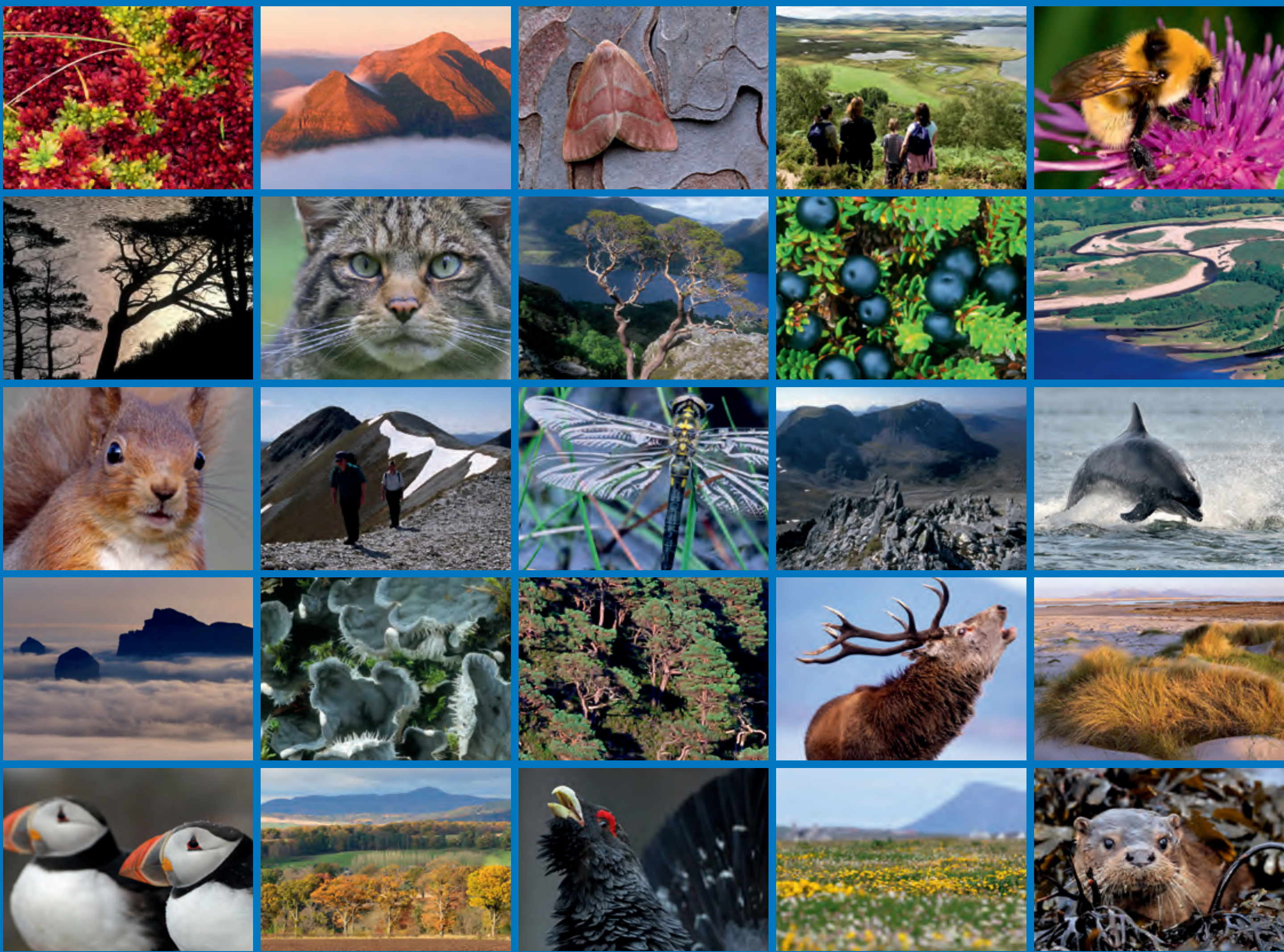
Scottish Natural Heritage
Commissioned Report No. 934

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

Review and recommendations



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COMMISSIONED REPORT

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

Review and recommendations

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COMMISSIONED REPORT

Summary

Assessing the nature and use of corvid cage traps in Scotland: Part 4 of 4 – Review and recommendations

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Review; literature; research report summaries; options; General Licence amendments.

Background

This is the fourth report in a series commissioned by SNH to investigate the use and impacts of corvid cage traps in Scotland. It reviews all known literature on the use of these traps in the UK and elsewhere. It also considers the reasons for using these traps, and the welfare issues that may arise as a result. A brief overview of the main findings of three other reports in the series (parts 1 to 3) is provided. Finally, a list of options for SNH is given, which may be informative to any future consultation or recommended changes to the General Licences regarding corvid cage trap use.

Main findings

- A review of literature relevant to live capture corvid cage traps is provided.
- The review includes the history and reasons for corvid control.
- The trap types permitted under the General Licences are described, and published rates of capture of target and non-target species provided.
- Approaches to welfare assessment are reviewed and compared with other live capture methods.
- The misuse and abuse of traps is described.
- The main findings of parts 1, 2 and 3 in this series of reports are provided.
- Possible options for SNH consideration for General Licence consultations and amendments are described. These options are listed as 'General Licences, registration and data collection', 'Changing practices', 'Modifications to traps' and 'Trap effectiveness'.

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1. INTRODUCTION

This is the fourth report in a series commissioned by SNH to investigate the use and impacts of corvid cage traps in Scotland, whose widespread use is authorised under the General Licences. It reviews the literature on the use of these traps in the UK and elsewhere. It also considers the reasons for using these traps, and the welfare issues that may arise as a result. A brief overview of the main findings of three other reports in the series (parts 1 to 3) is provided. Finally, a list of options for SNH to consider is provided. These could be used to inform future changes and consultations regarding corvid trap use in the General Licences.

2. REVIEW OF LITERATURE

2.1 History of bird trapping

Bird trapping in some form or another has probably been taking place ever since humans first started using traps to catch food. The trapping of birds such as crows (*Corvus* spp.) to protect crops and livestock may also go back into pre-history, probably not long after corvids first began to exploit man's early agricultural efforts. Bird trapping was common across Europe in medieval times and methods used included box and access traps, snares, nets, lures and bird lime. Most birds were caught for food, but some were almost certainly caught to reduce crop and property damage too (Reidinger & Miller, 2013).

In 1424 James I of Scotland passed legislation requiring the destruction of rooks at the nest, although this law did not specifically mention trapping, an extension of the law by James II to include birds of prey in 1458 urges that the birds be "*utterly destroyed by all manner of men by all engines and [any other] manner of way that may be found for this*" (Lovegrove, 2007; University of St Andrews RPS). A century later in England during 1532, after several very poor harvests, Henry VIII passed a 'Vermin' Act that very specifically targeted corvids, and required local communities to provide communal nets for the catching of crows and to organise corvid control alongside bounty payments (Lovegrove, 2007). Further evidence of the trapping of crows in the early modern period of European history can be seen in a well-known Dutch painting by Bruegel (1565). The trap in question is a simple 'deadfall' trap but it illustrates that the practice of crow trapping for whatever reason has existed for a considerable length of time.

Figure 1. Pieter Bruegel the Elder. Winterlandschap met schaatsers en een vogelval [Winter Landscape with Skaters and a Bird Trap]. 1565. Source: http://www.wikiart.org/en/pieter-bruegel-the-elder/winter-landscape-with-skaters-and-a-bird-trap-1565

Around the same time in England (in 1566) the existing 1532 Act was strengthened by Elizabeth I, and expanded the routine killing of corvids to protect crops and livestock by payment of a bounty for controlling other species too (Jones, 1972; Lovegrove, 2007). The laws described here seem likely to have encouraged the widespread use of traps for all manner of wildlife including the corvids, if indeed it wasn't already widespread.

There are many trapping methods that have been developed to target birds, including cage traps, deadfall traps (both kill and live trap), spring-over traps, leg-hold traps (such as gin and ‘pole’ traps), mist net, cannon net, sticky traps (bird lime), Bal-Chatri traps and noose carpets (Ward & Martin, 1968; Bailey, 2013). In the UK these devices, or variations of them, might have been used in the past but are no longer permitted due to the protection now given by legislation to all bird species. However, that legislation also provides mechanisms to permit the capture and killing of wild birds under licence. Scottish Natural Heritage are the licensing authority in this respect tin Scotland. Licences may be issued to individuals who have applied for one or General Licences are published that permit individuals to operate under their terms without the need to apply for a licence. The welfare of captured birds is an important factor, and thus some types of trap (e.g. Gin, bird lime) are unlikely ever to be allowed for catching birds anywhere in the UK, even under licence.

2.2 Twentieth Century legislation

The Protection of Birds Act 1954 granted protection to all wild bird species, their eggs and any nests in use. It also made exceptions for a number of species listed on a schedule (the ‘second schedule’) which could be killed or taken at any time by authorised persons such as the owners or occupiers of land. Crows (*Corvus corone*), hooded crows (*C. cornix*), rooks (*C. frugilegus*), jackdaws (*C. monedula*), magpies (*Pica pica*) and jay (*Garrulus glandarius*) appeared on that schedule, which was sometimes referred to as the ‘pest list’.

The Protection of Birds Act was superseded by the Wildlife and Countryside Act 1981, which continued with the use of a schedule list but with fewer species (Schedule 2 part 2). It still listed the same corvid species (although at this time hooded crow was treated as a sub-species of carrion crow). In 1992 an amendment to the 1981 Act removed the ‘pest list’ in order to comply with provisions made under the EU Birds Directive 79/409/EEC. At the same time the system of General Licences was introduced.

2.3 Basis of the General Licence

The EU Council Directive 2009/107/EC known as the ‘Birds Directive’ (formerly Directive 79/409/EEC) States under Article 5: “*Member States shall take the requisite measures to establish a general system of protection for all species of birds referred to in Article 1, prohibiting in particular:*

(a) deliberate killing or capture by any method;
(b) deliberate destruction of, or damage to, their nests and eggs or removal of their nests;…….”
Under Article 9, member states are permitted to derogate from the above provisions: “……*where there is no other satisfactory solution, for the following reasons:*
(a) — in the interests of public health and safety,
— in the interests of air safety,
— to prevent serious damage to crops, livestock, forests, fisheries and water,
— for the protection of flora and fauna;”

The above derogations must specify, amongst other things, the species involved, the methods to be used and the conditions and time under which they apply. There is a further provision in Article 8 that states: “*In respect of the hunting, capture or killing of birds under this Directive, Member States shall prohibit the use of all means, arrangements or methods used for the large-scale or non-selective capture or killing of birds or capable of causing the local disappearance of a species*…”, although Article 9 also permits derogation from this, where there is no satisfactory solution. Species licensing is a mechanism for permitting the above derogations, and trying to ensure that any activities undertaken meet the requirements of the Birds Directive as transposed into domestic legislation by the Wildlife and Countryside Act.

2.4 Trapping and General Licences

There are a number of bird species that are generally accepted to cause certain types of common damage, or pose specific types of threat, and for which applications for licences to kill or capture are likely to be numerous and frequent. For these common species and situations the licensing authority issue ‘General Licences’, which entitles people to kill or take birds under specific circumstances, while adhering to certain conditions, without the need to apply for an individual licence. Although the system has been in place since 1992 General Licences are reviewed and updated regularly.

The licences underwent relatively small changes over the years, but were subject to more major changes in Scotland after consultations in 2000, 2006 and 2013. SNH took over responsibility for General Licences for Scotland in 2011 for the year 2012 onwards; they were previously issued by Scottish Government Natural Resources Division.

SNH currently issue four General Licences that permit trapping of corvid species. The 2016 licences are listed in table 1, along with the corvid species that may be targeted and the methods permitted to take them.

Of all the methods permitted under the General Licences, only shooting is widely adopted as a practical alternative to trapping for the general control of corvids. However, shooting requires the marksman to be present at the site, while trapping allows a trapper to undertake control at several sites simultaneously, without having to spend much time at each site, other than to check, bait and empty the trap, and service the decoy bird, if used. The trap actually operates more effectively in the absence of the trapper, especially if the target species is unpredictable or wary of man.

Under the 2016 General Licences, all trap users must display a police contact phone number on their traps and a user ID code. To obtain their code they must contact their local police wildlife crime officer. This condition should allow the user of any trap to be identified and contacted, or a trap without any details to be immediately flagged up as suspicious. Unfortunately during the preparatory work for part 1 of this study, it was discovered that there was no mechanism or requirement to update details, so some trap users are no longer contactable, and some were no longer trapping (Reynolds, 2016).

Table 1. SNH General Licences that cover corvids, including species and permitted methods.

Licence	Corvids covered	Methods
GL 01 To kill or take certain birds for the conservation of wild birds	Carrion crow, hooded crow, magpie, rook, jackdaw, jay	Pricking of eggs Oiling of eggs Destruction of eggs and nests **A Larsen trap** **A Larsen mate trap** **A Larsen pod trap** **A multi-catch cage trap** Shooting Targeted falconry By hand
GL 02 To kill or take certain birds for the prevention of serious damage to livestock, foodstuffs for livestock, crops, vegetables and fruit	Carrion crow, hooded crow, magpie, rook, jackdaw,	As above
GL 03 To kill or take certain birds for the preservation of public health, public safety and preventing the spread of disease	Carrion crow, hooded crow, magpie, rook, jackdaw,	As above
GL 04 To kill or take certain birds to protect air safety	Carrion crow, hooded crow, magpie, rook, jackdaw,	As above, but also permits shooting with the aid of illumination or devices for night shooting.

