis catus*	7	4
Red fox	*Vulpes vulpes*	5	5
Grey squirrel	*Sciurus carolensis*	2	1
European hedgehog	*Erinaceus europaeus*	1	1
European badger	*Meles meles*	1	1
European pine marten	*Martes martes*	1	1
Brown rat	*Rattus norvegicus*	1	1
Ferret	*Mustela putorius furo*	1	1

3.5 Factors influencing capture of target species

3.5.1 Bait & decoy birds

A wide variety of items were used as baits. Dog and cat food, described as “canned dog food; cat food; dog biscuit; dog food; soaked dog food” was common, along with eggs (“hen’s &/or bantam eggs, egg shell, model/pot eggs, pasteurised eggs”), meat (“deer carcass; deer heads; deer offal; fish; fish and heart; gralloch; gralloch and rabbit; hare; heart; kidney; Lamb; liver; mallard; meat; mice; pigeon and rabbit; pheasant; pheasant, pigeon, and rabbit; pigeon; raw mince; partridge; roe deer; squirrel; venison; venison neck; white hare”), meat and bread (“Bread and meat; rabbit and bread; dog food and bread; heart and bread “), and meat and egg (“Deer offal and egg; egg and rabbit; dog food and egg; egg and gralloch; egg and pheasant; eggs and raw meat; egg and cat food”). Predominantly grain based baits were described as bread of a large variety of types, grain ("Maize; wheat; barley; grain"), nuts and seeds, 'mixed' (Mixed seeds; peanuts"), mixed ("Maize and egg; cat food and bread; dog food and muesli; egg and grain; sandwich; table scraps; wheat and pheasant pellets") and 'other' ("Calf blend; chips; muesli; pheasant pellets; sheep nuts"). Baits were re-categorised into groups based on their main component type (table 3.9).

Table 3.9 Bait categories, trap operators and total trap days

Bait category name	Bait groups	Number of trappers using baits	Total trap days
Protein based	Dog food, cat food, meat, meat and bread, meat and egg, egg	170	8359
Grain based	Grains, nuts and seeds, bread, 'mixed' and 'other'	64	2151
No bait	Nothing	5	5612

In addition to baits, live decoys were frequently used, both with and without baits. The use of no bait and no decoy bird ("none") was recorded relatively infrequently. It would seem unlikely that someone would set a trap without either bait or a decoy. Therefore, trap operators may only have recorded the bait on days when fresh bait was provided. Depending upon the level of small passerine and rodent activity in the area, baits can disappear rapidly from traps (Pers. obs; Campbell, pers. comm.).

Live (and plastic) decoy birds were frequently used to lure target species into traps, and traps with decoys were used ten times more often than traps with bait alone, although decoys were most often used in conjunction with baits, making it difficult to disassociate the relative impact of these two factors. Table 3.10 gives capture rates (total number of birds caught as percentage of days traps set for that variable) in bracketed percentage figures, and allows a comparison between the different rates of capture success when using decoys and different baits (grain based, protein based or no bait) in combination, or when using no decoy and different baits.

Grain baits (with or without a live decoy) appeared to be more effective than protein based baits or no baits at capturing target species, although both the grain based bait and the 'no decoy' catch consisted of a high proportion of jackdaws (see figure 3.6).

Plastic magpies failed to catch any bird at all, with or without baits, suggesting a possible aversive effect, although only two trappers used this device. Similarly, in the absence of baits, plastic decoy carrion crows also failed to catch anything, although in combination with protein baits they appeared to have some success, although they caught only jackdaws and not crows. However, these were also used by only two trappers (one of which also used plastic magpie decoys), and the number of trap days during which they were used were relatively few.

Table 3.10 Number of days when traps were set and capture success of any target species for traps using decoy species and baits, or no decoys or baits. Brackets = number of birds caught expressed as percentage of trap days. 'n' denotes number of trap operators using decoy.

Decoy species (number using decoy)	Grain based bait	Protein based bait	No bait
Carrion crow (n=105)	1330 (27%)	5543 (17%)	3855 (19%)
Hooded crow (n=12)	26 (19%)	919 (18%)	402 (13%)
Rook (n=4)	27 (56%)	41 (10%)	0 (0%)
Jackdaw (n=6)	100 (43%)	17 (18%)	3 (0%)
Magpie (n=33)	49 (33%)	1165 (26%)	997 (23%)
Plastic crow (n=2)	50 (18%)	82 (65%)	0 (0%)
Plastic magpie (n=2)	44 (0%)	42 (0%)	0 (0%)
No decoy (n=42)	203 (128%)	933 (6%)	355 (6%)

To fully understand the relative effects of bait and decoys in isolation from each other, capture success for target species using baits in the absence of decoys, and decoys in the absence of baits are shown below (table 3.11 and figure 3.6).

Table 3.11 suggests that crows (both species) and magpies are likely to be caught using decoy birds, while rooks and jackdaws are marginally more likely to be caught using baits alone. However, these data do not take into account the number of days during which traps were set using these attractants. Figure 3.6 show the same data but for trap success (number of days a trap successfully caught a species divided by the number of days the trap was set under these circumstances).

Table 3.11 Days when any trap caught a target species using either specific bait types in the absence of decoys, or certain decoy species in the absence of bait. Figures in brackets indicate number of trappers.

	Carrion crow	Hooded crow	Rook	Jackdaw	Magpie	Jay	Total trap days
Protein baits (no decoy)	23 (7)	0	3 (2)	2 (2)	13 (8)	1 (1)	894
Grain baits (no decoy)	29 (4)	0	9 (5)	35 (7)	0	7 (2)	203
No bait (no decoy)	11 (4)	3 (1)	0	0	2 (2)	0	355
Carrion crow decoy (no bait)	568 (31)	26 (4)	4 (1)	33 (4)	113 (15)	0	3855
Hooded crow decoy (no bait)	1 (1)	54 (3)	0	0	0	0	402
Magpie decoy (no bait)	52 (6)	0	4 (1)	11 (2)	163 (17)	0	997

Data in figure 3.6 for individual species are presented in pairs below based on similarity in behaviour/problems caused. Carrion and hooded crow are paired given their genetic relatedness (hybridisation is possible) as well as behaviour similarities; rooks and jackdaws due to the agronomic problems they can cause; magpies and jays due to their association with egg and chick stealing.

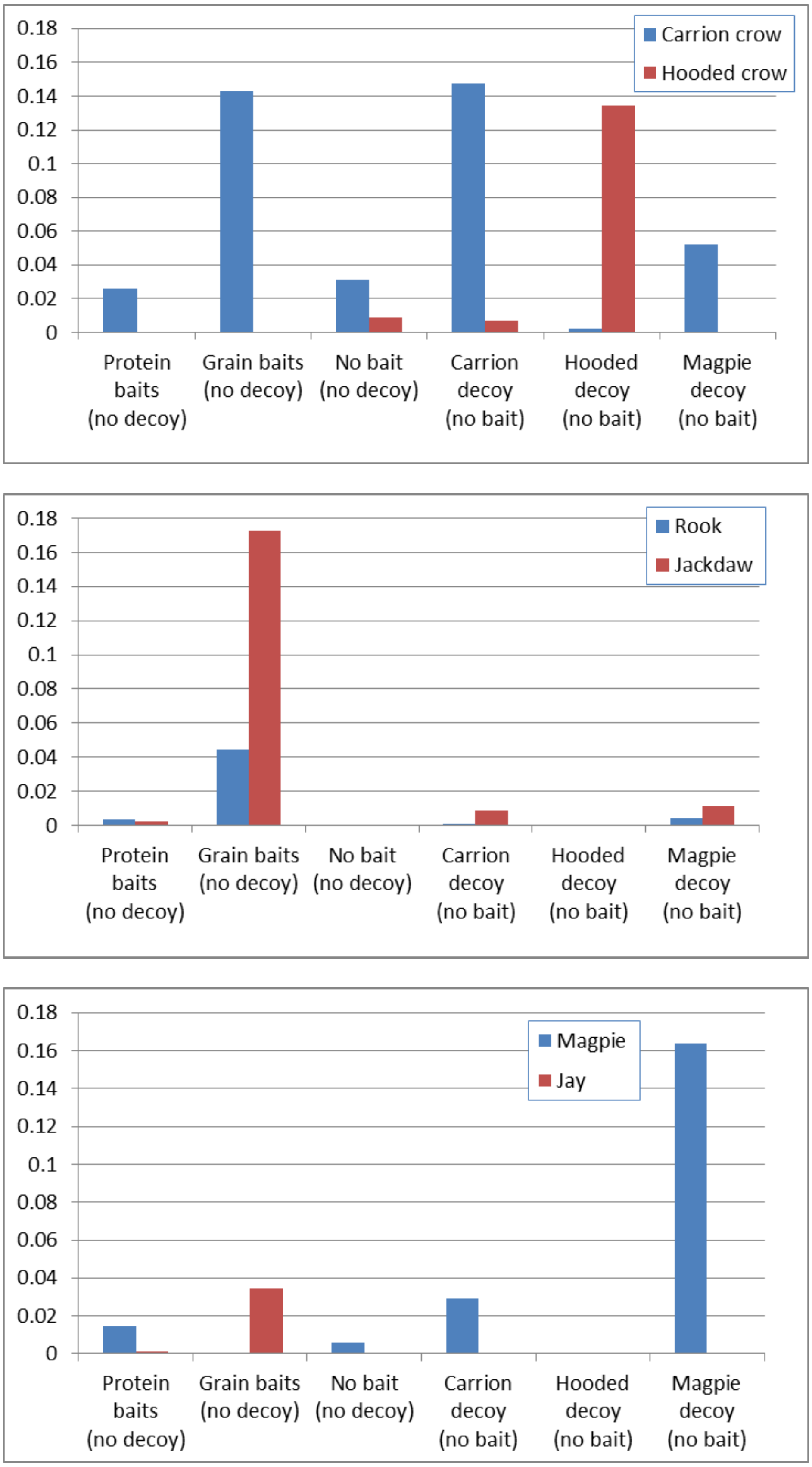

Figure 3.6 Proportion trap success (days traps caught/total trap days) catching carrion and hooded crows (top graph), rooks and jackdaws (middle graph) and magpies and jays (bottom graph) when using exclusively baits or decoys.

It is important to bear in mind the small samples sizes used in figure 3.6, with a limited number of trapping days and even fewer trappers (table 3.11). All species suffer from issues related to a small number of trappers (see bracketed figures in table 3.11), who may be especially good or bad at catching these species, and many sample sizes for trap days are also very low; as a result all data should be treated with an element of caution.

For carrion crows, the data indicate that the use of a conspecific decoy bird is most likely to maximise captures in the absence of bait. Although the use of grain baits alone appear to rival this factor in terms of capture success, these data are from only 4 trappers, of which just one individual contributed the majority of the data, and should therefore be treated with caution.