2.5 Traps permitted under General Licences

Of the four trap types specifically listed on the General Licences, only three (multi-catch, Larsen and small, single compartment) appear to be in widespread use across Scotland, with a number of companies manufacturing examples, and many trappers building homemade versions. The Larsen-pod was rarely encountered in Part 2 of this study, and not used in Part 3 (Hartley *et al.,* 2016; Campbell *et al.,* 2016), although details are provided below.

2.5.1 Larsen Pod trap

The Larsen Pod was made commercially only by a Dorset based company called Longmeadow Wildlife Management Ltd, which ceased trading in the late 1990's (M. Short, pers. comm.). As such, the trap is no longer in manufacture and appears to be quite rare, certainly in Scotland. However there may be homemade versions in use, that are broadly similar in layout being double open-ended, with a trigger that can operate a single door or both doors simultaneously depending upon the set. The advantage of such a trap is that it can be left adjacent to a trap with a decoy bird, and any territorial bird seeking a way to access the decoy, may be more willing to walk into a trap where they can see an obvious route out, rather than a blind-ended or drop-in trap with no obvious exit. However, the trap can also be used on its own, with suitable bait.

Figure 2.The Larsen Pod trap: aerial view. Copyright: GWCT

2.5.2 The small, single compartment trap

The small, single compartment is also a single compartment trap that has entered into widespread use only relatively recently. The name refers to the way the trap was designed to operate, being used in the vicinity of a decoy bird (e.g. in a Larsen trap), to maximise the probability of catching any bird attracted to the decoy, in much the same way as a Larsen Pod. However, like the Larsen Pod, when baited with a suitable food, the trap is equally suited to being used in isolation. Most 'small, single compartment' traps are 40 to 50 cm in cross-section, but larger examples also exist. These may be only slightly taller and wider, but can be almost twice as long.

Small, single compartment traps are also known by a variety of other names such as the 'clam trap', 'butterfly trap'[1], and the 'crow and magpie trap'[2]. The name 'clam trap' is probably the most accurate description as these traps consist of two cage sections hinged together along one side and held together by springs. The two halves of the trap can be wedged open with a split perch, and when a bird lands on the perch it collapses into the trap and the two halves close under the tension in the springs.

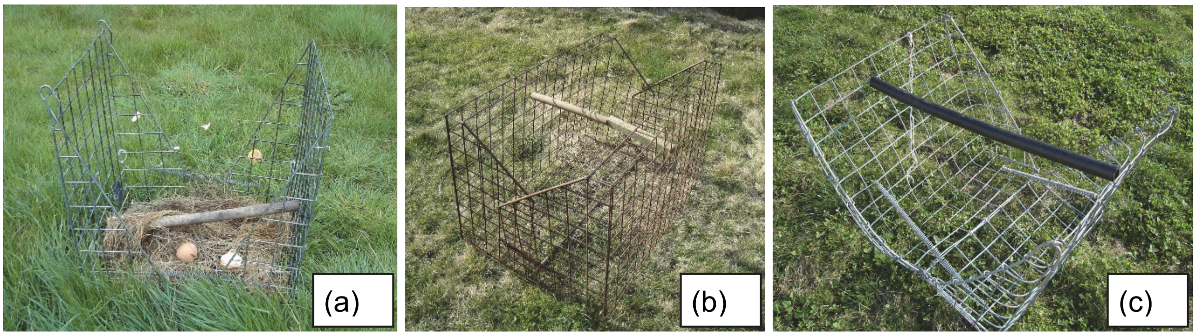

Figure 3. (a) Commercially manufactured 'small, single compartment.' (b) Non-commercially manufactured 'small, single compartment.' (c) Poorly constructed home-made 'small, single compartment.' Images: copyright SASA.

[1] http://www.uktraps.co.uk/index.php?route=product/productandproduct_id=52
https://www.solwayfeeders.com/vermin-control/crow-magpie-traps/solway-clam-trap-p1324-c426/
http://www.gamekeep.co.uk/prodpage.asp?productid=94

[2] http://www.elgeeco.co.uk/crowtrap.html

However, the various names are used quite loosely and there are some traps marketed as 'small, single compartments' that are not of the clam design. For example, one is simply a cube with a top opening spring-loaded door; essentially a Larsen capture compartment without a decoy bird compartment (Trap Man, 2016).[3]

Figure 4. Trap-Man Larsen mate. Photograph: Trap-Man.

There are also other single compartment traps, not described as 'Larsen mates' but may be used in the same way. For instance, Rustler traps manufacture a range of single and multi-compartment 'Larsen-type' traps which have both split perch triggers with sprung doors, and treadle triggers that are gravity operated.[4] Depending upon the details, some of the traps may fall outside of the current definitions of a 'small, single compartment' or 'Larsen pod' trap on the SNH General Licences (2016), while they are essentially no different in nature to those traps which happen to fall within the definitions. The type of small, single compartment examined in report 3 of this series, and discussed below, is the 'clam' type of small, single compartment.

The small, single compartment type trap first came to the attention of Scottish police in 2009, after several reports of their use to illegally target raptors (A. Stewart, pers. com.). At the time most of the traps encountered were home-made, but by 2011 there was at least one company manufacturing and selling them. By this time the trap was also being used in good faith by trappers to control corvids under the General Licences, which permitted the use of Larsen traps and "*any other crow cage trap*" (Scottish Government, 2011). The latter phrase was a description intended to cover large multi-capture traps, but was so broad, it could be argued to cover small, single compartment styles of trap. The General Licence specifically stated that a 'spring-over trap' was not permitted, and further concerns were raised because the small, single compartment's 'clam-like' action bore some similarity to this description, leading to more confusion regarding the legality of the trap.

[3] http://www.trapman.co.uk/trapman.co.uk-larsen-traps/larsen-mate.html
[4] http://www.rustlertraps.co.uk/humane-traps/magpie-traps

Figure 5. 'Spring-over','Flip-over' or clap-net trap. Copyright: Natural England. Source: General and Class Licence Consultation – Annex F. Live trapping Wild Birds under General Licence. A Code of Practice. https://consult.defra.gov.uk/natural-england/general-and-class-licences/supporting_documents/Annex%20F%20%20Trapping%20Birds%20under%20General%20LicenceCode%20of%20PracticeFeb%202014.pdf

After holding a consultation on General Licences in 2012, SNH altered the 2013 licences to specifically permit the use of the small, single compartment and Larsen-pod. They also changed the description "*any other crow cage trap*" to "a multi-catch cage trap" (SNH, 2013), thus slightly narrowing the opportunity for new traps to be introduced under the previously loose description, and making it clear that the term related only to the multi-capture type traps (see below).

Due to the concerns of police and others over the potential for the small, single compartment to be misused to catch raptors, some additional conditions were set, most notably that it could only be used with bread or eggs (no meat baits).

2.5.3 The Larsen trap

This trap was designed by a Danish gamekeeper (Christian Larsen) in the 1950's, primarily as a magpie trap. Experimental work by the Game Conservancy Trust (now GWCT) in the late 1980's established that it was a very effective method of catching corvids. At the time it was seen as offering an 'efficient legal alternative' to the illegal practice of using poisons to target corvids and other species (Tapper *et al.*, 1991).

The most common version is cuboid, with a base measuring around 80 to 100 cm. Half of the trap is the decoy bird holding compartment, and the remainder is split equally into two capture compartments with spring-loaded doors. The door is typically wedged open by a split perch that collapses when a bird lands on it, causing the door to close under the power of the spring. Bait is typically food and/or a decoy bird of the target species.

Many design variations exist, some with side opening doors, some circular with the decoy bird in the middle and surrounded by several capture compartments, or small ones with just a single capture compartment. There are other similar traps which use gravity operated doors. The description 'Larsen trap' is used very loosely by some trappers and trap retailers, and there are many closely related trap designs that might be referred to or accepted as a Larsen by some users, but be recognised as something different by others. The presence of a decoy compartment appears a common feature. The definition of the Larsen given in the General Licences is similarly wide, and some other broadly similar cage traps may be accepted under the definition. For example, certain types of hawk or owl traps that take the form of a mesh cage with a large capture compartment mounted above a smaller decoy (bait) compartment, with a top mounted door(s) that may or may not be spring loaded. Examples include the Whitlock's Hawk Trap and Black's Patent Hawk Trap, as described by Bailey (2013), and the Swedish Goshawk Trap (Meng, 1971).

Designs for the DIY construction of Larsen traps are widely available both in published form (e.g. Bryan, 2008; GWCT, 2008) and on many web-sites. There are also a large number of retailers selling a wide variety of professionally manufactured versions.

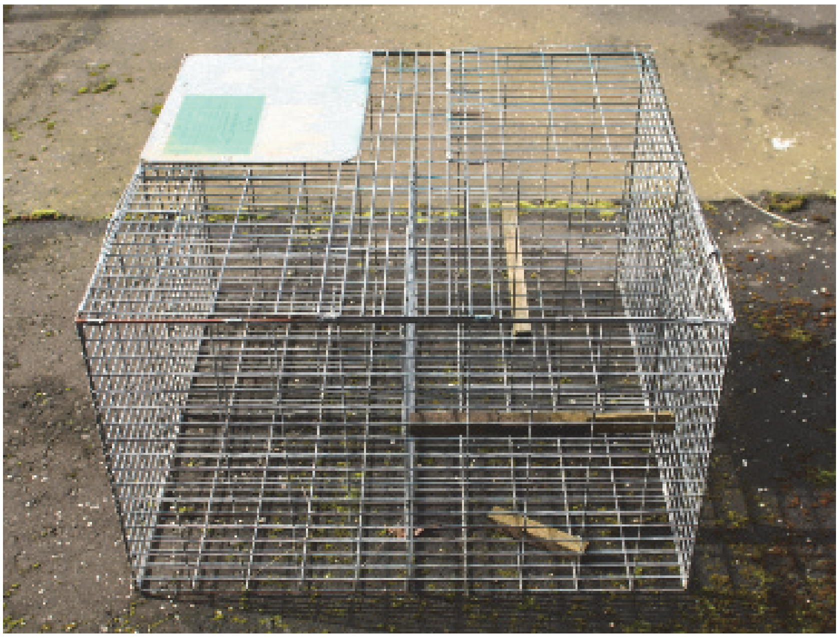

Figure 6. Typical Larsen trap (copyright SASA)

2.5.4 The multi-catch cage trap

Multi-catch corvid cage traps take the form of a cage (usually a large wooden or metal frame covered with a metal mesh) with a trap entrance positioned and shaped to make entry easy, but escape difficult. The entrance may be a slot in the roof (letterbox trap), often with horizontal bars added to reduce the risk of a bird flying out of the slot (ladder trap), or some form of funnel hanging vertically downwards (funnel trap). Funnels on the side of the trap and at the ground may sometimes be used, but this does not seem particularly common in the UK (such variants are known as 'walk-in' traps). A trap could have more than one entrance and could conceivably have both roof and ground entrances. The basic designs are well described in GWCT (2015a).

The most common variants used under the General Licence to trap corvids appear to be the ladder trap and the roof funnel trap. These traps are commonly referred to by trappers elsewhere in the world as the Australian Crow Trap (ACT) (Woodbury, 1961; Rowley, 1968; Moran, 1991) or Modified Australian Crow Trap (MAC or MACT) (Gadd, 1996). Sometimes mesh or wire strips are left hanging down from the ladder to prevent some birds flying back up to it easily.

The traps are generally baited with food, typically meat (carrion) or eggs for crows and magpies, although other baits, such as cereal grain or bread, can be used if rooks or jackdaws are being targeted. Traps can also be used with a decoy bird (also known as a call or lure bird).

These trap types have been used around the world to catch many different corvid species, and also other types of bird (De Grazio, 1964; Bashir, 1979; Gadd, 1996; Conover &

Dolbeer, 2007; Song *et al.,* 2015). Sizes can range from a cube approximately 1 to 1.5 meters per side, to large cages, 2 or more meters tall and wide and several meters long (e.g. Moran, 1991). The advantage of this type of trap is that it can hold large numbers of birds, and once a bird is caught, the activity of the bird inside the trap may attract more birds into it. An acknowledged down-side is that some birds can easily escape these traps if the entrance is not carefully designed (Tsachalidis *et al*., 2006; Shannon *et al*., 2014).

Figure 7. Multi-catch 'ladder' trap (copyright SASA)

2.6 Capture of target and non-target species

2.6.1 Effectiveness

Multi-catch traps and Larsen traps have been widely used for both pest control and research purposes. The multi-catch traps in particular are very effective in a range of situations and can capture high numbers of birds in short periods of time (Moran, 1998; Tsachalidis *et al*. 2007). Other studies have shown that Larsen traps to be particularly efficient at capturing territorial corvids, such as magpies and crows (Tapper, 1991; Diaz-Ruiz, 2010). There have been no studies so far that have reported on catch rates in small, single compartments.

Users generally agree that the use of a decoy bird is the most effective method of attracting target birds (Rowley, 1968; Reynolds, 1990; Moran, 1991; GWCT 2015a & b). Decoy birds may be placed into the trap at setting, or for those traps with multi-catch capability (multi-catch traps or multi-trap compartment Larsen traps), the first bird(s) caught will also act as decoy or lure bird. In a survey of trappers, Tapper *et al*. (1991) found that decoy birds increased Larsen trap efficiency by around five times for magpies and three times for carrion crows compared with food baits, although the GWCT's own trials (Reynolds, 1990) found Larsen traps to be 15 times more efficient for carrion crows, and 10 times more efficient for magpies.

2.6.2 Selectivity: non-target captures

All traps have the potential to catch non-target species, although the likelihood of capture will depend upon the bait (or decoy) used, the location and circumstances. A survey among 273 Larsen trap- users around the UK running 537 traps for >30,000 trap-days, found that non-targets formed 1% of 10,572 captures (Tapper *et al*., 1991). Among these non-targets, the species most frequently caught were blackbirds (*Turdus merula;* 34 birds), tawny owls (*Strix aluco;* 16), kestrels (*Falco tinnunculus;* 15) and buzzards (*Buteo buteo*; 12). As a group, owls and raptors formed approximately half of non-target captures (i.e. 0.5% of all captures). Traps without decoy birds took on average 5.2 non-targets per 1,000 trap-days. Traps with decoy birds took only 1.9 non-targets per 1,000 trap-days and had a greatly increased target capture rate (e.g. 6 times greater for magpies).

A study conducted on two hunting estates in central Spain resulted in 197 magpies caught using a magpie decoy in a Larsen-type trap (Diaz-Ruiz, 2010). Only four non-targets were caught: a buzzard, genet (*Genetta genetta*), hedgehog (*Erinaceus europaeus*) and red-legged partridge (*Alectoris rufa*), amounting to 2% of total catch. Another study in northern Greece using multi-catch traps, caught 370 target magpies and hooded crows; 17 non-targets comprised nine rooks, six buzzards, one short-eared owl and one kestrel (Tsachalidis *et al*., 2007). Non-targets amounted to <5% of total catch, of which half were non-target corvids and half were raptors. The authors concluded that the multi-catch ladder trap met the requirements of the EU Birds Directive (79/409/EU: now: 2009/107/EC Article 8) in being a selective form of control.

Dick and Stronach (1999) and Dick (1997) published lists of non-target species found in corvid traps that were reported to the RSPB. These lists only detail trapped non-target species identified from a limited number of encounters with each trap, and do not provide total catch of trap, hence the ratio of targets to non-targets is unknown. As in the quantified examples above, these lists are dominated by raptors. This is most likely due to the significant overlap in the diet of crows and raptors (i.e. carrion), and meat baits are likely to be attractive to many raptors.

The use of a decoy bird might also attract larger raptors that view it as prey. Similarly, any small species entering the traps to feed on the bait, such as mice or small passerines, may attract a range of diurnal or nocturnal predator species, including raptors, which may be trapped while the smaller species can exit through the wire mesh. As indicated above, decoy birds appear to increase both target catch rate and selectivity (Tapper *et al*., 1991), but the selectivity gain is ambiguous because it could simply be a result of increasing target capture rate. From a conservation perspective the critical measures are the risk of non-target captures per trap-day (not per target capture) and the number of trap-days.

2.7 Reasons for corvid control

Corvid trapping routinely occurs in many countries as a form of pest control. It is undertaken by farmers to protect livestock, feedstuff and crops; by game managers to protect breeding birds and their young; and sometimes by conservation managers for similar reasons. It may also be conducted to prevent the spread of disease, and finally there may be occasions when it is required to reduce the risk of bird collisions with aircraft. Trapping is also used by researchers studying corvids (and other species), but in the UK this particular purpose would not be covered by the General Licences, but would be subject to an individual scientific licence.

2.7.1 Livestock (sheep and poultry)

It is widely accepted that crows (hooded or carrion) can present a problem for sheep farmers, particularly those with hill flocks. There is a wealth of anecdotal evidence to support the fact that crows attack and injure lambs and occasionally ewes. It may be difficult for a crow to kill a healthy, fit lamb, but their habit of attacking unwell, immobilised or new-born animals, where the mother does not or cannot defend it, can result in substantial injuries that could hasten the demise of an already weakened and/or immobile animal.

Lamb losses directly attributable to crows appear relatively low on average, but they can increase at times when the animals are more vulnerable (e.g. inclement weather conditions). An investigation of carrion crow attacks in northern England (Burgess, 1963) found that both lambs and ewes were injured and killed by crows. However incidents amounted to only 0.5% of lamb production on the study farms, and ewe attacks were 0.13% of total ewes in the flocks recorded. Only half of the lambs were thought to be alive at the time of the attack, and half of these would have died anyway. Thus, the percentage of lambs killed by crows that would otherwise have survived was approximately 0.13%. Burgess noted that lambs tended to be attacked within 2-3 days of birth, and that twins and triplets were more vulnerable. If older lambs were attacked, they were generally sick. Attacks on live ewes generally involved animals that were incapacitated, such as 'couped' (on their backs), stuck in snow, stuck in a fence or while birthing; many were healthy, but a few ewes were unwell (most suffering from 'staggers').

In a separate study in Argyll, hooded crows scavenged or predated 48% of all lambs found dead on the hill, but only 8% were alive at the time of the attack and most of those were dying. Taking into account those lambs likely to die anyway, crows reduced the lambing percentage by approximately 0.12% (Houston, 1977). Both studies above found that the eyes, tongue, anus and the area around the umbilicus were all frequently attacked.

Elsewhere, others have found similar patterns of damage (and relatively low average losses) from comparable corvid species, such as those in Australia (Rowley, 1969 and 1970). It is important to remember however, that these losses were recorded against a backdrop of widespread crow control. Furthermore, since the time that these two UK studies were published (late 1960's/early 1970's), the UK carrion crow population has increased by an estimated 89% (between 1970 and 2010, with stability since 2010), due largely to a reduction in control, although increased productivity may also have occurred. In contrast, the hooded crow has declined by an estimated 21% (between 1995-2010), due in part to a shift in the hybridisation zone of the two crow species, as carrion crows appear to dominate in lowland areas (Balmer *et al.,* 2013). Unfortunately data are not available for Scottish populations dating back to the early 1970s, although table 2 provides recent population sizes and changes for Scotland. Despite possible changes to the Scottish corvid population, there has also been a reduction in the size of the Scottish sheep flock by around 10% since 1970, although the total Scottish flock has varied considerably during the intervening years.[5]

Given these factors, one might expect crow damage to sheep flocks to have generally increased in the intervening years. In areas with minimal management of low density flocks, on poor quality hill grazing, one might expect crow damage to be above average, especially at times when sheep are most vulnerable to attack.

Communal nesting corvids such as rooks and jackdaws can also be problematic when exhibiting behaviours in large groups, as opposed to the same behaviour by one or two individuals. In the 1960's and early 1970's on St Serfs Island in Loch Leven, there was a substantial Jackdaw colony and many more additional birds flying into the island on a daily basis to feed. Over 400 pairs of jackdaws developed a habit of plucking wool from the backs of sheep that grazed on the island, which became a serious nuisance for the sheep and the tenant farmer (Allison, 1970; NCC, 1976).

Another similar problem widely reported with magpies, but occasionally with other corvids, is intermittent pecking of livestock sores and wounds. The corvids open up the wounds to the extent that they affect the animal's welfare (Berry, 1922; Country Smallholding, 2014; De Kay, 2015). It is probably opportunistic behaviour that develops when birds are searching

[5] http://www.gov.scot/Topics/Statistics/Browse/Agriculture-Fisheries/Publications/histagstats

for insects on the hides of large animal, but has the potential to become serious, particularly if the affected animals are immobilised, or for whatever reason, are unable to escape.

Corvids have also been known to bring disease risks, and occasionally kill or injure young free-range poultry, they will take food or eggs if accessible. A study in rural France found that predators accounted for 6% of chicken losses on free-range farms, but the majority (61% of losses) was attributable to surplus killing by canids, as opposed to crows, which accounted for 4% of losses (Stahl *et al*., 2002). However, based on predation 'events' as opposed to absolute numbers, crows were responsible for around 9% of losses, equivalent to 0.5% of output, but still relatively low (Stahl *et al*., 2002). In this study, young chicks were kept indoors for the first 5 weeks, but on some smaller operations that might not be the case and having younger birds out in the open may lead to greater losses from crows. There are many anecdotal reports of this from small scale chicken farmers. However, the biggest problem for free-range poultry farmers from corvids is likely to be through the spreading of disease from contaminated feed and water (Gortázar *et al*., 2009; Veen *et al*., 2007; Wiethoelter *et al*., 2015) or the cost of stolen food.

2.7.2 Feedstuff

Corvids (especially rooks), gulls and starlings stealing livestock feed from troughs located outdoors and in open barns is a commonly reported activity (Feare, 1974; Hartley pers. comm.). It can often be resolved by the use of covered feeding troughs, and other exclusion methods. Careful relocation of feeding areas, and the use of scaring techniques, may also offer short-term relief, but there are circumstances where it is difficult to protect against such losses. For instance, where herded livestock, held outdoors, compete for feed and free feeding (constant access to feed) is not possible.

It is increasingly common for farms to store silage in large wrapped bales instead of in a 'silo'. Rooks, jackdaws and sometimes crows, are known to peck at and create holes in the tough plastic wrapping around silage bales. Atmospheric oxygen then seeps into the bale, and interferes with the fermentation process spoiling the silage, and can allow bacteria, such as Listeria, and fungi to contaminate the bale. If these bales are then fed to livestock, listeriosis can result in high abortion rates. In Ireland, 57% of farms surveyed reported bird damage to bales while they were standing where they had been made, but this rose to 67% of farms when bales were moved together for long-term storage (McNamara *et al*., 2001a). Further experimental work revealed variable, but often severe levels of damage and silage losses (McNamara *et al.,* 2001b).

2.7.3 Crops and grassland

Jackdaws, and especially rooks, are known to breed in large colonies, e.g. rookeries. They often continue this flocking behaviour when foraging and can occur in large numbers on farmland, as single or mixed flocks. Here they can cause significant problems for farmers at different stages in the crop cycle (Lockie, 1956). In Aberdeenshire, losses due to rooks feeding on sown grain were highest for spring sown cereals (coinciding with rook breeding season), and the damage amounted to approximately 7% of total expected yield (Feare, 1974). Kennedy and Connery (2008) reported that rook activity could reduce plant densities in some cereal crops by more than 50%.

Losses to mature cereal crops lodged by rooks (trampling the tillers flat to get at seed) accounted for 3.5% of the area of barley crops surveyed in Aberdeenshire, but could be as high as 6% (Fuchs & Lawrie, 2002). The types of damage included loss of grains, damaged grains, combining difficulties and increased drying costs. Feare (1974) calculated that losses due to lodging of mature cereals were small, but later noted (Feare, 1988) that subsequent trends toward autumn sown barley in Scotland had by the late 1980's led to increased levels of damage in the summer when the crop ripens at an ideal time for rooks to exploit. Although in contrast, the autumn sowing trend may have reduced levels of damage to newly sown cereal from rooks. Rooks will also remove grain from cereals that have been lodged by other factors (Lovegrove, 2007).

Rooks also attack potato plants being grown for seed, with between 5% and 42% of plants in sample plots being attacked. However, this damage did not significantly affect plant yield (Feare, 1974). Damage to cereal stooks, consumption of livestock feed (at piggeries and from sheep troughs), and occasional damage to germinated grain and turnip seedlings were also noted (Feare, 1974), all of which have potential financial implications for farmers.

It is worth noting that rooks are also sometimes credited with beneficial control of some invertebrate pests of grassland, such as leatherjackets (*Tipulidae* larvae) and chafer (*Phyllopertha spp.*) grubs (Moore, 1992), although Feare was sceptical that this was significant. Studies elsewhere suggest that the impact of rooks on invertebrate pests of grassland may not be so positive. No measurable economic benefits were found in a New Zealand study of predation by introduced non-native rooks on grassland invertebrates. However, the rooks often damaged the grassland severely while searching for grubs, some of which was still visible seven months later (McLennan & MacMillan, 1983). The study also noted that complaints to the Ministry of Agriculture regarding insect damage to grassland did not increase when rooks were removed, implying that the rooks had no substantial impact on any of the common invertebrate pests that they predated. Damage to grass in the UK by flocking corvids, and other animals such as badgers (*Meles meles*) and foxes (*Vulpes vulpes*) hunting for invertebrates is well known in the amenity industry and to some farmers, although since some invertebrates also damage the grass, the solution is often to control the invertebrates rather than the vertebrate predators.

2.7.4 Conservation and game management

Conservation is concerned with protecting species and their habitats to safeguard biodiversity. This involves measures to maintain or enhance the status of populations of species in terms of factors such as their abundance, range and availability of suitable habitat. . Game management is likewise concerned with population well-being of the species in question, but additionally aims to produce a sustainable harvest.