For hooded crows (limited sample size) and magpies (reasonable sample size), the highest rates of capture were clearly obtained when using conspecific decoys (in the absence of bait). Hooded crows and magpies rarely overlap their species range in Scotland, so opportunities for either species to be attracted to other species' decoy were virtually non-existent. Both species however, overlap with carrion crows, especially magpies, and both species were caught at low rates when carrion crow decoys were used (figure 3.6). Protein based baits alone also caught magpies at low rates.

As expected, based on diet and associated issues (crop damage), grain based baits were most successful at capturing rooks and jackdaws (figure 3.6). Neither rook nor jackdaw decoy birds were deliberately placed into traps, although magpie and to a lesser extent, carrion crow decoys did capture small numbers of rooks and jackdaws. While the deliberate placement of a decoy did not appear to capture many birds, multi-catch traps are believed to attract large numbers of birds by the presence of other birds caught in them, and it is possible that the apparent success rate of decoys provided in the graphs above is an underestimate of their true influence, especially since the majority of jackdaws and over 50% of rooks were caught in multi-capture traps (see 3.5.2).

Virtually all 18 jays caught in the study were trapped using grain/seed based baits (figure 3.6), but most were caught by just one trapper (table 3.9), and so these data should be treated with caution. Jays were not caught without baits, irrespective of any non-jay decoy species used, and jays themselves are not permitted for use as a decoy species.

Overall, the species of decoy is likely to attract conspecifics more than it will attract other species. The degree to which a species of corvid may be deterred by another species is unknown. For this to be determined, it would be necessary to run identical traps in the same locality, but with different decoy species.

3.5.2 Trap types

By far the most popular traps were Larsen traps and multi-catch ladder and roof funnel traps, with these 3 types being used by 88% of trappers, and making up 95% of trap days (table 3.12). Table 3.12 data include all baits and all decoys, if used.

Table 3.12 Relative use of different types of trap based on numbers of trap users and total trap days. All Larsen pod traps were used alongside a decoy bird.

	Larsen-mate alone	Larsen-mate with Larsen	Larsen pod	Larsen	Multi-catch ladder	Multi-catch roof funnel	Multi-catch other
Number operators using traps (n = 185)	6%	3%	1%	63%	14%	11%	2%
Total trap days (n=16184)	2%	2%	0%	73%	9%	13%	1%

To understand which traps caught most target species, figure 3.7 shows capture rates (total number of target species caught per trap day), as well as trap success (whether or not a trap caught a target species in a given day) per trap day. It is important to bear in mind that these data were likely to be strongly influenced by any baits or decoys used. Trap types are grouped into small single compartment traps (Larsen mates and Larsen pods, with and without a Larsen trap nearby), regular Larsen traps, and all three multi-capture trap types. Differences between solid and hatched bars of the same colour indicate the extent to which individual traps achieved multiple captures in a single day. Thus, multi-capture traps (green), which are capable of catching very large numbers of birds in a day, can show marked differences. Larsen traps (red) typically have several capture compartments and can show quite large differences between the solid and hatched red bars. The small single compartment traps (blue) rely entirely on the trap operator emptying the trap several times each day in order to achieve any difference between the size of the solid and hatched bars, which nonetheless, a proportion of trappers managed.

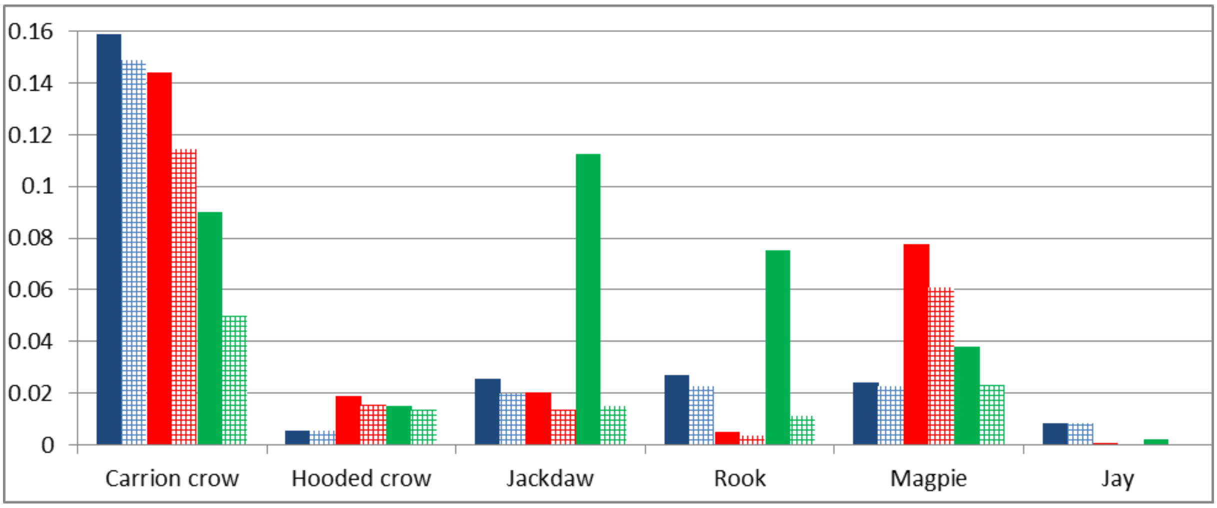

Figure 3.7 Proportion capture rate (solid bars = total catch per trap day) and trap success (hatched bars = trap success [yes/no] per trap day) for different target species using single compartment traps (blue), Larsen (red) and multi-capture (green) traps.

Figure 3.7 suggests that carrion crows were more often trapped using any Larsen 'type' trap, especially the single compartment traps, than they were using multi-catch traps. Hooded crows however, were most often caught in Larsen traps, although these data represent a small sample size.

Species that typically flock, such as rooks as jackdaws, were more easily caught in the multi-catch traps, which have the capacity for simultaneous capture of large numbers of birds. Nonetheless, these species were also caught successfully in single compartment and Larsen traps, although clearly not in the same number each day.

Magpies were most often caught in Larsen traps, but were also caught in both single compartment and multi-catch traps.

Only 18 jays were caught by a total of 6 trap operators, so the data in figure 3.7 will inevitably be highly influenced by the traps used by these few trappers, and should be treated with caution. Nonetheless, they suggest that jays are easily caught in small single compartment traps.

3.5.3 Effectiveness of small single compartment traps without or with adjacent Larsen traps

To understand the effect of running single compartment traps alongside or in isolation from Larsen traps, capture rates (catch rate and trap success) were compared between 'isolated' single compartment traps, single compartment traps run alongside Larsen traps, and Larsen traps themselves (figure 3.8). Small single compartment traps used alongside Larsen traps did not catch hooded crows, jackdaws or jays and data are not presented here. The data shown should be treated with caution, since they involve very small sample sizes. For instance, these data are based on the capture of only 23 crows, 6 magpies and 16 rooks for small single compartment traps run in isolation.

For carrion crows (for which the largest data set exists), single compartment traps run alongside Larsen traps appeared to offer the best trap success. For magpies, Larsen traps alone caught birds at the highest rates, while for rooks, isolated single compartment traps worked best, although rooks were caught at very low rates. Overall, these data support earlier findings, in that crows and magpies are clearly attracted to decoy birds, present either within the Larsen or nearby, while rooks are more attracted to bait than to decoys *per se*.

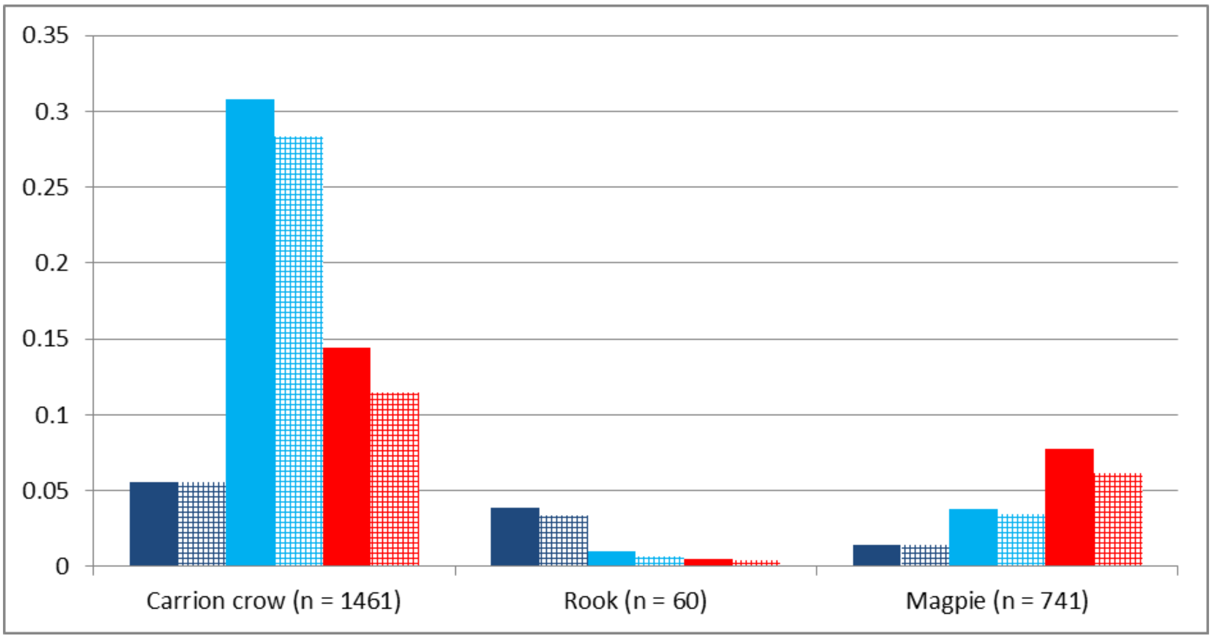

Figure 3.8 Proportion capture rate (solid bars = total catch per trap day) and trap success (hatched bars = trap success per trap day) for different target species using isolated single compartment traps (dark blue), single compartment traps run alongside Larsen traps (light blue) and Larsen trap (red).

3.5.4 Land category and trap type

Different types of trap may be more appropriate for use in particular habitats, depending upon the target species and the timing and type of damage taking place. The relative use of the three main types of trap within each land category is shown in table 3.13 with absolute numbers of trap used given in brackets.

Table 3.13 Percentage of trap days that a type of trap is set within each land category (bracketed figures = numbers of actual traps used)

Land Category	Small single compartment traps	Larsen	Multi-capture traps	Total trap days (traps)
Forestry-woodland*	2% (21)	86% (507)	12% (126)	2089 (654)
Lowland Agriculture	5% (99)	79% (1608)	16% (661)	7650 (2368)
Lowland Other*	13% (14)	65% (85)	22% (49)	704 (148)
Semi-urban, Urban and Recreational	3% (20)	84% (435)	14% (196)	2112 (651)
Upland	4% (16)	48% (519)	48% (165)	3598 (700)

* Forestry-woodland' includes all types of woodland, including mixed and deciduous; 'lowland other' includes mire, bog, scrub, coastal heath.