The primary threat from corvids is predation of eggs and young of the species of conservation interest. Adult birds have occasionally been the victim of crows, for example lapwings (McMahon, 1996), although this is relatively uncommon. Crows (carrion and hooded) and magpies are most commonly known for nest raiding but jays, rooks and jackdaws can also be involved. For some species of conservation concern where breeding productivity is not limiting their populations, this may not be a serious problem. Where other factors increase the vulnerability of a species and predation adds to this vulnerability, or where external factors result in large corvid populations and incidental rates of predation, then control of corvids could well be of benefit. For exploited game species, predation that limits productivity will generally result in reduced harvests and will therefore be a cause of concern.

Madden *et al*. (2015) used a rigorously objective meta-analysis approach to review the impact of corvid birds on the productivity and/or population size of other bird species vulnerable to corvid predation. Out of 1,191 potentially relevant studies considered, 42 (4%) met the strict criteria for inclusion, of which 20 were experimental, and 22 were correlational. In 10% of the 42 studies a negative impact of corvids on the abundance of prey species was reported. Forty-six percent of studies found a negative impact on prey productivity. The authors suggested that corvid removal may be beneficial where the aim is to increase productivity, but that in many cases prey abundance must be limited by factors other than corvid predation. Furthermore, removing corvids alone was much less effective than removing them in conjunction with other potential predators, leading to the conclusion that other predators were more important or that compensatory predation may occur when corvids alone are removed. An important point to note is that the impacts of different corvid species varied considerably. Studies of carrion crow alone showed them to have a negative effect on prey productivity in 71% of cases, but for magpies alone only 12%. Studies where carrion crow and magpie were both considered revealed a negative impact on prey productivity in 64% of cases. For studies considering abundance the variability was far less between species, carrion crows had a negative effect in 7% of studies, magpies in 4% and combined studies 9%. The meta-analysis has been widely discussed and is clearly influential. Nevertheless, like any type of evidence, literature review by meta-analysis has its own limitations, which are discussed in the paper itself.

An extensive review recently published by the Moorland Forum (Ainsworth *et al.,* 2016) discusses many of the problems associated with the interpretation of evidence on wild bird predation. Like the Madden *et al*. review, it indicates that the control of corvids for the benefit of other bird species is a complex issue. What both studies appear to agree is that while the lethal control of corvids may not be appropriate to all situations, it can be of benefit in some circumstances, particularly as part of a co-ordinated predator control regime.

2.8 Crow traps in research

There have been studies that focus on the use of traps and their impact, but these have tended to examine the use of traps in the context of corvid damage mitigation. Nonetheless, multi-catch ladder traps, and occasionally Larsen traps, have been widely used by many researchers as a tool for catching both corvids and other species for research. Uses have included radio-tagging, marking/banding studies, morphometric measurements, translocation studies, disease testing, biological sampling, or to obtain live birds for use in other experimental studies. Research examples can be found in Kalmbach and Aldous (1940), McLaughlin (1968), Hansen *et al*. (2000), Smedshaug *et al*. (2002) Jones and Nealson (2003), Morishita *et al*. (2003), Avery *et al.* (2004), Schaefer (2006), Johnson and Smith (2008), Jaspers *et al.* (2009), Humphreys *et al*. (2010), Ward and Raim (2011), Velasco (2015) and Whisson *et al*. (2015).

2.9 Necessity of control, and utility of trapping

The result of many scientific studies appear to suggest that corvid problems have a low overall impact on human activities, but damage is often variable, and there may be situations where localised damage can be serious. For example, many farmers may only suffer negligible rook damage to crops, and lamb deaths due to crows, but for small numbers of farmers these problems could be significant, or at a level that raises concern for the future. For farmers, the jackdaw may be a species of increasing concern, given estimated changes to the Scottish population, and while rooks are currently declining at a significant rate, their population is still estimated at probably over 1 million individuals. The carrion crow population appears to have stabilised at approximately half a million individuals in Scotland, while the hooded crow, like the rook, is also in decline (see section 2.7.1).

Table 2. Estimated population size (all figures are individual birds, not pairs) of GB and Scotland corvid populations, with estimated Scottish change. Source: Scottish Breeding/winter population (Forrester & Andrews 2007), change in Scottish population (SNH 2015), GB Population.

Species	Estimated Scottish Breeding population 000's	Estimated Scottish Winter population 000's	Estimated change to Scottish population (1994 to 2014)	Estimated GB population (individuals) 000's
Carrion crow	200 to 400	350-700	0	1000
Hooded crow	50 to 90	75-150	-32%	160
Rook	600 to 1000	1000-1750	-32%	990
Jackdaw	160 to 240	250-400	+34%	1300
Magpie	28 to 44	40 to 50	+34%	550
Jay	12 to 20	20 to 40	Possible increase	170

Against these population changes, it is also important to remember that corvid control at variable intensities, has been taking place for many years across a very wide geographic area, and that data on corvid damage may well reflect the impact in the presence of that control, even when there is little or no actual control on a study area itself. What level of damage mitigation occurs as a result of this background level of control, and the long-term impacts if this corvid management were stopped or seriously curtailed, is largely speculation. The variable nature of damage leads to the obvious suggestion that rather than a blanket 'General Licence' to cover everyone with a problem or perceived problem, perhaps individuals should apply for a licence if or when they recognise a problem. However, the wide distribution of corvids, and the fact that these species can cause variable levels of damage, means there are a very large number of people who would potentially apply. The urgency with which some may need to react to a developing problem; the difficulty of establishing whether damage is serious enough to justify a licence, or if it is likely to occur at a level justifying one, and the difficulty in determining if the corvid control will achieve its aim, means that a significant amount of resources may have to be expended by applicants and authorities to ensure the supporting evidence exists to justify the licence. This could potentially hamper efforts to undertake control, and result in a significant increase in costs for both applicants and the licensing authority. Thus the General Licences have a useful role in allowing a quick response in situations where the population of the target species is not of conservation concern.

A general principle of modern pest control, based on ethical and conservation concerns is to opt for non-lethal options first, where they are appropriate. This principle is enshrined in the EU 'Birds Directive', which only permits derogations to kill or capture birds "*where there is no other satisfactory solution".* General Licence GL 03/2016 states [applicants must] "*only use it where they are satisfied that appropriate non-lethal methods of control (e.g. scaring or bird proofing) are either ineffective or impracticable*" (SNH, 2015). There are many options for non-lethal corvid control, including changing management techniques (e.g. lambing parks, or lambing indoors), exclusion (e.g. nets over silage bales), or a very wide range of visual and auditory scarers.[6] However, many of these options may be impracticable in certain circumstances (e.g. auditory scaring is limited in areas when disturbance and noise is an issue), or simply unaffordable for some (e.g. erection of buildings; physical exclusion over large areas). Deployment of an effective scaring regime takes time, effort and may be costly in terms of outlay and manpower, and over the long-term, birds may simply habituate the

[6] https://www.sasa.gov.uk/document-library/equipment-used-exclude-and-scare-birds

different types of scaring device (Bishop *et al.,* 2003). Habituation in flocking species can often be prevented by shooting, where it is used to reinforce scaring by providing a genuine threat to birds in conjunction with the scarer (Baxter & Allan, 2008). Nonetheless, over the short-term, scaring does deter birds, and this may be sufficient to lower damage to acceptable levels. In Scotland, while shooting is the most popular choice of (lethal) control (SASA unpublished data), not all land managers have access to a gun, and some sites are unsuitable (unsafe, disturbance) for shotgun or rifle use.

Trapping, however, is a method that offers relatively low levels of disturbance, can be low cost, enables multiple sites to be managed by one person, and unlike shooting, does not require presence of the operator, and therefore has a relatively low demand on manpower. Thus trapping may be the most practical choice for a number of situations.

2.10 Welfare assessment of trapped birds

In general, assessing animal welfare can be a difficult process (Mason & Mendl, 1993); although one can attempt to set and measure objective criteria there is often a substantial degree of subjective assessment required to interpret what is observed. There are many factors that could influence welfare and there may be considerable interaction between those factors, further complicating any assessment of impact. Differences in responses to situations between individuals, species, age groups, sexes, and seasonal factors all complicate any welfare assessment.

In an attempt to standardise the process within the discipline of wildlife management, Sharp and Saunders (2008) developed a model for use in assessing the welfare of pest control methods used in Australia. This model was used by Baker *et al*. (2016) to assess the welfare impact of several common control methods used in the UK against rabbits (*Oryctolagus cuniculus*), moles (*Talpa europaea*) and carrion crows. They assessed three crow control methods: lethal shooting, scaring with gas guns and trapping using Larsen traps. The model splits the assessment of a method into two parts, A and B, as follows.

Part A is an assessment of the overall non-lethal impacts and is split into five ‘domains’ which attribute an impact score to different aspects of the method; these are: 1.Water/food restriction and malnutrition; 2. Environmental challenge; 3. Disease, injury, functional impairment; 4. Behavioural or interactive restriction; 5. Anxiety, fear, pain, distress, thirst and hunger. Each of the five ‘domains’ is scored as either no impact, mild, moderate, severe or extreme impact. These scores along with duration are then used to produce an overall impact score.

Part B of the process assesses the mode of death and has two components: 1. Time to insensibility; 2. Level of suffering. The former is scored either as immediate to seconds, or minutes, hours, days or weeks. The latter is scored as either no suffering, mild, moderate, severe or extreme suffering. While the model described is beneficial in trying to breakdown welfare assessment into component parts, the scoring of those individual parts still involves significant subjective decisions. Nevertheless it is useful process that at least allows a more open insight into how an overall welfare impact was judged.

The conclusion of Baker *et al*. (2016) was that of the three crow methods assessed, trapping had the greatest negative impact on welfare. However it is important to note that the process actually scored trapping as having a ‘moderate impact’ overall compared to the other two methods which they judged to have an overall ‘mild impact’. Of the scoring of the Part A ‘domains’ for trapping, three were scored ‘mild’ and two were scored moderate (domains 4 and 5), so arguably trapping sits between ‘mild’ and ‘moderate’ in terms of welfare based on this assessment. It is also questionable if it is appropriate to use equal weighting for the five domains since some are arguably of greater welfare concern than others. For Part B, time to insensibility was given the lowest score (immediate to seconds) and level of suffering given 'moderate'. In addition Baker *et al*. (2016) indicated that reducing the trap-checking routine from 24hrs down as low as 2hrs would still result in it having the highest impact of the three. Some of the evidence on which the welfare scores are given is questionable. They have assumed that water is provided for the captured bird, which may often not be the case, although bait (food) will be present in a baited trap. If a decoy bird is used, even food may not be available, although it is common to provide the added incentive of food in the capture compartment, even when a decoy is present. They also indicate that birds in the traps may not eat food for a 'short' while after capture due to "neophobia", although given that the bird entered a baited trap in order to access the food it is reasonable to assume that neophobia *per se* is not an issue. Video observations from part 3 of this study, suggests birds typically lift the food to fly out of the trap, but drop it once they realise they are trapped. Nonetheless, it is rare for a trapped bird not to have eaten the bait by the time is it removed from the trap, even when removal occurs after just a few hours (Campbell, pers. obs.).

Baker and co-workers also indicate that removing birds prior to nightfall will reduce risk of predator interference, but it is unclear whether this assumption is incorporated into their score.

The evidence quoted for assessing 'level of suffering' appears to be based on the assumption that cervical dislocation (the method of dispatch used) does not cause concussion and that therefore there may be an elongated period of suffering prior to unconsciousness. While this is true, it is likely that cervical dislocation alone is not the preferred method of dispatch for most trap users. The GWCT trapping guidance (GWCT, 2015a & b) recommends a sharp blow to the head first, followed by cervical dislocation. A blow to the back of the head is the method most commonly encountered by the authors and is probably the most frequently used. Therefore it seems likely that in most situations the period of suffering due to the mode of death will be less than that assumed by Baker *et al*. Furthermore, shooting does not guarantee instantaneous death, since some birds may be 'pricked' or wounded by shot, but may still be able to escape the immediate attention of the marksman (Merkel *et al*., 2006; Guillemain *et al*., 2007; Noer *et al*., 2007).

2.10.1 Definitions of stress, distress and suffering

Stress is a physiological disturbance that may be brought on by a 'stressor' such as a threatening or harmful situation (Gregory, 2004). These may trigger a number of different changes in an animal's physiology or behaviour, and are often linked to the secretion of stress hormones, activation of the sympathetic nervous system and mobilisation of the immune system (Ward *et al*., 2008). These changes are the body's way of trying to cope with the effects of the 'stressor' and restore the animal to a 'normal' state.

Stress and distress are often used interchangeably but it is important to distinguish the two terms. Distress can be characterised as a negative state in which the adaptive mechanisms described above in response to a stressor have failed to return the animal to a 'physiological and/or psychological homeostasis' (Ward *et al*., 2008). Distress can result from either chronic (long term) stress, or from acute (short term) stress. Ward and co-workers offer three statements which are potentially useful when considering the concept of stress and distress:

1. The two are dissociable concepts, distinguished by an animal's ability or inability to cope or adapt to changes in its environment and experience.
2. Stress responses are normal reactions to environmental or internal perturbations and can be considered adaptive in nature. Distress occurs when stress is severe, prolonged or both.