From the sample of trappers involved in this study, most trap days and traps were run in 'lowland agricultural' habitats, followed by 'upland', 'suburban', 'forestry' and 'lowland other' in that order. These data are likely to be strongly influenced by the participants' background and reasons for trapping. However, figure 3.9 provides the capture rate (total numbers caught per trap day) of all target species within each land category.

The relative high capture rates of the multi-catch traps (figure 3.9) was almost certainly due to the ability of multi-capture traps to catch large numbers of birds in a single day, and may reflect bird densities, and therefore availability for trapping, in habitats such as forest/woodland, lowland and urban habitats. Comparatively, small single compartment traps were also apparently quite effective, but with the exception of the lowland habitats, although these data were derived from relatively few traps, and may be influenced by just a small number of highly effective trappers.

Larsen traps were apparently most successful in upland habitats, but were the least successful of the three trap types in forestry/woodland and urban areas. One possible explanation, particularly if the trap is run with a decoy bird, is differences in the visibility of the decoy bird in these habitats.

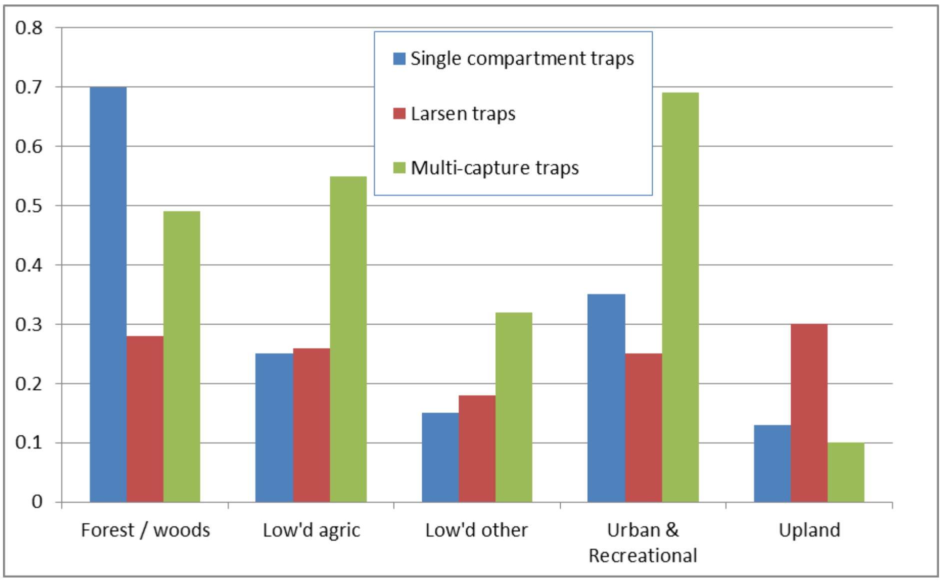

Figure 3.9 Proportion capture rate (total numbers of target species trapped) per trap day within different land categories for single compartment (Larsen mates and Larsen pods), Larsen and multi-capture traps.

When total numbers of target birds caught per day (capture rate) is exchanged for whether or not a trap successfully made a catch (trap success) regardless of actual numbers caught, trap success is dominated by the single compartment traps across most of the land categories (figure 3.10). Bearing in mind possible issues associated with the low sample size for the single compartment traps in most of these habitats, the relative success of Larsen traps increased.

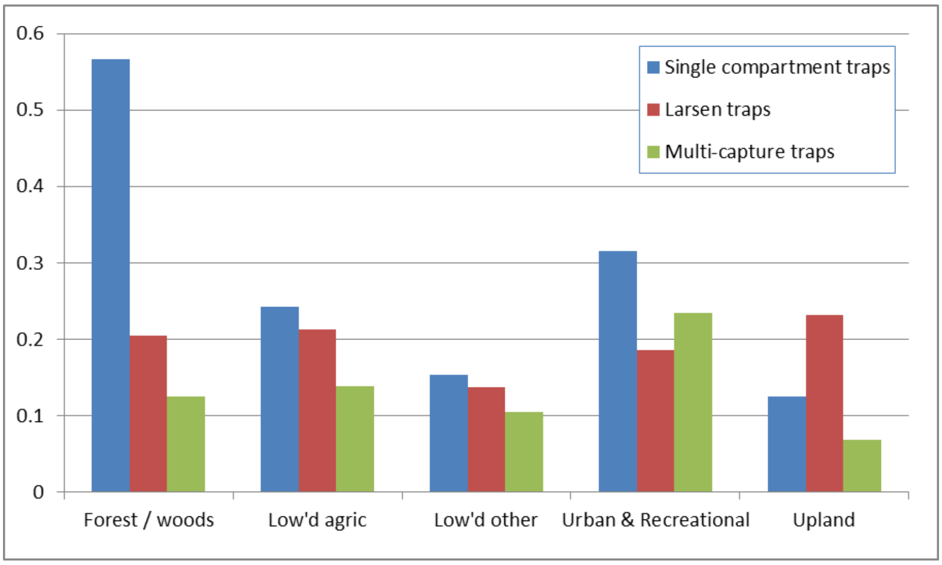

Figure 3.10 Proportion trap success (number of traps catching species per trap day) of target species within different land categories for single compartment (Larsen mates and Larsen pods), Larsen and multi-capture traps.

3.5.5 *Time of year*

Trapping is often applied seasonally to control corvids, e.g. to protect the eggs and hatchlings of other wild bird species, or to protect emerging spring planted crops. Figure 3.11 shows trap success for each of the target species by the month that traps were set throughout the study period. These data are indicative of the most effective times of year to trap these species, and trap success removes the bias associated with high daily catches observed for some traps, such as multi-catch traps. Note that data are presented for September and October in 2014 and 2015 coinciding with the start and end of the study.

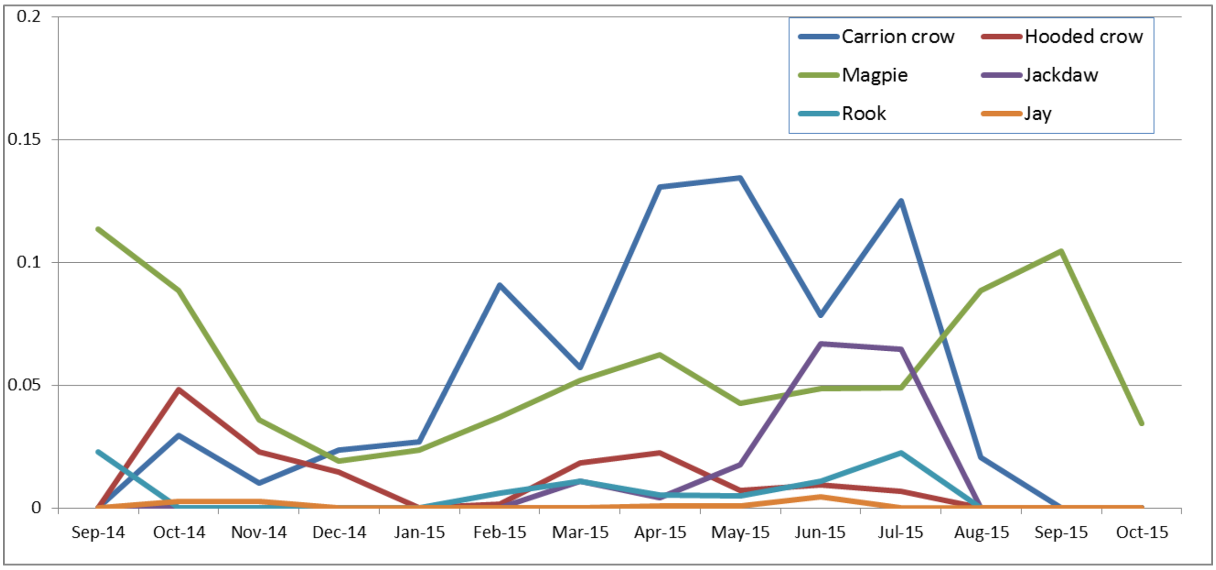

Figure 3.11 Proportion trap success (days traps were successful over all trap days) catching target bird species.

Carrion crow trapping was most effective between April and July, but rapidly declined into August and did not begin to increase again until February. Hooded crows were caught in relatively low numbers but appeared to show a peak in capture rates in April and especially in October. Magpie catches occurred across the year, but peaked in September in both years, with a smaller peak in April. Jackdaw catches, and to a lesser extent rooks, appeared to peak in late summer. Only 18 jays were trapped in total, so it is difficult to draw any conclusions on peak in trapping, although one may have coincided with June.

3.5.6 *Time of year-bait-decoy interaction*

Further analysis was undertaken examining the capture rate of crows during months where sufficient data existed and allowed a comparison of month, bait and decoy. Only carrion crows were examined since this species had the largest data set from all the species, and allowed this type of detailed analysis across months of the year without concerns regarding very small sample sizes.

Figure 3.12 strongly suggests that in April and May, decoys alone (mainly conspecific decoys; see figure 3.6) were a far more effective attractant than grain baits alone for trapping crows, while in June and July, the opposite is the case.

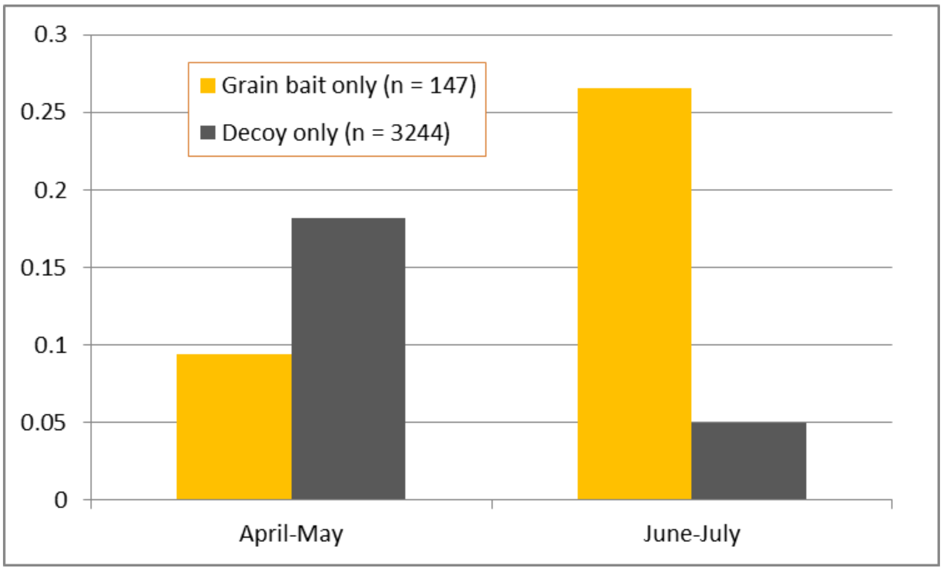

Figure 3.12 Spring and summer proportion trap success catching carrion crows when grain baits were the only attractant, or where conspecific decoys were the only attractant present in the traps. 'n' = number of trap days in both samples.

Figure 3.12 suggests that trappers may deploy different attractants seasonally with varying success. Seasonal use of different attractants (decoys only, decoys and bait, and bait only) is examined in figure 3.13, and uses trap days to calculate the proportional use by trap operators of any trap using baits, decoys or both, throughout the year. The year quarters selected were based on seasons (winter, spring, summer and autumn months).

The use of baits alone was the least popular attractant, being used on approximately 5% to 10% of trap days throughout the year. The use of decoys however, was by far the most popular option, being used in conjunction with baits on at least 55% or more trap days across all seasons. Decoys alone appeared to follow a seasonal pattern of popularity, being most popular in the spring and summer, but decreasing in popularity in the autumn, and were used less than baits alone in the winter (figure 3.13). Note that plastic decoy birds were included in this analysis, although they were only used by 3 trappers in total and have little influence on the overall results.

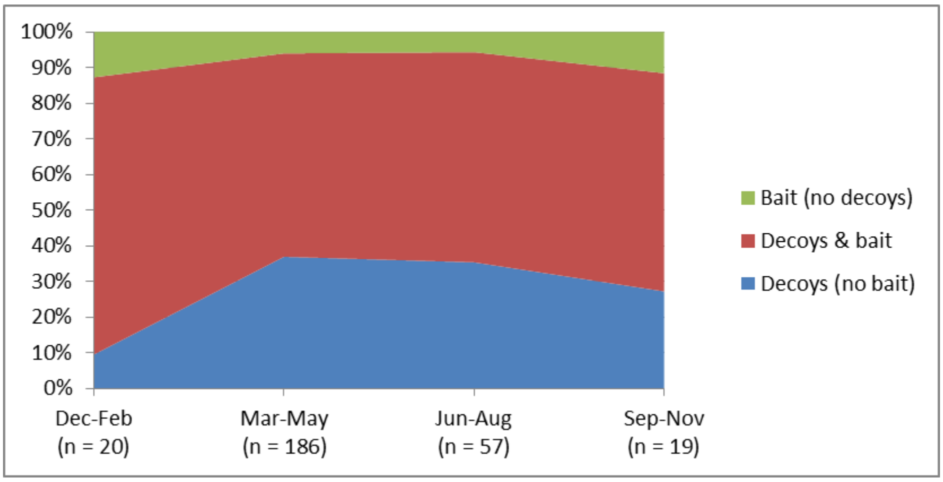

Figure 3.13 Seasonal uses (percent of total trap days) of different attractant combinations. 'n' indicates the total number of trap operators using traps over the quarter year.

A more detailed analysis, combining trap data for the trap success of selected target species using different attractants across quarters of the year was conducted (figure 3.14 and 3.15). Data were combined to maximise the sample size while retaining sufficient detail to interpret any interaction. By not using total capture rates, these data remove the effect of the very large daily catches seen in some traps with a multi-capture ability. Data are not presented for hooded crows and jays due to the very low sample sizes.

Figure 3.14 top (carrion crows) indicates that on average, decoys (with or without a bait) were more effective at catching this species, with the exception of the summer period (June to August), when baits alone were more effective. Only during the spring (March to May) was the use of decoys in the absence of bait, more effective than decoys in the presence of bait, probably indicating that behaviours associated with defence of the nest, young and territory were a major factor driving captures at this time. Carrion crows were least likely to be caught, regardless of the attractant used, during the autumn period (September to November).

Magpies however (figure 3.14 bottom) were at no point in the year more likely to be caught using a bait alone than when using a decoy. Magpies could be caught relatively effectively at any time of the year using a decoy bird, with or without bait. Although baits and decoys appeared to be marginally more successful than decoys alone during the spring and summer, and the opposite during autumn and winter, these data should be considered with some caution, particularly during the autumn and winter when relatively few magpies were trapped.

It may be worth noting that magpies were caught at approximately half the rate of carrion crows, although this may be driven by local population densities, i.e. availability of birds to capture, and magpies have a more restrictive range than carrion crows in Scotland.

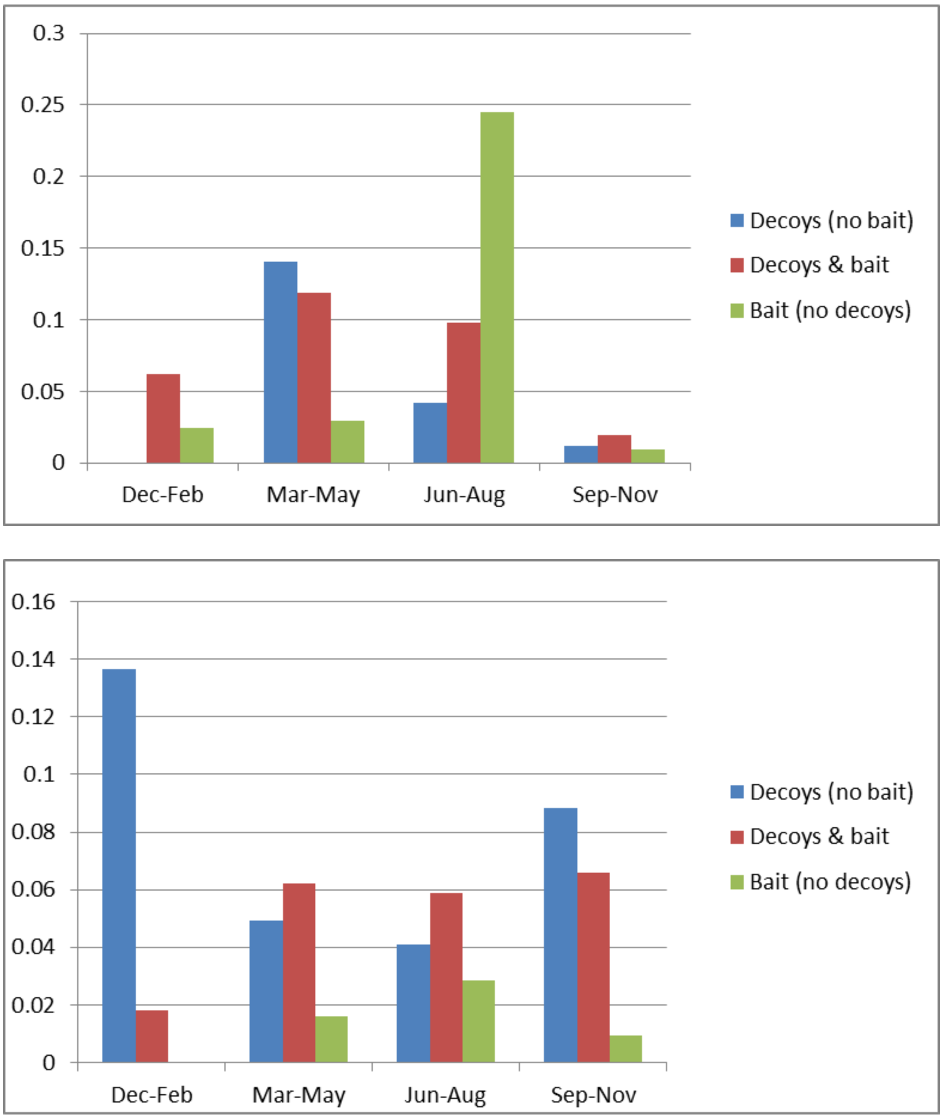

Figure 3.14 Proportion trap success catching carrion crows (top) and magpies (bottom) across different seasons of the year and using different attractants.

Figure 3.15 provides relative capture rates of rooks (top) and jackdaws (bottom). Rooks were not caught in the autumn in this sample, but were mainly caught in the spring and summer, when the use of bait alone or decoys alongside bait appears to have been an important factor driving trap success. Given the relatively low proportion of traps set using baits alone (figure 3.13), these data may indicate that capture of rooks is driven largely by the presence of bait, and that the presence of a decoy bird may not be particularly aversive, especially since rooks are approximately the same size as crows and larger than magpies (the two main decoy species used).

Like rooks, jackdaws were not trapped at all during the autumn, and were also not trapped during the winter in this sample. Capture rates of jackdaws were predominantly driven by the presence of bait alone (figure 3.13 bottom), although they would still enter traps with either a carrion crow or magpie decoy (see figure 3.6). To what extent these decoy species were attractive or aversive to jackdaw captures is unknown.

Note that the capture rate of jackdaws is almost ten times that of rooks, and might indicate a much higher availability / population density in those areas where they were trapped, or that jackdaws are more readily trapped than rooks despite often occurring together.

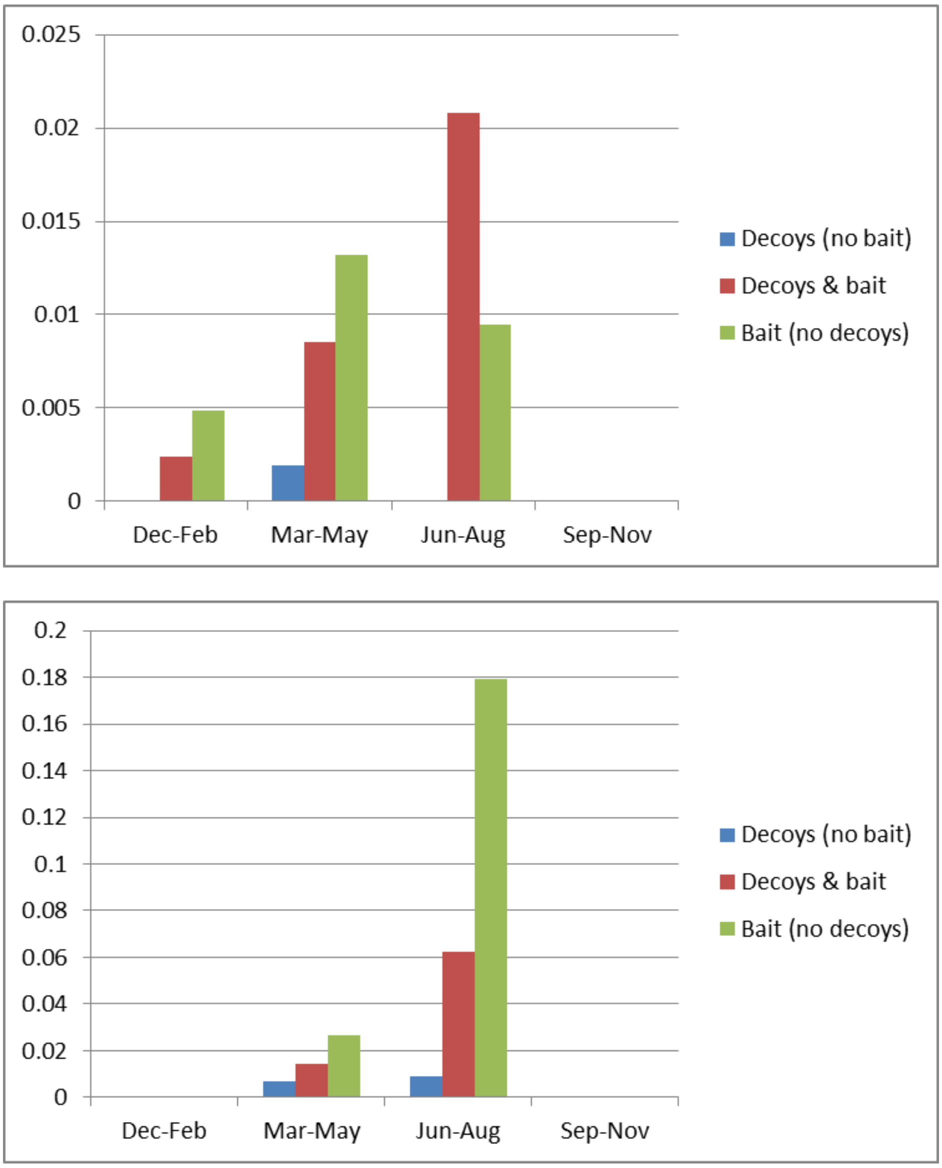

Figure 3.15 Proportion trap success catching rooks (top) and jackdaws (bottom) across different seasons of the year and using different attractants.