3. The concepts of stress and distress can be distinguished from that of welfare in that an adaptive and beneficial stress response may occur against a backdrop of a transient negative emotional state.

Another way to view this is that stress is the process of trying to cope with a situation; distress is the failure of that process. Distress is highly likely to have welfare implications, while stress itself may not.

2.10.2 Stress physiology

In birds and other vertebrates, stressful events or factors (stressors) usually trigger the rapid release of corticosteroid hormones in the form of glucocorticoids, which trigger some of the physiological responses to stress. Small passerines that have been trapped exhibit elevated corticosterone levels within a few minutes of capture (Romero & Romero, 2002; Lynn & Porter, 2008). However the level of corticosterone response varies between different species and by season (Lynn & Porter, 2008), and birds left in two different trap situations showed inconsistent patterns of corticosterone release between species and capture technique (Romero & Romero, 2002). The latter study compared stress responses in birds caught in mist nets and Potter (walk-in cage) traps. They found that the Potter traps did not induce an immediate increase in corticosteroid concentrations compared to the nets (although levels did increase). One potential explanation was that the Potter traps are less stressful than a mist net because the birds are able to move around in them relatively freely, and are able to eat. Indeed, there was some evidence that eating may have had an inhibitory effect on further corticosteroid release, and the authors speculated that the consumption of food in some way ameliorated the stress of being in the trap (an effect that has been observed in rats) (Romero & Romero, 2002). These findings might have some relevance to use of the General Licence traps assuming corvids respond in a similar way.

2.10.3 Tonic immobility and capture myopathy

There are two well recognised conditions that can affect animals that are trapped and handled. The first is tonic immobility, a state of paralysis or 'freezing' that can be elicited in some species by an encounter with a predator (real or perceived), and is sometimes used as an indicator of acute fear in birds (Hawkins, 2001). Tonic immobility is often triggered in a situation that involves physical restraint, but may last beyond the point when the animal is released from that restraint (Gallup, 1977). Thus, being gripped by a predator might trigger it rather than the close proximity of the predator. Hawkins (2001) recommend that for people handling birds, that tonic immobility should not be deliberately induced as it imposes extra stress, and birds can still experience pain and fear while frozen. We are not aware of this response being reported in corvids but it may apply to other species that are trapped and handled, or which are harassed by predators while in a trap.

The second condition is capture myopathy, also known as exertional myopathy. It is frequently reported in mammals (especially deer), but has also been reported infrequently in birds (Spraker, 1987; Marco *et al*., 2006; Ruder *et al*., 2012). It is characterised by damage to muscle tissue related to factors such as extreme physical exertion and stress. It is sometimes seen in animals that have been trapped, restrained and then released, and can take effect days after the events that caused it; in some cases it can be fatal (Ruder *et al*., 2012). Susceptibility of species to this condition varies widely and there is little evidence of it being common in corvids. Duarte (2013) could find no documentation regarding capture myopathy in passerines, although mild signs of rhabdomyolysis (muscle damage), attributed to capture myopathy, have been observed in a small number of wild-caught corvids (Nemeth *et al*., 2011). However these corvids were caught using a cannon net, transported 700 miles by lorry, then kept in aviaries for 6 months prior to study, so the relevance of their findings to typical crow trapping activities may be slight. A significant number of studies have used cage traps to catch corvids and raptors for radio-tracking studies, and none of them have reported significant deaths subsequent to release, that might suggest capture myopathy is a problem.

2.10.4 Injuries and mortality in crow traps

Given the large variation in types of corvid trap listed on the General Licence (plus variations within each trap 'group'), there would appear to be scope for injury to target and non-target species caught in them. However, few studies have focused on injury risks, and those that have used traps do not report on injuries or deaths, and if they do, they seem to be very minor.

In studies that were specifically trap focused (Alsager *et al*.,1972; Acquarone *et al*., 2004; Tsachalidis *et al.* 2006; Diaz-Ruiz *et al*. 2010), which together trapped over 1000 corvids and several non-targets, including raptors, in various Larsen or multi-catch traps, no mention is made of any injuries (or looking for them). In addition, Tsachalidis *et al.* (2006) claim to have released two non-target buzzards "without serious stress", while Olsen and Schmidt (2001), despite their paper focussing on the impact of trapping and handling activities on hooded crows, do not note any injuries.

In studies that utilised trapping as a method to catch corvids for other research purposes, there are again, no mention of trap injury or mortality (Smedshaug *et al*., 2002, hooded crows; Morishita *et al*. 2003, jungle crows (*Corvus macrorhyncho*s); Whisson *et al*. 2015, little ravens (*Corvus mellori*).

Similarly, studies that trapped non-corvids, including raptors, do not report incidents of injury or mortality (Redpath & Wylie, 1994, 16 tawny owls; Meng, 1971, 54 varied hawks and owls). Humphreys *et al*. (2010) used Larsen traps to capture sparrowhawks (*Accipiter nisus*). They acknowledged the potential for injury and had the SSPCA inspect the birds, but reported that there were no issues relating to welfare with all seven captures. Buck and Craft (1995) trapped 56 owls and hawks in walk-in cage traps and reported "no serious injuries or mortality", although they did expand on this to say that some birds exhibited minor scrapes on the cere. Jones and Nealson (2003) did not refer to any injuries in a sample of 141 Australian magpies (*Cracticus tibicen,* which are not corvids) trapped using a walk-in cage trap for relocation.

The lack of injury or mortality reports, across a wide range of studies that use cage trapping (corvid or raptor), strongly supports the hypothesis that significant injuries (or mortalities) are very rare with this form of trapping, and that any injuries that occur are considered too insignificant to be reported. In particular, scientists who use cage traps as a means of acquiring birds for research would not use methods if they consider the traps posed a significant welfare risk to study animals. However some, but not all researchers, closely monitor the traps, and birds are removed within a few minutes to a few hours after capture (e.g. Whisson *et al*. 2015). This contrasts with the standard guidelines for crow trapping in the UK, which may result in birds being trapped for up to 24 hours. Nonetheless, the use of traps in research, at the very least, supports a lack of injury during the initial capture and trapping period, and in many studies, timescales for capture may be comparable to the 24 hour maximum period.

Some researchers have recorded repeat captures of birds, i.e. individuals that have been released from traps then returned to re-enter them. Tsachalidis *et al.* (2007) reported a 45% re-capture rate for magpies (n=39 of 86) and 15% for hooded crows (n=3 of 15) in ladder traps. Picozzi (1975) also recorded multiple recaptures of crows released from a funnel trap. Moran (1991) reported that a short-toed eagle (*Circaetus gallicus*) was re-trapped several times in a ladder trap used for hooded crows. Anecdotal evidence from trappers taking part in part 2 of this study also indicates that raptors, especially buzzards, will be repeatedly caught in traps, in some cases many times (S Jamieson pers. comm.). This phenomenon suggests that the experience of being caught in a corvid trap, at least for some birds, is not completely aversive.

2.10.5 Comparison of injury and mortality of other catching methods

Detailed data on bird injuries acquired using corvid traps, and also other forms of capture, is sparse. However, a comparative account allows perspective to be gained in this controversial area of bird trapping.

A comparison of 18,936 waterfowl captures over a 10 year period, using several methods (cage traps, duck decoy pipes, swan pipes, cannon netting and roundups of moulting birds) recorded injuries as mild, moderate, severe or fatal (O'Brien *et al*., 2016). Across all methods and species groups, average mortality was 0.1% and average injury rates were 0.42%, though severe injuries were marginally lower than fatalities. Injury and mortality rates varied between species and methods, but at no time for any trap type and species group (swans, ducks, geese or rails) did the combined rate exceed 1%.

Over a five year period, several thousand Sora (*Porzana carolina)* and Virginia rails (*Rallus limicola*) were caught in walk-in cage traps. The mortality rate was 1.6%, almost half of which was due to predators (Kearns *et al*., 1998). Using modified leg-hold traps, 24 American white pelicans (*Pelecanus erythrorhynchos*), 23 great blue herons (*Ardea herodius*) and five other species were caught without injury, with the exception of a mild abrasion to the leg of one pelican (King *et al*., 1998). Rocket nets were also used on five occasions to catch 142 pelicans, resulting in one mortality and one serious injury (broken wing) resulting in euthanasia, and giving an overall mortality rate of 1.4%.

Rocket nets used to capture shorebirds, resulted in a mortality rate of between 0 and 2.1% per net fired (average = 1%), although on one occasion, 10.7% mortality occurred, which was due to a lack of resources to process an extraordinarily high catch. Birds died while waiting to be processed rather than during the initial capture event (Jurek, 1974).

Berger and Mueller (1959) used Bal-Chatri traps to catch over 400 raptors, 90% of which were American Kestrels (*Falco sparverius*), and experienced no bird mortalities; they did not report on injuries. Wang and Trost (2000) used several methods of catching 116 black-billed magpies (*Pica hudsonia*), including walk-in funnel, Bal-chatri and a modified mist net. They did not report any trapping incidents but mention the lack of injury or deaths in later DNA sampling procedures, implying that if any trapping incidents had occurred, they would have mentioned them.

An analysis of some ringing organisations in the US (covering 345,752 captured birds) using mist nets, found that mortality rates varied between 0%-0.07% for raptors and from 0.13% to 0.56% for passerines, while injury rates varied from 0% to 0.13% for raptors, and from 0.06% to 2.1% for passerines. Average rates of mortality and injury across all types of bird and all organisations was 0.23% and 0.59% respectively (Spotswood *et al*., 2012). However, in a single Australian study, 1.3% mortality in 4184 mist netted birds was recorded (Recher *et al*., 1985), while Jurek (1974) reported a mortality rate of 1.2% from the mist netting of 677 shorebirds. Overall, mortality associated with mist netting rarely exceeds 1%, and is often zero (Ralph *et al.,* 1993).

Rates of injury or mortality associated with other methods of bird trapping appear to compare well with equivalent rates found in General Licence trapping techniques. In general, injuries are so minor and infrequent that they appear to be given only the briefest of mention or none at all, and these welfare impacts for traps used under the General Licence appear no worse than those for many other methods used to trap birds.

2.10.6 The importance of injuries in corvid trapping

When trapping under the General Licence there are a number of potential issues related to injuries. Firstly there is general welfare of the trapped bird, and under The Animal Health and Welfare (Scotland) Act 2006 the trapper has a responsibility to any bird (or animal) in the trap to prevent unnecessary suffering. In this respect it is clearly desirable to minimise the risk of any injury that might cause suffering in the trap. The second issue is concerned with what happens to the animal once it is removed from the trap. Clearly for corvids taken under the General Licence, this is not a significant issue as they are invariably killed upon removal, although a small proportion may escape while they are being removed from a trap. For non-target species it is arguably more important that they do not suffer any injuries, since their suffering may be prolonged on release, and this may also impair their subsequent survival. Furthermore if birds manage to escape a trap prior to being removed, they should not be similarly disadvantaged.

As noted previously, there are relatively few records in the literature of injuries to either corvids or non-targets from crow traps, and those that are mentioned are minor. For non-targets being re-released, particularly raptors, the literature on survival of injured wild birds gives some perspective on what can be considered 'minor' in this context. Roth *et al*. (2002) examined 339 individuals of three hawk species from wild caught museum specimens collected between 1921 and 1998, and found that 18.6% had healed fractures to the pectoral bones. Bedrosian and St Pierre (2007) examined 93 wild-caught raptors of three species, and noted any pre-existing injuries to live birds before re-release, such as broken or missing talons, missing toes, healed fractures or eye injuries. Those that they recorded are considered minimum values, as they were unable to give the birds a full examination, so may have missed some healed fractures. Between 9% and 20% of raptors by species, had pre-existing injuries. The majority of captures were red-tailed hawks, and the condition scores of injured vs non-injured showed no difference, suggesting that the assorted injuries were not a lasting handicap for these birds These and other studies imply that among raptors at least, a significant number of birds are capable of successfully surviving what might be described as moderate (missing talons and toes) and possibly even some severe (broken bones) injuries. Another study involving the examination of 12,860 ducks, gulls and pigeons, found less than 0.5% with healed fractures (Brandwood *et al*., 1986), this might reflect a much lower rate of injury than raptors, or a much lower injury survival rate. Given the concern regarding the by-catch of raptors in traps used under the General Licence it is important to note the significant proportions of birds that survived what appear to be moderate or even severe injuries, the extent of which can be considered more serious than anything typically reported from corvid trapping activities in the available literature. Together, these data suggest that corvid traps are unlikely to pose a significant injury or subsequent population threat to any non-target species accidentally caught in them.