3.5.7 Distance from cover

This study aimed to provide some information on the finer details of habitat that may be useful in determining those factors likely to affect catch rates of target species. As such, trap operators were asked to identify the distance between the trap being monitored and cover. Cover was considered any natural habitat feature, such as trees or shrubs that could physically provide an element of shelter from prevailing sun, wind or rain, and would not necessarily have to overlay or shroud the trap. Data are presented as trap success in figure 3.16 where ‘distance from cover’ varied from 0 metres, i.e. the trap was sheltered to some extent, in a logarithmic scale up to 10 metres, 100 metres, 1000 metres and over 1000 metres.

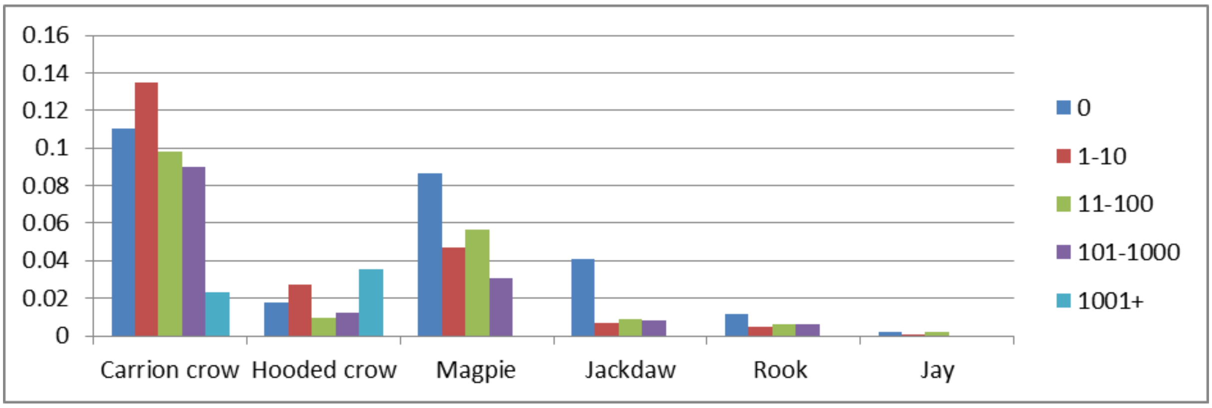

Figure 3.16 Proportion trap success (number of traps catching species per trap day) of target species at distances from cover.

The majority of traps were set in ‘the open’ rather than under cover (at a rate of about 5:1), but catch rates were much higher on average in traps located under cover or adjacent to cover than those located further away (i.e. >10m from cover).

Both carrion crows and hooded crows were effectively trapped at 1-10 metres from cover, although hooded crows were also caught at higher rates when over 1km from cover. Carrion crows were only occasionally caught at distances over 1km from cover. The differences between the crow species may be a reflection of their distribution and typical habitat across the species range.

Capture rates of magpies, jackdaws and rooks were highest beneath cover. While magpies could also be caught relatively often at further distances from cover, the capture rate of jackdaws fell dramatically at 10m+. The relationship between capture rates and distance from cover in rooks appeared to follow a similar pattern to jackdaws, although for a much smaller sample size.

Jays were caught too infrequently in this study to attempt an explanation of this variable.

4. NON-TARGET CAPTURES

Table 3.8 above provides a list of numbers of all species recorded as by-catch in this study, including the number of trap operators recording them. The small number of non-targets caught does not lend itself to robust interpretation of the data, and any information provided below should not be relied on as a complete picture of a particular species' behaviour. Due to the very small numbers of non-target birds and mammals caught, in all cases amounting to less than 10 individuals per species with the exception of pheasants and buzzards, the following section will focus on raptors, in particular, the buzzard.

4.1 Factors related to raptor by-catch

A brief overview of those circumstances in which raptors were caught is given below, and as stated above, should be viewed with caution.

Figure 3.2 (section 3.2) provides information on the absolute by-catch of raptors when different bait types were used. Fifteen of the 25 buzzards caught entered traps containing a 'meat' bait and a decoy, and only five buzzards entered traps with a 'meat' bait only. However, due to the relatively small number of trap days in which meat-only baits were used (582 in total) in comparison with meat baits and a decoy (3374), the trap *rates* of buzzards and owls, changes accordingly (figure 4.1). These data show that buzzards are more likely to enter traps containing a meat bait in the absence of a decoy. Similarly, tawny owls are also more likely to enter a trap containing a bait only and in the absence of a decoy, although this probably reflects the willingness of small mammals (the actual prey item of owls) to enter a trap to take the bait without risk of predation from the decoy bird.

The single raven was captured when it entered a trap containing a hooded crow decoy, and most likely reflects the relative densities of these particular species. The sparrowhawk entered a trap containing a carrion crow decoy.

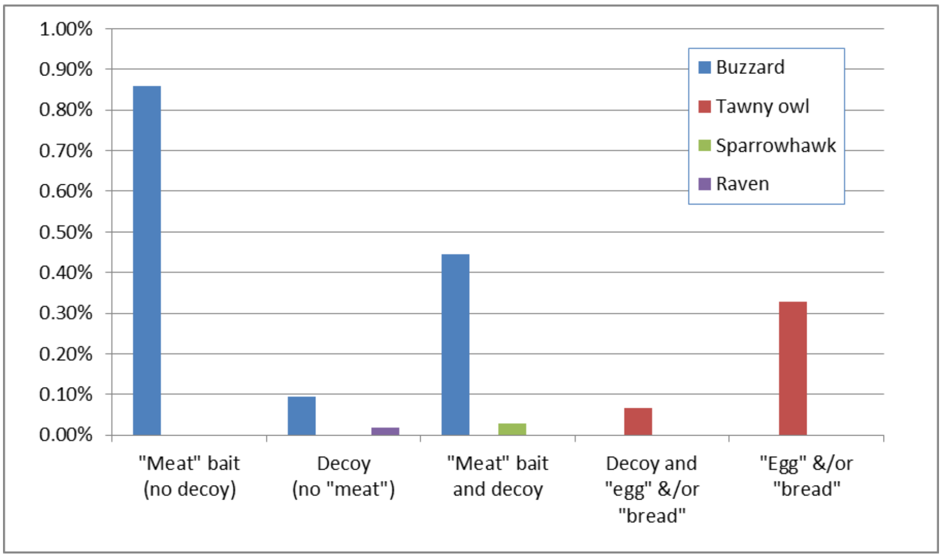

Figure 4.1 Proportion catch rates of raptor species with different attractants. Catch rate was based on the number of species caught over the total number of days the attractant was used.

Figure 4.2 shows the capture rate of raptor by-catch in different types of trap. These data demonstrate that buzzards are willing to enter a variety of different trap types. Sparrowhawks favour live bird prey in their diet, and may have entered the multi-catch trap in pursuit of the carrion crow decoy. However, no predation event was recorded in this instance.

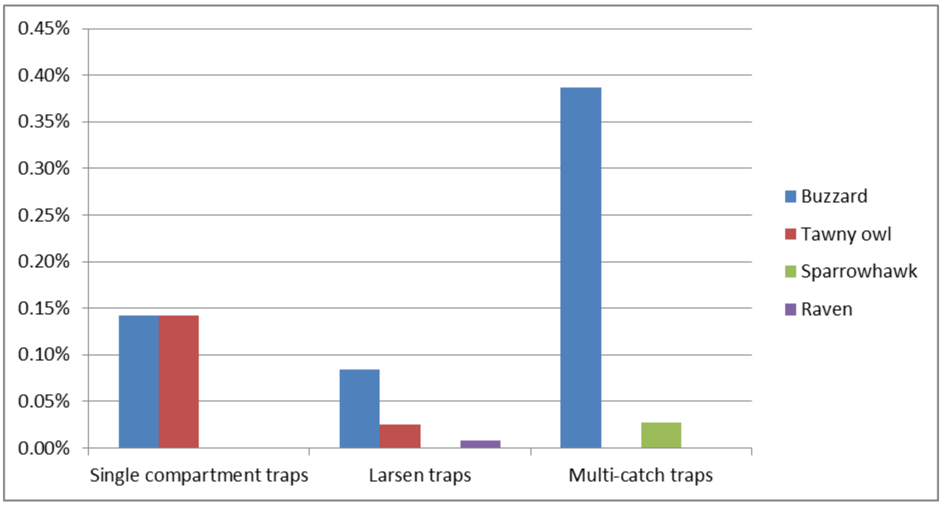

Figure 4.2 Proportion catch rates of raptor species in different trap types. Catch rate was based on the number of species caught over the total number of days the trap was used.

Figure 4.3 shows the capture rate of raptors caught at different distances from cover. Although buzzards nest in woodland, they range over mixed habitats, and this is perhaps reflected in the variability at which this species was caught away from woodland. Tawny owls are commonly found in woodlands, and are most likely to be caught in traps located under cover, or close to cover. Ravens are often found in open moorland habitat, which is reflected by the circumstances for the capture of this single bird.

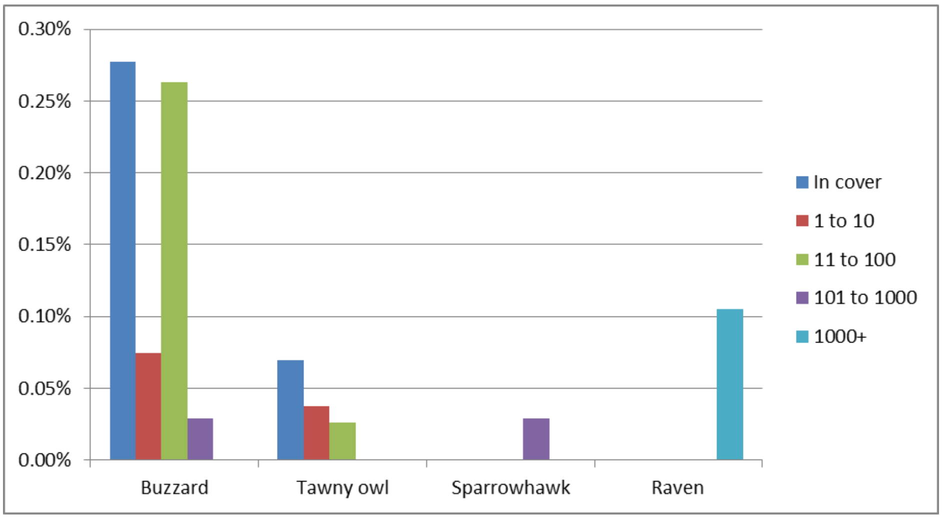

Figure 4.3 Proportion capture rates of raptors at varying distances from cover. Catch rate was based on the number of species caught over the total number of days traps were used at these distances.

4.2 Buzzard re-captures & by-catch estimate

Only the buzzard was caught in sufficient numbers to permit an extremely crude estimate of national by-catch for this species. Twenty five buzzards were caught on 24 trap days by nine trap operators, but anecdotal evidence suggests that buzzards could well have been re-caught on several occasions in a single trap. For instance, one trap operator caught a buzzard on six consecutive days in the same trap, and while it is not possible to confirm that this catch was repeat catch, it would seem a distinct possibility. See section 3.2 for details of all possible re-capture events. Overall it was possible that from the group of 27 trap operators who permitted photographic, and therefore confirmatory evidence of their catch, the 17 buzzards caught by only 4 trap operators, may have represented only 6 individual buzzards caught.

Part 1 of this series of reports (Reynolds 2016) suggested that there were 1471 registered trap users in Scotland, but at least 92 had stopped trapping. Therefore, the total number of registered trap users in Scotland is likely to be in the region of 1379. Using buzzard by-catch information on the 27 trap operators that permitted the use of cameras on their traps, and the likely total number of trap operators in Scotland, table 4.1 provides a crude estimate of the minimum and maximum number of buzzards that may be caught as by-catch across Scotland per year.

Table 4.1 Estimated minimum and maximum buzzard catch each year across Scotland based on data from trap operators that permitted trap record verification using cameras. '' denotes calculated estimates.*

	Trap operators (camera group)	All trap operators in survey	All trap operators in Scotland
Minimum buzzard catch	6		
Maximum buzzard catch	17		
Number of trap operators	27	129	1379
Total number of trap days	4178	16197	173145*
Minimum buzzard catch rate per trap day	0.001436		
Maximum buzzard catch rate per trap day	0.004069		
Estimated minimum buzzard catch		23*	249*
Estimated maximum buzzard catch		66*	705*

These data suggest that buzzard by-catch across Scotland could be at least between 249 and 705 birds per year. This is likely to vary considerably in relation to the relative distribution of trap operators and local buzzard densities, and may also be affected by the way in which traps are deployed (see 4.1). Given suspicions regarding the level of multiple catches of individual buzzards, the actual catch of individual birds may be closer to the lower end of approximately 250 buzzards a year. Furthermore, it is worth noting that not all trap operators may have provided data on all traps they were using. It is possible that had trap operators provided data on only 50% of their traps, the buzzard by-catch might be close to twice that estimated.

5. DECOY BIRDS

The deployment of cameras at trap sites provided an incidental opportunity to record information on decoy birds that were in traps. Not all camera-verified traps used a decoy bird, and of those that did, there was not always one present during a visit. In total, 35 traps containing decoy birds were visited (24 Larsen and 11 multi-catch traps).

5.1 Decoy food and shelter

Type of food supplied to the decoy birds and the details of any shelter were recorded at the time of the visit (tables 5.1 and 5.2). Two third of decoys were fed on meat, fish or dog/cat food.

Table 5.1 Food provided for decoy birds.

Food type	Number of birds
Rabbit	8
Dog / Cat food	6
Other meats	8
Pheasant	2
Seeds / grain	2 (rooks)
Fish	2
Bread	3
Bread & egg	1
Bread & pate	1
Assorted	2

Most traps provided some form of shelter from a simple roof to a hutch or box. Two traps did not have a specific shelter but were in thick vegetation that provided cover. The majority of Larsen traps had only a roof covering, but one third had either a roof and one wall, or a roof and two walls. Multi-catch traps all featured a shelter with at least a roof and one wall.

Table 5.2 Shelter provided for decoy birds.

	Roof	Roof + 1 wall	Roof + 2 walls	Hutch / Box	Bushes
Larsen traps	16	6	2	0	0
Multi-catch traps	0	4	2	3	2
Overall percentage	46%	29%	11%	9%	6%

5.2 Decoy and trap condition

The overall condition of decoy birds and the trap was noted. Condition was noted as either 'poor', 'moderate', 'good' or 'very good' (table 5.3). The overall condition was established by looking for visible injuries to eyes, bill or feet, and the bird's general activity level. (i.e. any obvious signs of injury or sickness) This measure was restricted to a visual inspection, and any damage to wings or legs that was not obvious, would be missed.

Table 5.3 Overall conditions of decoy birds.

Overall condition	Very good	Good	Moderate	Poor
Larsen traps	6	15	2	1*
Multi-catch traps	6	4	0	1*
Overall percentage	36%	58%	6%	6%

The two birds that were in "poor" condition were both found dead after being killed by a predator (most likely to be a fox in both cases, see section 5.4). The majority of birds were in good or very good condition, and no living bird was found in poor condition.

The above condition score was an overview of the birds overall condition, and incorporated the condition of feathers. However, feather condition was also recorded for live birds as 'poor', 'moderate', 'good' or 'very good' (table 5.4). Feather condition was based on fraying, soiling and missing feathers. Birds with soiled, frayed feathers and bald patches had 'poor' feather condition. Relatively few birds were classed as having feathers in poor condition.

Table 5.4 Feather condition of decoy birds.

Feather condition	Very good	Good	Moderate	Poor
Larsen traps	6	9	5	3
Multi-catch traps	3	4	2	1
Overall percentage	27%	39%	21%	12%

Cleanliness and state of repair was recorded for traps as either 'poor', 'moderate' or 'clean'. Traps listed as 'clean' were in a good condition (table 5.5). The intention was that traps listed as 'poor' would indicate either those that were poorly maintained or in a very poor state of repair, for instance, exposed sharp points on the mesh that could cause injury, excessive levels of soiling with baits and faeces that were mouldy. However the majority of traps were clean and in a good state of repair.

Table 5.5 Condition of traps.

Trap condition	Clean	Moderate	Poor	Not recorded
Larsen traps	18	4	0	2
Multi-catch traps	8	1	1	1
Overall percentage	74%	14%	3%	9%

5.3 Decoy bird care

Corvids are generally omnivorous and have a varied diet comprising chiefly of invertebrates, seeds, fruits, other plant matter, eggs and nestlings, some small vertebrates, carrion and human food scraps as and when available (Cramp & Perrins, 1994). In this respect mimicking an acceptable diet for a corvid is potentially easier than for many other bird species. However, while the birds are willing and able to eat a wide range of foods, any one food type may or may not provide all of the nutrition they require.

The diet of birds kept as decoys varied greatly, and while the majority were fed on a meat dominated diet that probably came close to meeting their needs, a few birds were recorded being fed on a diet of bread. Bread alone would be unsuitable as the main dietary component, especially if it was mainly white bread. However, a visual spot check does not necessarily reveal the extent of the full diet received by the birds, and most birds were nonetheless in good condition. Several trap operators fed their decoy birds a mixed diet of bread, eggs and meat paste which would have probably provided them with a reasonable overall diet.

The shelter provided for decoys varied greatly between trap operators. Many made use of objects that happened to be available, such as old wheelbarrows, rabbit hutches, corrugated iron, to add protection to the trap. Most trap operators were careful about avoiding overly exposed areas, and situated traps beside vegetation to provide a wind break where possible. However, occasionally it was arguable whether a minimum standard of shelter was being met based on conditions set in the General Licences, and some shelters looked as if they might be easily be damaged by the very weather they were probably intended to protect birds from. Once again however, a snapshot of conditions does not necessarily provide the full picture of decoy treatment, and some trappers may move traps, or move decoy birds to an aviary or another trap, during periods of inclement weather.

For the most part, traps were kept clean and in a good state of repair. However occasionally, baits and faeces were left until clearly rotting away, which might pose a risk of disease for the captive birds. It is important to recognise that all of the corvid species will eat carrion in the wild, but given a choice, may be more selective about the state of decay for their food. This issue appeared to be more common in large multi-capture traps where there was space for more food/bait to be added on top of old food/baits instead of cleaning the trap (or to provide too much food/bait in the first place), and the scope for moving the trap to a clean site was more difficult. In some instances however, the traps, even large ladder traps, were re-located every few days to move birds away from soiled grass. Where practical, this could be adopted as best practice for trap operators to ensure optimal cleanliness for birds.

The lengths trap operators went to look after decoy birds also varied. One trap operator kept two magpie decoy birds and fed them on canned dog food and a high protein fish paste. When visited, he commented that these birds had been his decoy birds for more than four years, which was markedly longer than anyone else who mentioned the length of time for which they kept decoys. As well as feeding his birds on a high protein diet, he moved the decoys into an aviary each night for their safety and comfort, and did not use them if the weather was very poor that day. His birds appeared to be in very good condition.

Among trap operators running traps with decoy birds there was a good awareness of the weather, with many people removing traps and sheltering call birds in extreme conditions. This suggested that decoy bird welfare was a priority for many trap operators, although the wide variation in standards of care and provision suggests that it may be worth providing practical and formal guidance for trap operators about how best to care for different species of decoy bird.

5.4 Decoy fatalities

5.4.1 Death in trap

Out of 16,184 trap days, there were 18 occasions (involving 19 birds) when birds were recorded dead in traps, with one incident involving both a decoy and captured bird (0.12% of trap days). Seventeen of these birds were decoys, and two were captured birds.

The majority of incidents occurred in Larsen traps (table 5.6) but these traps were used more frequently than multi-catch traps or single compartment traps. Proportionally, the rate of decoy deaths was only around 25% higher in Larsen traps than in other traps, although all rates were very low.

Table 5.6 Birds found dead in different trap types

Fatalities in trap	Larsen trap	Multi-catch trap
Decoy bird	14	3
Captured bird	2	0

Decoy deaths occurred on 0.13% of days when decoys were used, and the death of captured birds were reported in 0.04% of captures. Both capture deaths were magpies. No non-target deaths were recorded in any traps.

5.4.2 Cause of death

Predation was a commonly cited cause of death, although one bird was found dead but intact and reported as 'stress' (although the cause could have been some underlying health condition), while some records did not specify the cause (table 5.7). Four predators were named as fox, buzzard, pine marten and stoat. In the case of the stoat, there was also a buzzard in the trap, and there is insufficient information supplied to be sure that it wasn't the buzzard that killed the decoy.