2.11 The misuse and abuse of traps

There is a considerable body of anecdotal and confirmed evidence of both abuse (deliberate use for illegal purposes) and misuse (use for a legal purpose but incorrectly, or in contravention of the legislation) of corvid traps. Typical problems reported are a failure to check and remove birds (sometimes linked to the deaths of birds in traps), failure to ensure traps cannot capture birds when not in use, use of incorrect decoy bird species, failure to provide adequate food/water/shelter, the killing of raptors caught in otherwise legally operated traps, and traps being set deliberately to capture raptor species. The RSPB have collated annual statistics on both confirmed and anecdotal reports of raptor persecution which sometimes involves corvid traps, and have also collated data on corvid traps. There are two widely cited papers (Dick & Stronach, 1999; Dick, 2005) that examine abuse and/or misuse of corvid traps in depth.

Dick and Stronach (1999) collated data on reports received by RSPB Scotland between 1985 and 1997 from many sources concerning multi-catch crow traps (funnel and ladder). Fifty-two reports were received involving ‘protected species’, and from these they list eight incidents that are considered deliberate abuse, although the total number of reports received involving target species or empty traps, is not recorded. The remaining 44 reports are a list of non-target species reported in corvid traps over the 12 year period, but again, because the total trap days, or total numbers of target species caught are unknown, this by-catch cannot be set into context in terms of non-target capture rates.

A second part of Dick and Stronach’s (1999) paper involves a survey of raptor workers in 1988, who provided details of known multi-catch corvid traps in their local areas, and from which 36 traps were selected for two visits, one in spring and one in early summer. However details of the selection process, either by the raptor workers or the RSPB, is not provided, and hence could be biased towards those traps likely to be run inappropriately. Seventy-eight percent of the traps surveyed were said to be operated illegally based on the “open General Licence conditions 1997”. The breakdown of reasons given was lack of provision of water (64%), food (61%), shelter (61%) and not being visited daily (43%). However, the survey took place in 1998, and licence PS/1998 (Scottish Executive, 1997) to use a crow cage trap to prevent the spread of disease and to prevent serious damage to livestock, foodstuff, etc. did not contain any conditions on the provision of water, food or shelter either for decoy birds or for captured birds in multi-catch traps, suggesting that some of these traps were operating legally. Current General Licences require food, water and shelter to be provided for decoy birds but not for captured birds, irrespective of the whether they are in Larsen or multi-catch traps. Nonetheless, the presence of a variety of dead target and non-target species in some of the traps, a few of which had probably died of starvation, does suggest that offences under the General Licence had been committed, because either traps were not being checked daily or were not rendered incapable of holding or catching birds when not in use.

Live birds (seven corvids, two mistle thrushes (*Turdus viscivorus*), two starlings (*Sturnus vulgaris*) and a kestrel (*Falco tinnunculus*)) were found in nine (27%) of the traps surveyed, and which may have been operated legally, although a shot and injured long-eared owl (*Strix otus*) next to a trap, was very likely abuse.

The authors also point out that many multi-catch traps were found with their doors closed but containing no bait (61%). They make a reasonable point that a trap left closed, but not in use and therefore not checked, poses a significant danger to birds that may enter it. However, the authors may have over-estimated the number of traps in their survey to which that applies if some traps were being operated with bait, but birds had entered the trap, eaten the bait and then later escaped, an occurrence that can be quite common depending on the trap design (e.g. Tsachalidis, 2006; S Campbell pers. obs.).

Dick (2005) produced a follow-on report to Dick and Stronach’s paper, where data are presented from 407 reports regarding multi-catch crow traps that came to RSPB’s attention from 1998 to 2004. Of all reports 25% involved birds found in traps, and 40% of birds found were dead. Unlike the previous paper, this one also includes reports of legitimate target species and these comprised approximately three quarters of the dead birds, the remainder being protected species. In four cases, dead birds were sent for analysis and were found to have starved. Around half of all non-targets were found dead, and the author notes that there were more unconfirmed reports that weren’t included in their figures that involved an additional 20 raptors of various species.

Of the traps found with live target species, it was noted that it was impossible to tell whether birds were used as decoys or not. Over half of these live target reports included details on provision of food, water and shelter, with 59% containing food, water and shelter, and the remaining traps were missing at least one. Of traps containing food, the food was described as inadequate in many cases. Seventeen percent of reports involved open traps (i.e. not set), 85% of those were secured open as specified under the General Licence if not in use, but the others were not, and they even reported some traps that had no doors built in.

Both Dick (2005) and Dick and Stronach (1999) highlight some valid problems and inconsistencies in the General Licences of the time, indicating areas where the licence conditions could be improved. The data presented make it clear that there was significant misuse and abuse taking place with traps, but the raw figures provided probably overestimate the extent of that abuse/misuse because the sample is highly likely to be non-random and skewed towards the reporting of events of concern (i.e. dead birds and live birds, especially raptors, in traps). Overall the data in these two reports give an important snapshot of how some traps were operated under past General Licences and these two reports were instrumental in driving some of the changes that were made to the General Licences such as those after the 2006 consultation.

Since the production of Dick (2005), reports of crow traps being used illegally have continued. RSPB (2015) list 38 incidents of raptors being caught or killed illegally in a Larsen or multi-catch cage trap over the 20 year period 1994 to 2014, including some in 2013 and 2014. However no information is given on how ‘illegality’ was determined. This summary paper includes data from the previously discussed reports (Dick & Stronach, 1999; Dick, 2005) so may have miscategorised some legal use as illegal. Nevertheless, given that people knowingly committing crimes do so away from the public eye and are therefore difficult to detect, the report is likely representative of a minimum level of illegal activity. Recent evidence of on-going misuse and abuse cases include starvation of captured birds (STV, 2012), inappropriate methods of killing birds (Onekind, 2012), and the deliberate trapping and killing of raptors (Cramb, 2015). Such cases of misuse highlight the importance of continuing to improve the General Licence conditions to try and minimise risks of misuse. Dick and Stronach (1999) themselves state that most illegal trap use was not believed to be malicious, but rather down to carelessness. While many trap users may be aware of the General Licences, it is possible that many do not realise their terms and conditions can change from one year to the next. A survey of 178 arable farmers in 2010 found that 17% used traps, although 68% of these farmers did not know what a “General Licence” was. While these individuals may not be aware of the name of the secondary legislation under which they were acting, it does not necessarily indicate they were operating illegally, but does suggest that they might be at risk of operating illegally if changes to the General Licences are made. Since that time, SNH and various practitioner organisations have made efforts to increase awareness of the General Licences amongst user groups, although ignorance may still be an issue.

It is also desirable to amend the General Licences in an effort to make abusive practices easier to identify, although deliberate wildlife crime can be difficult to combat as individuals are likely to adopt different practices, as required, to fit their objectives such as the use of spring/leg-hold traps, poisons or shooting.

2.12 Summary

This literature review has attempted to cover a broad range of issues associated with the use and impacts of the General Licence traps, and compared practices to some other forms of bird capture and management. It also summarises information on the possible levels and types of damage which are attributed to corvids in the UK. The key issues can be summarised as follows.

1. Corvid control has taken place across Europe for centuries. In the UK, most studies that have taken place, do so against a backdrop of this long-term and widescale control. If this level of control ended, it is uncertain what the implications for man and other wildlife species would be.
2. Corvids can cause damage. Studies quantifying agricultural damage (crops, livestock, stored food and livestock feed) generally show small but very variable impacts; most of these studies are somewhat dated. Studies examining damage to other wildlife are more recent, although the impacts again are highly variable depending upon specific circumstances.
3. Trapping offers some advantages over other forms of corvid control such as scaring and shooting, primarily that it is quiet and unobtrusive, and allows coverage of multiple sites without a continuous human presence.
4. Non-target capture rates in traps allowed under the General Licences are generally low, particularly when compared with capture rates of target species.
5. Injury and mortality rates of target and non-target captures in traps allowed under the General Licences are also very low, and compare well with other forms of bird capture.
6. While trapping clearly induces stress in captured birds, there is a paucity of literature dealing with the degree and the effects of that stress and its implications for the birds.
7. Misuse of traps can lead to serious welfare issues. Changes to the General Licence terms and conditions have increased in clarity in recent years, and this has probably reduced some of the welfare and misuse issues, although it is possible that many users are still unaware of all current terms and conditions, and the need to check for amendments each January. Further changes to both the licences and the communication of them may be beneficial in achieving greater reductions in misuse.
8. The types of traps approved under the General Licences have been, and occasionally still are involved in cases of deliberate abuse. Nonetheless, the size of the traps used and the fact that they must be left outdoors and unattended, makes them easier to detect by enforcement agencies or members of the public than poison baits and single shooting incidents. As such, trapping may be the least desirable of these possible approaches for anyone wishing to illegally kill non-target species.

3. MAIN FINDINGS OF ASSESSING THE NATURE & USE OF CORVID CAGE TRAPS – PART 1: QUESTIONNAIRE SURVEY OF CORVID TRAP USERS IN SCOTLAND 2013

- 1,471 questionnaires were sent out, yielding 595 replies, 580 of them from people using traps in the survey year. Means of detecting bias were limited, but no bias was detected within the dataset or by comparison with other sources of data.
- Respondents often cited multiple reasons for trapping corvid birds. 89% of respondents were trapping corvid birds to assist the conservation of wild birds (General Licence 01), with wild game birds and songbirds cited with similar frequency. 52% of respondents controlled corvids to prevent serious damage to livestock, foodstuffs for livestock, crops, vegetables and fruit (GL02). 5% cited GL03 (preservation of public health, public safety, and preventing the spread of disease), but only one respondent gave this as the sole purpose of control.
- Correspondence Analysis was used to objectively group respondents by similar characteristics. Three clusters were identified, which were broadly characterised as 'Game management' (35% of respondents), 'Agricultural' (40%) and 'Suburban' (25%).
- The Suburban cluster was focused particularly on magpie as a predator of songbirds. Agricultural and Game Management sectors trapped far fewer magpies: their catch was dominated by carrion crows, with hooded crow, jackdaw, rook and magpie following in order of numbers caught.
- Depending on species, trapping accounted for 38% (rook) to 82% (magpie) of corvids killed by respondents; the remainder were killed by shooting. Trapping accounted for 65% of carrion and hooded crow bags.
- The current system for registering details of corvid trappers is clearly inadequate and fails to provide a reliable means of communication between SNH and trap users. We recommend that it should be overhauled. We also note that there is no equivalent 'handle' on those who shoot corvids under the General Licences, but do not use traps.
- Because of the partial engagement with the trapper community, knowledge of the overall scale of corvid control in Scotland is incomplete. We extrapolated to estimate the likely total bags of corvids taken by those using traps. Comparison of these estimated total bag sizes with estimated corvid population sizes in Scotland flagged no particular concerns about the impact of control measures on the status of these species.
- Crows reported as hooded crows far south of the known region of hybridisation with carrion crows caused considerable puzzlement. These cases were numerically few compared with carrion crows in the same areas. Differences between colloquial use of the term 'hoodie' and taxonomic use of 'hooded crow' may be responsible for mis-classification in some of these cases, but other explanations are also possible.

4. MAIN FINDINGS OF ASSESSING THE NATURE & USE OF CORVID CAGE TRAPS – PART 2: FIELD SURVEY OF TRAP USE IN SCOTLAND 2014-15

- 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 target species most commonly caught. Pheasants were the non-target bird and domestic cats the non-target mammal most commonly 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 trapping also took place, with much lower intensity, 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 combined.
- Of all birds caught, magpies were trapped 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 suburban areas 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 peaked between February and July. 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. Rook 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 ‘cover’. Nonetheless, trap rates for most target species were highest when traps were placed under or within 10 metres of cover.
- Visits by the field worker to trap sites 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 could be attributed to predation events.
- Trap users gave feedback on difficulties associated with the General Licences.

5. MAIN FINDINGS OF ASSESSING THE NATURE & USE OF CORVID CAGE TRAPS – PART 3: TRAP OPERATION AND WELFARE

- In 1601 trap days, a total of 138 corvids, 9 buzzards, 4 blackbirds, 1 small passerine, and 1 squirrel triggered traps, and were therefore identified as a catch. Of these, 12 corvids, 2 buzzards, 3 blackbirds, the small passerine and the squirrel escaped by their own means. These traps are therefore considered relatively selective.
- Between 25 and 30% of target species caught in multi-catch traps escaped, despite a modification put into place to try and reduce this issue.
- Buzzards, the only raptor caught, were only trapped when meat bait was set in the traps.
- Buzzards were caught in all trap types. One buzzard was caught three times.
- 'Small passerines' were the most commonly identified species group seen in and within one metre around the traps. In all cases, these birds were able to leave the traps, often through the mesh, with various levels of ease depending upon the mesh size.
- For other bird species, different types of escape pattern were observed from small, single compartment and multi-catch traps, some with behavioural impacts on trap rate of target species. Target birds did not appear to escape from Larsen traps.
- For crows, the use of a decoy bird provided the highest catch rates, followed by meat; egg and bread gave similar catch rates, while for magpies, the use of a decoy bird provided the highest catch rates, followed by eggs, bread then meat. Similarly, decoy birds (jackdaw or magpie) also provided the highest catch rates for jackdaws, followed by bread baits (meat and egg baits were ineffective; grain baits were not used in this study).
- Detailed behavioural analyses were conducted on carrion crows and magpies, the two main species caught. Birds trapped overnight were most active in the first daylight period, less active in the second daylight period and least active at night. In magpies, a short burst of activity was recorded around dusk. The main behaviour observed was walking/pacing in the trap, although other key activities were identified that could be interpreted as likely escape behaviours. Birds were equally active whether caught in the morning or afternoon.
- There were differences between individuals and possibly between species in their behaviours, particularly when caught in different trap types. These differences may to some extent be associated with the amount of available space each species had within a given trap type.
- Buzzards exhibited lower activity rates than other species analysed.
- Veterinary examination of all euthanized corvids determined that 21% of corvids suffered no injury prior to death; 78% had minor or moderate injuries, not believed to be detrimental to their survival had they escaped; and 1% had serious (life threatening) injuries.
- The most common injury was minor bill abrasion (70% of birds), which was probably related to both the trap mesh size and construction, and the behaviour of birds in certain traps. In the majority of cases, no serious injury concerns were raised by the traps used in this study, irrespective of the time left in the trap (within the legal restrictions).
- Most trapped birds were in reasonable body condition, and disease was detected in 6% of birds examined. It seemed unlikely that traps were selecting birds in particularly poor condition, although without further information on background levels of disease in untrapped birds in the area, there remains some uncertainty around this.
- Two birds became entangled in small, single compartment traps during the trapping process, although both disentangled themselves.