Table 5.7 Cause of death of birds in traps

Fatality	Unknown	Fox	Buzzard	P marten	Stoat	Stress?
Decoy	4	3	1	2	1	1
Captured bird	4	1	0	0	0	0
Not specified	2	0	0	0	0	0

Three of the predated decoy birds were magpies, one was a jackdaw, and the remainder were carrion and hooded crows. Predation of decoy birds was mentioned anecdotally by several trap operators. Pine martens and foxes were the most commonly mentioned predators. Some trap operators recorded efforts to deter predators such as raising traps on platforms or reinforcing the wire used when building or repairing traps.

In one instance a camera installation had to be cancelled at short notice due to the predation of a call bird which stopped the operation of the trap. The carrion crow had been collected during the day, and in its first night in the trap was predated by a pine marten.

Two predated birds were witnessed during camera collections at different sites. The first was a carrion crow found in a Larsen trap with a severe injury resulting in the loss of its left leg. In the second instance, the mesh of a multi-catch trap had been broken and both the pheasant bait and carrion crow decoy bird had been substantially eaten.

In another instance, an urban trapper provided footage (recorded outside of this study) of a fox attracted to a trap. The fox remained at the trap for approximately 30 minutes before moving on. Although the decoy was not injured or killed, it died within days, but any link between the presence of the predator and the decoy death remains speculative.

6. DISCUSSION

6.1 Sample sizes

This study provided an opportunity to take a snapshot, across a calendar year, of how trap operators used corvid cage traps under the General Licence, including information on the target and non-target species caught. Taking into account the number of people likely to be no longer trapping despite their details still being present on the national trap register (see part 1 of this series of reports; Reynolds, 2016), the data presented in this report are from a sample of approximately 10% of all active trap users in Scotland, in other words, a 10% sample from the entire Scottish population of General Licence trappers. The dataset is not inconsiderable, encompassing over 16,000 trap days, and over 4,500 target species trapping events, with over 150 possible variables for each trapping event, including the many sub-categories of the trap operator, the trap, trapping regime, as well as the species caught. In order to simplify analysis and maintain sample sizes, many of the possible variables have been grouped. For example, 12 general 'bait types' have been drawn into just 3 broad categories. Despite this, small sample sizes were still a problem for those species which were trapped relatively infrequently such as the hooded crow, rook and jay. For this reason, the level of inference that should be drawn from these data for these three species should be limited.

The sample sizes for jackdaws, magpies and in particular the carrion crow, were generally quite high, although some individual trappers were highly effective and caught very large numbers of birds, representing a large proportion of the total sample for a given set of criteria, and have the potential to influence the results. For example, 667 jackdaws were caught in total by 28 different trap operators. However, just 1 trapper accounted for 181 jackdaws representing 27% of the catch. The top three trappers caught 345 jackdaws or 52% of the catch, while the top third (nine) trappers caught 83% of the total catch. Clearly these trappers have the potential to influence the data set. In general, the report attempts to warn readers to exercise caution when interpreting the results that may be subject to such potential bias. The carrion crow data however, is larger than for any other species, with over 2000 birds being caught by 88 trappers, while over 1000 magpies were caught by 67 trappers. Thus, data regarding capture of these species is more reliable than for the other species. Useful information is provided on the capture of jackdaws and rooks, hooded crows and jays, but it may be difficult to draw firm conclusions as the sample size for these species decreases.

Of the non-targets, 120 individuals from 19 different species were recorded as by-catch. However, the sample size for these animals is so small that rigorous interpretation of the data is fraught with difficulties. Pheasants formed the major by-catch species by number, but were mostly caught by one trap operator. Buzzards were the second largest by-catch by species, but there was some anecdotal evidence from both the camera verified group of trap operators in this study, as well as from experimental work that was conducted in part 3 of this series of reports, that where buzzards were caught, the same individuals were often repeatedly caught. It is difficult to know if this phenomenon is widespread or localised or just happened to be common for a few individual birds. Due to the small sample sizes and the uncertainties regarding data from trap operators whose data were not verified, detailed analysis of non-target or raptor by-catch has not been conducted.

Overall, these data have been analysed in such a way to try and tease out critical information that can be used by SNH to inform any decision that either the licences appear to be working as intended, or to identify potential issues that may need to be considered further. Where unexpected results have occurred, SNH should be able to assign importance to such results, and may choose to commission further research work, perhaps in the form of controlled experiments, that will reveal to what extent these issues are a problem to the trapped birds or to the practitioners.

6.2 Factors influencing the capture success of target species

Capture rates for carrion crows were highest between February and July (figure 3.11), and may be explained by a mix of different behaviours and availability of birds of different reproductive statuses and age. Within carrion crows, increased levels of intrusion into territories by single and paired flock (non-territorial) birds takes place between January and May, and is the main cause of total clutch loss in breeding (territorial) birds (Charles, 1972). Thus, it is likely that the territory holders would be anxious to drive away intruders, and may be willing to enter traps holding decoy birds (both conspecific decoys, and also to drive away other species that may threaten their young: such as magpies: figure 3.6) at this time. The February peak found in carrion crows may also have reflected either increased levels of conflict between intruders and territory holders or heightened interactions and pair bonding in advance of breeding. Carrion crow offspring typically disperse within five weeks post fledging (Baglione *et al.*, 2005), and the July peak in captures may be partly explained by the availability of young and possibly naïve birds to trap. Depending upon the time of year, between 35% and 50% of the carrion crow population consists of non-territorial, non-breeding birds (Charles, 1972) and these individuals may also be entering traps at any time of the year in search of food as well as drawn by the presence of conspecific decoy birds.

The various drivers behind trap success (territoriality, sociality and food acquisition) likely to be influencing carrion crow capture rates will be similar for other territorial species such as hooded crows and magpies. Hooded crows however are more sociable than carrion crows, and will feed together in flocks, a behaviour that is likely to delay dispersal of offspring, and may explain the later summer peak in catch (RSPB, no date). Behaviourally, magpies are perhaps more akin to hooded crows, and stay within their parents' territory until September or October, and this again may explain the late peak in catch rates (RSPB, no date.).

Non-territorial, flocking species such as jackdaws and rooks, did not appear to have a marked peak in the trap rate during the spring, but for jackdaws at least, there was a very distinct summer peak in June/July. Again, this may have coincided with the availability of young and possibly naïve birds to trap. Grain baits in particular, were clearly capable of attracting very large numbers of birds into multi-catch traps. The sociable nature of these species however, may have enhanced capture rates, as birds may have been drawn to the presence of previously caught birds, which in effect, acted as decoy birds.

Larsen traps were the most popular trap used in all habitat types, with the exception of upland habitats, where multi-catch traps were also popular. However, the single compartment cage traps were only included onto the General Licences since 2013, and it is possible that their widescale use has yet to become more established amongst trap operators.

In terms of trap effectiveness, the multi-capture traps were particularly effective at catching large numbers of the flocking species in response to mainly grain-based baits (figure 3.9), and this may be particularly important for crop protection purposes when flocks of corvids are capable of causing wide scale damage to crops.

The single compartment traps, despite their lack of use, were comparatively more effective than other trap types in most habitats (figure 3.10), but particularly in woodland/forest, even when taking into account their inability to catch multiple birds simultaneously (figure 3.9). It is important to remember that damage mitigation can sometimes be achieved not by a measurable population reduction, either at the national or local level, but sometimes by the removal of a small number of individual birds that exhibit problem behaviours. For instance a farmer looking to protect lambs from corvid predation, may only need to remove a relatively small number of territorial pairs or intruders in order to achieve his objective, although by doing so, there may be no obvious reduction in the size of the wider corvid population.

Nonetheless, the decision to use a particular type of trap may be influenced by a number of factors including damage mitigation objectives, the logistics of the site in which the trap must be placed, the ease with which the trap type can be serviced, the target species, the cost of the trap to buy versus the ease with which it can be manufactured, or the need to avoid the risk of possible interference by the public, as much as it is by perceived effectiveness.

The majority of traps were set in 'the open' rather than under natural cover (at a rate of about 5:1), but catch rates were much higher on average in traps located under cover or adjacent to cover than those located further away (i.e. >10m from cover). Target species will nest in trees and bushes may use them for roosting and as observation perches, and such habitats may also provide a source of food, all of which may have contributed to the trapping success found in relation to the proximity of cover. Capture rates of magpies and rooks were highest beneath cover. While magpies could also be caught relatively often at further distances from cover, the capture rate of jackdaws fell dramatically at 10m+. The relationship between capture rates and distance from cover in rooks appeared to follow a similar pattern to jackdaws, although for a much smaller sample size.

Due to the very small numbers of jays caught in this study (18 in total), it is not possible to describe circumstances which may increase trapping success of this species.

6.3 Distribution of hooded and carrion crows

The distribution of hooded and carrion crows was brought into question in part 1 of this series of reports, as some returns suggested that hooded crows were far more widely distributed than bird surveys indicated. Through discussions with many trap operators during the course of this part of the project, it appears that the name "hoodie" is often used by some trap operators as a generic term to refer to the most common species of crow in their location. This means that in some areas, the term "hooded crow" means exactly that, but in other areas, such as the Scottish Borders, "hoodie" refers exclusively to carrion crows. For those trap operators involved in this project who were in areas with both carrion crows and hooded crows, they would often record one as "hoodie" and the other as "carrion crow", making distinguishing between the two easier. "Corbie" was also used occasionally to refer to carrion crows. In general, this project found no reason to question the accepted wisdom on the geographic distribution of the two crow species.[3]

6.4 Timing of trapping by operators

Many trap operators reported in part 1 of this series of reports (the questionnaire survey; Reynolds, 2016), that they began trapping in February, which was not often reflected in the current study. Trap operators may be willing to run traps from February, but taking cues from weather, corvid presence and their own schedules, it was found that the actual start of trapping could be much later. This also applied to dates when they finished trapping, with some ending sooner or later than they specified in the questionnaire. There were also trap operators who stated that they trapped in autumn, but when contacted turned out not to be trapping, and a very small number who were trapping at times that they stated they did not trap. The overall impression from practitioners on the ground was that many actually trapped for less time than their questionnaire response indicated, and perhaps a small

[3] http://app.bto.org/mapstore/StoreServlet?id=1247

number trapped more. The actual timing of trap use appeared to be relatively flexible, and much depended upon external factors, such as health, family and work commitments, the availability of a decoy bird, unforeseen circumstances, as well as the degree to which corvids were causing problems. It should be borne in mind by anyone hoping to gather precise data on when traps are used, that the on-the-ground reality is highly variable.