- The most serious welfare issue that arose was when a bird was attacked by fox while trapped overnight. Various strategies that could be adopted to mitigate this risk are discussed.
- Further consideration is given to the advantages and disadvantages of possible changes to the traps and the terms and conditions of use, including the use of home-made versions of such traps.

6. OPTIONS FOR SNH

The following options for discussion are based on the findings of parts 1, 2 and 3 of this study which can be read in more detail in the three reports that accompany this one (Reynolds, 2016; Hartley *et al.,* 2016; Campbell *et al.,* 2016). A summary of the issues that have been identified in these reports, and recommendations for their implementation, including priority and approach, is tabled in Annex 1.

6.1 General Licences, registration & data collection

6.1.1 Trapping register

There was clearly a problem with the accuracy of the trapping register run by Police Scotland, with around 20% of entries found to be inaccurate or out of date. This is not necessarily surprising, given that there is currently no mechanism in place to update and maintain the register, and no requirement to notify the police when personal circumstances change. A common complaint of practitioners was obtaining a new trap code (ID number) from their local police station. The licences explicitly state that "The *operator* of the trap will contact their local wildlife crime officer to obtain this code in advance of use of traps", although the ease with which they could identify and contact their local wildlife crime officer, which should be possible via the local police station, is unknown. Nonetheless, if obtaining a trap code can be problematic, then updating personal details will be just as difficult.

There were indications that gamekeepers may have been under-represented in the survey sample, and this could have been due to traps being registered to estates rather than to individual trap operators. However this is explained by the fact that since 2008, when it became a requirement to display a trap sign, these General Licences have stated that a unique code must allow "*the owner*" to be identified rather than the operator(s).

Given these various issues, it may be appropriate to review the current registration system, as well as the precise wording on the General Licences, to ensure that they are fit for the purpose for which they are required. While a web-based registration system could be considered, a substantial minority of trap operators did not have immediate access to a computer, and tended to rely on their local library for internet access, so any reliance on the internet for communication purposes could cause considerable issues for these individuals.

6.1.2 Awareness raising

Despite participants in this study being aware of the General Licences, several stated they were confused about how the general licence system worked, and some were unsure about the exact content of the licences, particularly given the potential for annual changes. Those with restricted internet access may have relied on practitioner magazines for updates on changes to the Licences. There is a need for SNH to increase awareness and accessibility of information regarding the General Licences to trap operators via a wider variety of media outlets than currently used. A survey of 172 arable farmers in 2010 found that of those who took action covered by the General Licence, over ¾ of them answered "no" when asked the question "do you know what a General Licence is?" although less than 20 percent used corvid traps (SASA unpublished data). Since that time, SNH and various practitioner organisations have made efforts to increase awareness of the General Licences amongst user groups, although ignorance may still be an issue. Feedback from operators suggests that any additional publicity of the General Licences, particularly that highlights annual changes, has the potential to improve their understanding of the conditions, and helps to ensure full compliance with the requirements. If SNH were to take governance of the register, this could provide a more direct means of ensuring trap operators are kept informed about where to go to update their knowledge, including any changes to the General Licences. While the simplest approach to ensuring that every trap user is aware of the terms and conditions of trap use is to undertake an occasional mail-drop to all registered users, the problems with the database (see 6.1.1) will reduce the effectiveness of this approach.

Trap vandalism was a commonly reported problem amongst trap operators. To help the general public understand the legal use of such traps, SNH could consider creating a webpage informing the public of their legal uses.

6.1.3 Layout of the General Licences

A number of trap operators stated that they found it difficult to pinpoint specific topics of interest to them within the General Licence, and would prefer to see a simplified summary of the critical points, highlighting any recent changes. The layout and wording of the General Licences could be reviewed to try and identify ways to make information easier to find and interpret (also see 6.1.5).

6.1.4 Best practice guidelines

Working alongside industry bodies, Police Scotland and Scottish Government, SNH could consider the development of best practice guidelines covering basic principles of General Licence trapping that are unlikely to change annually, as well as codes of practice regarding the maintenance and welfare of decoy birds. Such guidance would go some way to assuring users that they are adhering to 'best practice'. The GWCT (2015a & b) already produce detailed guidance for Larsen and multi-catch traps, which is specific for Scotland, and which may be suitable for this purpose with minor modification. Wide accessibility of any guidance, in addition to the internet, would be most useful for practitioners.

6.1.5 Data & returns

SNH may consider a need for the register to provide general information about trap use (e.g. the current number of users, number and type of traps in use, geographic spread, etc.). Any regular requirement to update the register could also be linked to some form of compulsory submission of information about trap use, which could include bag records. However, with shooting accounting for a significant proportion of corvid species taken, any compulsory bag submission would need to account for shot as well as trapped birds. This is considerably more complicated given that there are approximately 146 times more registered shotgun and firearm certificate holders in Scotland than registered trap users (Alpers *et al*. 2016; BBC, 2013). Additionally, marksmen from outside of Scotland also shoot here, and may occasionally shoot some crows in addition to their primary activities. Nonetheless, doing this could allow some monitoring of annual bags if it was required. SNH already require an annual return detailing the numbers of certain gull (Laridae) species taken under the General Licences, but this applies only to those species where there is evidence of significant population declines. Thus this return system occurs on a considerably smaller scale, and it is unknown how reliable this system is.

6.1.6 Small, single compartment cage traps

Trap operators also expressed some confusion regarding the legality of the different types of small, single compartment traps, and were uncertain about whether or not their trap was legally permitted under the General Licences. Currently the Licences mention only two types of small, single compartment cage trap (Larsen-mates and Larsen pods), and many individuals in Scotland do not know what a Larsen pod trap looks like. There are also a number of other small, single compartment trap designs commercially available and there is no obvious reason not to include other types of small trap such as the Rustler Hedgerow Trap (Rustler Traps, 2010) or the Trap Man Larsen mate (The Trap Man [no date]) on the General Licence. Both of the traps mentioned have a slightly different configuration to the listed traps, which would otherwise make them illegal in the current Licences. Furthermore, along with the Larsen pod traps, the Rustler Hedgerow trap and Trap Man Larsen mate are not of the 'clam-style' configuration, which may provide a number of advantages (see 6.2.5, 6.3.4, 6.3.5, 6.3.6, 6.3.7, 6.3.8 and 6.4.1 below).

6.1.7 Carrion crow and hooded crow distribution

There is sufficient information from the survey to suggest that hooded crows and/or hybrids could be more geographically widespread than the existing literature suggests. Further investigation into the distribution may be useful if the impact of trapping on conservation status is to be assessed by comparing estimated bag size against population estimates. At the least, if bag record data are collected, operators should be advised how to recognise and record hybrid phenotypes.

6.1.8 Jays

Although not an objective of this study, the fact that in over 16,000 trap days, only 18 jays were caught by a total of six trappers, suggests that jay control may not be widely practiced, at least using traps. It appears unlikely that control under the General Licence is having population level impacts, given that the UK population of jays is currently estimated at 170,000 territories (Musgrove *et al*., 2013), and the range of the jay is expanding within Scotland (Balmer *et al*., 2013). If justifiable concerns are however raised regarding the control of jays under these licences, then it may be appropriate for SNH to consider removing the jay from the General Licence, and to permit control under specific licences only, as and when required. This would presumably not create a significant administrative burden, although completing and justifying a licence application may be burdensome to individuals wishing to control this species.

6.2 Changing practices

Many trappers could probably improve both bird welfare and the effectiveness of their trapping, although these may require additional resources in terms of outlay of manpower or equipment. The potential problem with being more proscriptive in the General Licence conditions is that it reduces flexibility and any one particular way of operating traps may not be suitable for all situations at all times.

6.2.1 General changes to practice

Trap operators should regularly review those activities detrimentally affected by corvids and assess whether or not changes can be made that might reduce the problem and therefore the need for trapping. There is likely to be a cost involved in some changes, and in many cases these costs may outweigh any benefits, or be impractical. For instance, it may not be possible for hill farmers to move lambing activities to in-bye fields or to pens, and to do so might undermine the relatively low-maintenance advantages of hill sheep breeds.

6.2.2 Non-lethal options

General Licences GL1 to GL4 all state in their terms and conditions that authorised persons must "only use it where they are satisfied that appropriate non-lethal methods of control (e.g. scaring or bird proofing) are either ineffective or impracticable". Thus it is the responsibility of the person operating under the licence to ensure that they have considered non-lethal options, and tried any which might reasonably be expected to help resolve the problem provided it is practical to do so before resorting to lethal control.

Lethal techniques such as trapping should not be seen as a direct alternative to non-lethal options but as complementary to them. The 2010 survey of arable farmers found that of all those with a corvid problem, 39% used scaring alone or in combination with other lethal techniques (SASA unpublished data).

There is a wide range of non-lethal techniques available, including exclusion, visual deterrents (static and animated) and auditory deterrents, diversionary feeding and scaring by human presence. Not all methods and techniques are suitable or practical for every situation, and some people will be very aware of why certain methods are unsuitable, but others may mistakenly believe that a method won't work or is inappropriate either through hearsay or because they have witnessed them being used incorrectly or badly. It is important to realise that even when used correctly, many non-lethal scaring devices may be of limited effectiveness when used over extended periods, due to factors such as bird habituation. The fact that habituation can occur does not mean that a scaring device is completely ineffective, but it is important that devices and techniques are used in ways that minimise these problems. Similarly, diversionary feeding used over the short term may be effective, but over the long term may increase the local predator population.

6.2.3 Frequency of trap checks

Birds are most active during their first few hours in the trap, and this is likely to be the time when they may develop injuries, although the vast majority of injuries recorded in this study were minor, and even the small percentage of moderate injuries recorded would not have affected the survival of the bird had it escaped. There was little evidence from the physical condition of birds (used to indicate levels of potential stress and general welfare) that they became significantly more injured the longer they spend in traps. There was therefore little to suggest that more frequent checking of traps would resolve any serious welfare issues with regard to injuries. Nonetheless, it might be argued that reducing the time any trapped bird is left in a trap, would offer some welfare benefits to that individual bird.

Increasing the number of daily visits to a trap would reduce the maximum time a bird could spend in a trap and also increase the efficiency of some traps (especially the small, single compartment traps) as they are more quickly available to catch further birds. The more remote the trapping location, the more impractical increased visits are likely to be. Such activity would also cause additional disturbance at the trap location which may deter some wild birds and cause additional stress to any decoys. Traps capable of multiple captures might also lose the attractant effect of a previously captured bird.

The case for more frequent visits being either mandated or incorporated into best practice guidelines, needs to be considered bearing in mind that to keep trapping practical and effective, there may also be a need to maintain flexibility according to circumstances.

6.2.4 Overnight birds

In this study, all birds exhibited a decline in activity during darkness, although a few exhibited a temporary increase in activity at twilight, possibly reflecting the bird's need to find a roost site. Thus, there is no evidence of any significant welfare issue from the behaviour of birds at night. However, removing captured birds around dusk would reduce the risk of predator harassment of birds caught in baited traps, but would not resolve decoy harassment problems. Daily removal of decoys could be very stressful for some birds due to the increased handling, transportation and frequent change of housing; there is also an increased chance they will escape. Dusk removal would be a significant extra burden on manpower resources for some users, and may reduce capture efficiency because of trapping time lost in early morning. , It is also important to bear in mind the changing daylight hours at different latitudes. Dusk visits might be less practical in northern Scotland during the spring or summer, and closing the trap after the afternoon visit could have a significant impact on trap success, since birds may continue to visit the trap over any daylight period, even during the very early morning hours.

There may be scope for best practice guidelines to recommend the removal of birds at the end of each day when there is evidence to suggest an increased risk of predator activity at the trap.

6.2.5 Food and water for captured birds

There is currently no requirement to provide food and water for trapped, as opposed to decoy birds. The desirability of this provisioning will vary with environmental conditions and time in trap.