6.5 Buzzard re-captures

Data from this study, from part 3 of this series of reports, and anecdotal evidence from trap operators, suggests that the re-capture of raptors in some corvid traps is not uncommon. One volunteer located in Central Scotland reported capturing one ringed female buzzard 51 times over one season (prior to this project). In such cases of repeated capture, it is likely that the bird has learned that by entering the trap, it will get a free meal and suffer no ill effects. If this applies to even some of the raptor captures recorded during the course of this study, it may partly explain the fact that some trap operators appeared to have much higher levels of raptor by-catch than others.

These instances lend weight to the suggestion that for some raptors, the experience of being captive in a trap and then released is not sufficiently stressful to deter them from returning, or at the very least that the chance of some food is enough to overcome any deterrent effect of the experience. It might be expected that such activity would be highest in winter, when food may be scarce. However, the majority of multiple buzzard catches by single users in this study occurred during late March and early April, although one sequence of four catches took place late November. It is not thought that weather conditions were particularly adverse at these times, and the spring catches may be related to a higher energy requirement for breeding, while the November catches could have been of a young bird that was struggling to find food. These explanations are in both cases, speculation.

Certainly however, there is evidence of buzzard by-catch being ‘clumped’ in nature. Even amongst the trap operators that permitted cameras on their traps, and so had their catch records verified, 23 of 27 (85%) caught no raptors, while the 4 that did (15%), each caught at least 3 buzzards.

6.6 Catch rates & data validation using cameras

An unavoidable issue with any research project that requires the use of volunteers to collect data is the knowledge that they are self-selected, and the risk that the data obtained could contain bias. This is particularly the case in this study for two reasons. Firstly, any method that permits the capture and killing of wild animals, especially a method that has been used to illegally kill high-profile species such as raptors, is subject to a high degree of scrutiny by the public and media. Trap operators are very likely to be aware of this, and may wish to present their data in such a way to minimise criticism of the method, in particular to reduce the implied risks of raptor captures, or may choose not to participate at all. Secondly, while relatively untrained people are capable of trapping birds, years of experience are likely to refine skills and increase trapping efficiency, and there is a risk of this sampling bias being reflected in the data. This study attempted to take account of potential biases by comparing results of trap operators who permitted the use of camera verification at their traps with those who did not.

We identified differences in the data collected, and trap operators whose traps were monitored using cameras caught proportionally fewer target species ($p=0.025$) and more raptors ($p<0.001$) as a proportion of their total bird catch, than non-camera operators.

Certainly sensitivities arose early in the data collection period (see 2.4.1; Cramb, 2015), which involved a high profile court case of trap abuse that had been recorded without the knowledge of the trap operator. In this study, camera placement was only with permission from the trap operator, but sufficient concerns were raised amongst trappers that some withdrew from the option of having cameras placed at their traps, and in some cases, from the project altogether. It is therefore possible that some trap operators who decided to keep providing records, may then have omitted reporting raptor catches, possibly for fear of drawing attention to themselves or because they wanted to avoid giving the impression that they occasionally or regularly caught raptors.

The majority of raptors caught were buzzards, and it's likely that some (see 6.5 above) were re-caught on several occasions. If possible re-catches are removed from the total catch, trap operators with cameras might have caught six buzzards and those without cameras twice this number. Regardless of this potential adjustment to the buzzard catch however, raptor species were still trapped proportionally more frequently by those with cameras than those without. Nonetheless, the very small number of buzzards caught, by just a small proportion of trappers in total, makes this anomaly difficult to interpret with certainty. Only four trappers out of 27 (with cameras) caught buzzards, and it is not possible to identify those factors most likely to influence their buzzard catch, to see if these same factors were absent from trap operators who did not catch buzzards, and they could simply have been an anomalous group of trappers.

While reasons may exist for under-reporting of raptor by-catch, reasons for over or under-reporting target catch are less clear. The camera group caught proportionally fewer target species than non-camera operators, and while this result may be a consequence of over-reporting of target catch in the non-camera group, it may also be the result of differences in long-term trapping effort. Trap operators that permitted cameras may be more enthusiastic and skilled trappers, and as a consequence, may bring about a lowering of their local corvid population to the extent that their target catch rate is less on average than the non-camera group. Or they may be less successful as trappers than the non-camera group.

Unfortunately, there are no clear explanations for these differences in proportions of birds trapped. Efforts have been made throughout the report to alert the reader to exercise caution when interpreting data due to concerns regarding a small or potentially biased dataset. Nonetheless, the overarching findings in terms of the circumstances of capture (baits, decoys, trap type, land category, seasonal application, user group, proximity to cover) are likely to be a reasonable reflection of general trapping activity in Scotland.

6.7 Non-target captures

The advantage of live capture techniques, such as corvid trapping, is that under the vast majority of circumstances, non-target captures can be released unharmed at the time of trap checking. Other studies (see parts 3 and 4 of this series of reports: Campbell *et al*., 2016a and 2016b) have found little evidence to suggest that non-target birds are physically injured while in these traps, although there is a paucity of information on mammal by-catch, probably because of the low rates of capture. However, anecdotal evidence of re-captures of buzzards strongly suggests that the process of capture and release is neither particularly aversive nor damaging to individual birds. Combined with the very low numbers of non-target birds and mammals recorded as captures, it would appear unlikely that these traps represent a significant conservation concern when used legally.

6.8 Trap user feedback

A number of issues were raised by trap operators regarding the General Licence system, and these are discussed in detail in part 4 of this series of reports (Campbell *et al.,* 2016b). However, a summary of the issues include:

- Confusion about the details of the current terms and conditions of the Licences, which can change annually.
- Concerns about their ability to update their knowledge given personal difficulties in accessing the internet.
- Related to this, a need to diversify media outlets for dissemination of information regarding General Licences.
- Desire to see official guidance or a Code of Practice on use of General Licence traps and decoy care and maintenance.
- Need for more information about the different sorts of small, single compartment cage traps.
- Improvements to the system to simplify the mechanism for issuing of a trap user code/ID number.
- Increased public awareness of legal trap use to mitigate effects of increased public access to land, which trap operators felt was associated with increasing numbers of trap interference/ vandalism incidents.

6.9 Decoy welfare

Although not a main consideration of this research project, the opportunity provided to examine decoy care was taken, and data were collected for a small number (35) of birds. This opportunity only provided a snap-shot of care for the one, and sometime two occasions, that a trap was visited to place and uplift cameras (decoy birds and even traps were not always present at camera uplift, and operators sometimes collected cameras on behalf of the field worker). Overall, standards of decoy bird care varied, although instances of poor care and welfare were infrequent, a very small number of trap users were potentially keeping their decoy birds in less than ideal conditions. Trap operators themselves occasionally asked about the availability of 'best practice' for decoy welfare. The two main areas that would benefit from specific guidance include the type and condition of the food provided for particular decoy species, and the type and nature of the shelter provided.

7. CONCLUSIONS

The results from this study show little in the way of surprises from perceived wisdom as to how these traps are deployed by practitioners, and likely levels of capture success for the target species. For instance, the use of decoy birds in the spring appears to be particularly effective at capturing conspecific birds. Also, that the summer and autumn are productive in terms of numbers of corvid that can be caught. In these situations, traps capable of catching many birds simultaneously, such as the multi-capture traps and to some extent Larsen traps, may be particularly effective. At these times, the use of appropriate baits may have greater effectiveness than a decoy bird for some species, although it may be unwise to dismiss the positive effects of inadvertent decoy birds where multiple captures are taking place.

This report also provides direct feedback from General Licence trap operators on suggested areas for improvements to the system. These, along with a body of information from this report on trap efficacy, and various issues raised in Parts 1 (Reynolds, 2016) and 3 (Campbell *et al.*, 2016a) of this series of reports, are presented as options for discussion in Part 4 of this series of reports (Campbell *et al.*, 2016b).

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ANNEX 1: EXAMPLE OF A TRAP RECORD BOOK

Below provides only the first five pages, and the last page, of a ‘three trap’ record booklet. Individual booklets were created on request for as many traps as an operator wished to collect information on, up to a maximum of 10 traps.

Game & Wildlife CONSERVATION TRUST

SASA
Science and Advice for Scottish Agriculture
Agriculture, Food and Rural Communities Directorate

TRAPS USED UNDER GENERAL LICENCES

THREE TRAP BOOKLET

Once this booklet is completed please return it to SASA using the pre-paid postage labels and the address below.

Any queries please contact Seonaidh (Shona) Jamieson by email (seonaidh.jamieson@sasa.gsi.gov.uk) or by phone (**T:** 0131 244 8889; **M:** 07817560221)

Seonaidh Jamieson; SASA,
Roddinglaw Road, Edinburgh, EH12 9JF
www.sasa.gov.uk

Book number **ID**

TRAPS USED UNDER GENERAL LICENCES

Instructions for use

1. Fill out information below before beginning. Please do not record data for more than five traps in this booklet.
2. Record the date at the start of each week
3. Record the species and number of all catches and the use of bait/ decoys
4. **Use the notes section to record actions (closing or moving the trap) and any additional information on the habitat surrounding the trap.**

Please record information at the time of inspection wherever possible.

To request additional booklets please contact Seonaidh (Shona) Jamieson via email (**seonaidh.jamieson@sasa.gsi.gov.uk**) or telephone (**0131 244 8889**)

1

Please fill in the following table:

Trap Number	Trap Type	Location	Is the trap in the open OR under cover? (trees/shrubs/bushes)	If in the open, how far is the trap from the nearest woodland?
1				
2				
3				

Key

L- Larsen
LM – Larsen mate
LP- Larsen pod
MC- Multi-catch, ladder entrance
MR- Multi-catch, roof funnel entrance
MO- Multi-catch, other

LA- Lowland agriculture (crops and grazing
LO- Lowland other (mire, bog, scrub, coastal heath
U- Upland grass and moorland
F – Forestry (deciduous, coniferous or mixed woodland)
SU – Urban / semi urban gardens, industrial estates, airfields, amenity

2

Date on Monday: ***Week 1***

Day	Trap	Time	Trap set (✓/ X)	Captures (all species)	Species of Decoy	Type of Bait	Notes
Mon	**1**						
	2						
	3						
Tues	**1**						
	2						
	3						
Wed	**1**						
	2						
	3						
Thurs	**1**						
	2						
	3						
Fri	**1**						
	2						
	3						
Sat	**1**						
	2						
	3						
Sun	**1**						
	2						
	3						

3

Date on Monday: *Week 1*

Day	Trap	Time	Trap set (✓/ X)	Captures (all species)	Species of Decoy	Type of Bait	Notes
Mon	1						
	2						
	3						
Tues	1						
	2						
	3						
Wed	1						
	2						
	3						
Thurs	1						
	2						
	3						
Fri	1						
	2						
	3						
Sat	1						
	2						
	3						
Sun	1						
	2						
	3						

4

Additional information:

Once this booklet is completed please return it to SASA using the pre-paid postage labels and the address below:

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Please contact Seonaidh Jamieson (seonaidh.jamieson@sasa.gsi.gov.uk; **T:** 0131 244 8889;**M:** 07817560221) if you have any problems.

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