Provision of food in any of the traps should be relatively simple. If a trap has been baited, then food is already provided. If a decoy bird is in use then some trappers may choose not to use bait, although arguably, it would be relatively easy to do so, and it might even increase trap efficiency slightly. Provision of food with a moderate to high moisture content might partially negate the need to provide water in the capture compartment, but it is also likely to be more perishable, particularly in summer.

The capture compartments of Larsen traps and small, single compartment traps tend to be relatively small, and an open container of water could be obstructive to the bird or the closing mechanism. A water (dripper) dispenser of the type used for pet rabbits might be feasible, and are sometimes used by trap operators for decoy birds, but it is unknown how quickly a captured bird might take to such a device and thus if it would be of benefit. The advantage of using pet water dispensers would be the relative ease with which a clean water supply could be maintained. In this study, all decoy birds washed their food in their water supply, and within a short time, any water bowl would become dirty. This occurred despite two sources of water being provided in most traps, and three sources (including an upturned dustbin lid suitable for bathing) being provided in aviaries. It would however be difficult to provide water in a bowl or dripper bottle in most clam-style traps, where it is likely to tip over when the trap is triggered or might affect the trap closure dynamics. All of the options for the provision of water should be tested to demonstrate practicality while maintaining trap efficacy.

6.2.6 Dependent young & seasonal restrictions

This is a welfare issue that applies to corvids when any form of lethal control, including shooting, takes place. Many corvid problems are alleviated by trapping during the breeding season, particularly if trapping to protect breeding birds. Also, trap efficacy is high for several corvid species at this time of year. Therefore, restrictions during ‘breeding seasons’ may have significant damage implications for some trap users.

This issue also applies to non-target species that might be accidentally caught in traps. The implications for non-targets will vary with the species, e.g. the presence of two provisioning parents, and the weather conditions during the period of capture, which will not exceed 24 hours, and in many cases, may be far less. To lower risks of raptor/buzzard catch, a breeding season restriction of the use of meat baits may be possible, relying on decoy birds to maintain corvid trapping efficacy during this time of year. However, the presence of a decoy will continue to attract some raptors, and meat baits may be one of the few effective means of trapping a decoy bird in the first instance. Trap operators may then be forced to trap for a decoy in advance of the breeding season using meat, but retain the decoy for a longer than necessary period to permit use during the breeding season. This could have welfare implications for the many decoy birds that will be required, which may outweigh any risks to the relatively small numbers of raptor young (based on trapping rates of raptors), who may be without the presence of a parent bird for several hours.

Individual licences could be issued for a ‘close season’ but given that the majority of applicants were trapping to protect wild birds (see table 4, Reynolds, 2016), and therefore focussed on spring trapping, there could be significant resource and cost issues for licensing authorities. While there is clearly a debate to be had regarding closed seasons for pest species, it is much wider than the use of traps.

6.2.7 Fox and other predator management

One approach to minimising the risk of predator interference is to undertake predator control. In effect this probably occurs by default in many situations as gamekeepers and farmers may already be controlling predators for the same reasons as they are undertaking corvid control, or for different reasons, but at the same time. Any best practice guidelines for corvid trapping should also include ground predator control if appropriate, and guidance on how to deal with a persistent problem. Possible ways of tackling ground predators will vary with the type of trap where this problem occurs (see below).

6.3 Modifications to traps

6.3.1 Walls of Larsen and small, single compartment cage traps

Changes could be made to the construction of the Larsen and small, single compartment traps to prevent or deter mammalian predator interference (examples might be the fitting of a double skin of mesh around the trap, effectively making it a cage within a cage; or by adding a solid strip of plastic around the lower 10 cm of the trap. If such a strip were made of clear Perspex, the visual impact of any decoy would not be lost on nearby corvids, although there is potential in some circumstances for sunlight to reflect off such a surface and possibly deter some birds. Alternatively prongs or wires could be fitted to the outside of a trap). However, the effectiveness of such modifications are as yet unexplored. Such design modifications might significantly increase the cost of manufacturing traps and may do nothing to resolve the issue of predator harassment as opposed to predation. Where issues arise, various recommendations could be made in any general practice guidelines covering fox and pine marten (*Martes martes*) predation (the only mammalian predators identified in the study, although cats (*Felis catus*), badgers and other mammals may also represent a problem).

6.3.2 Raising traps

Lifting traps above ground to avoid grasping of feathers by mammals might protect against predation, although harassment may be unavoidable under every circumstance. Raising traps by over one metre, such that a fox standing on its hind legs and at full stretch, could not reach the base of the trap with its mouth, would make it harder for a fox to reach captive birds. However, the trap would require some form of solid base underneath the mesh, such as a table, to prevent a predator attacking the feet of the bird through the floor. A solid base however, would interfere with the partial self-cleaning process whereby food debris and faeces fall through the mesh. The height to which a trap could be raised may also be limited by the practicality of gaining sufficient access to the birds, their food, water and bait through the top mounted doors, and may increase the risks of escapes when servicing the traps.

Foxes can undertake standing jumps of 1.4 m and can climb chain link fences of over 2 m (Dickman, 2012), so a fox could still access the top of the trap, but would hopefully be unable to grasp a bird from this position. Nonetheless, any raised trap would have to be securely attached and stable, so it couldn’t be dislodged from the platform.

The GWCT (2015b) suggest that Larsen traps are more effective on the ground for crows but that raising a trap could be beneficial for magpies depending on the surrounding vegetation. It seems likely that the relative effectiveness of a raised Larsen trap might vary, but this option could be considered if there is an expectation of substantial fox interference, although the height would have to be considered carefully. Raising a Larsen-mate trap would pose some extra problems in attachment without compromising the mechanism. Again, the impact of any such modification is unknown, and could impact on the effectiveness and/or the ease of trap maintenance.

6.3.3 Mesh type

The most common injury found among trapped birds was bill abrasion, with 70% of captured birds having some form of abrasion mark on or around their bill. This was almost certainly caused by birds pushing their bills through the mesh repeatedly. It was not considered to be a serious welfare issue, as the injuries were mostly very minor. However, it would clearly be desirable to minimise even minor issues if it could be done easily. Abrasion scores from birds in Larsen-mate traps were noticeably lower for several species. It was felt that this was probably due to the use of a large 50 mm mesh with a smooth surface (e.g. powder-coated).

The use of the 50 mm mesh in Larsen traps and multi-catch traps might offer some small but real benefits by reducing minor abrasions and bill damage. A further benefit of using such a large mesh would be that a greater range of non-target species would be able to escape the trap. In this study blackbirds were unable to escape the Larsen and multi-catch traps through the mesh, but a blackbird and grey squirrel easily passed through the 50 mm Larsen-mate mesh. If this size of mesh was standard on all corvid traps then starlings, blackbirds, and various other members of the thrush family, which have been reported caught in traps (Tapper *et al*. 1991; Dick, 2005; Hartley *et al.,* 2016) would be able to escape along with smaller birds. Making it easier for small birds to exit a trap might also reduce the risk that any raptors will enter a trap in pursuit of them.

The disadvantages of a larger mesh include an increased risk of predators getting purchase on trapped or decoy birds. One potential counter to this would be to make one half of the capture compartment from a much smaller mesh that would help to prevent predator attack, but for the other half to be made from the larger mesh. A larger mesh might also allow birds in adjacent Larsen compartments to attack each other so this would need to be taken into account An additional advantage of the 50 mm mesh is its lower cost compared to finer mesh (contains less wire and fewer welds) and should it be significantly lighter, making any trap easier to carry.

The woven (rabbit/chicken netting) mesh used on many multi-catch traps can be bitten through by foxes, and foxes are also proficient diggers (Dickman, 2012). Therefore, foxes would be able gain access into most multi-catch traps should they choose to. While foxes were not observed attempting to gain access into the multi-catch traps used in these trials, others have found this to be a problem (Part 2 of this series).

6.3.4 Shelter improvements

The General Licences do not define what is considered to be appropriate shelter for decoy birds, and there is no current requirement to provide shelter for captured birds. The shelter provided by commercial traps and by trap operators for decoys varies significantly. It is relatively easy to incorporate useful shelter into a multi-catch cage trap. Adding shelter to the capture compartment of a Larsen and the non-clam style small, single compartment traps might be possible but may impact on the effectiveness of the trap. Shelter provision in a clam-type, single compartment trap could prove more problematical. Evidence from part 2 of this series of reports suggested that trap success was high for most target species (except hooded crows) when traps were placed under cover, e.g. from trees or shrubs; such positioning could aid shelter depending upon the prevailing weather, and may be required to provide shelter for Larsen-mates.

The horizontal metal plate that was part of the shelter provided for the decoy bird on the commercial Larsen traps used in part 3 of this study, was adequate for mild to moderate weather conditions, but additional shelter was often provided temporarily when it was both windy and raining heavily. Due to its position at one end of the Larsen trap, the integral shelter plate also offered shade from the sun at only a restricted range of angles; this could also have welfare issues associated with it.

The General Licence states that (decoy birds) "must have adequate protection from the prevailing wind and rain", which suggests that side protection as well as roof protection, may sometimes be necessary. Accommodating all wind directions might significantly increase the size of the trap, or would require trappers to exercise judgement under changeable and extreme weather conditions. The placement of traps into an environment that offers partial protection, such as close to man-made or natural cover, may help in this respect.

6.3.5 Perches for trapped birds

As with shelter, it is relatively easy to incorporate perches into multi-catch traps, and two high perches set apart (e.g. sticks fed through the corner sections of the trap) might allow a bird to escape the attention of a pine marten. However perches placed in the wrong place may facilitate escape from the trap. In the majority of conventionally constructed Larsen traps or non-clam style small, single compartment traps, there is little room for a perch. A redesigned trap with a larger capture compartment could incorporate a perch, although the benefits may be slight. A perch within a clam-type, single compartment trap is impractical.

However it was noticed that roosting birds in the capture compartments often sat on the split perch that had fallen onto the floor of the trap when the door closed rather than on the mesh floor itself. This suggests that there may be no need to provide a specific perch, and a raised ridge or wooden baton of appropriate dimensions attached to the floor, may be an acceptable substitute for the short period of time a bird will be captive.

6.3.6 Larger capture compartment

The size of the capture compartment has been raised as a potential welfare concern in that the bird hasn't much room to move. The Wildlife and Countryside Act 1981 (WCA), section 8(1) states: "*If any person keeps or confines any bird whatever in any cage or other receptacle which is not sufficient in height, length or breadth to permit the bird to stretch its wings freely, he shall be guilty of an offence*". The General Licence creates an exception from this rule for the purposes of trapping. Confining a bird to a small compartment is not necessarily a welfare issue in itself, but clearly there are situations where it could be, particularly if it is for a prolonged period. However the WCA itself allows some exceptions including:

"(a) while that bird is in the course of conveyance, by whatever means;
(2)(b) while that bird is being shown for the purposes of any public exhibition or competition if the time during which the bird is kept or confined for those purposes does not in the aggregate exceed 72 hours"

Compared to prolonged transportation and or 72 hours on public display, a period of <24hrs in a small corvid trap could in many circumstances be less stressful. Nevertheless, many people would probably prefer to see more spacious capture compartments, and enlarging the compartment may also allow food, water and shelter to be added to the capture compartment with less potential impact.

There is however little evidence that a larger capture compartment for either Larsen or small, single compartment traps would bring significant benefits to welfare. In terms of injuries, there was no convincing evidence from the findings of part 3 of this series to suggest bird welfare was significantly compromised by the 'small' size of compartments. Furthermore, it is conceivable that the small restrictive space in these traps could prevent some birds from getting too energetic in trying to escape and subsequently becoming injured, although at the other extreme, there was no evidence of this from birds caught in multi-capture traps.

In clam-type, single compartment traps, a larger capture compartment (i.e. a larger trap) may require stronger springs to be used; the trap may be heavier and have greater travel, which may induce welfare issues if a trapped bird becomes entangled between the trap jaws. Increasing the size of Larsen and Larsen-mate traps might also significantly reduce their portability.

6.3.7 Spring strength

Birds can occasionally become entangled in the mechanism of clam-type, single compartment traps. The commercial traps tested did have some problems but none were serious. Although one jackdaw was trapped by the neck for four minutes, it freed itself, but there is a possibility that it may not have done so if the springs had been significantly stronger. One crow that forced its way out of a Larsen-mate was also held by the neck for a period of time. Spring strength is likely to be important in determining whether such entanglement becomes a significant welfare issue. There is no regulation of spring power or the way the springs are positioned on the traps which leaves scope for people to modify or 'over engineer' traps with excessively powerful springs. However regulating spring strength could be complex, requiring the testing and possible approval of each trap model. Having spring position marked clearly on commercial traps may help to prevent users inadvertently repositioning the springs and affecting spring strength.

6.3.8 Stops on jaws of clam-style, single compartment traps

The General Licence currently requires that Larsen-mate traps "…. *must not shut tightly along the majority of the length of the meeting edge*", but how this is done is not specified. In the two commercial traps tested, this was achieved using stops (figure 8). Given potential issues with entanglement and spring strength, the use of these stops could be made mandatory. There is scope to specify a minimum gap that could be controlled using stops. Doing this could reduce the potential for strong springs to cause problems. Ideally the stop should be part of the trap structure so that it cannot become detached, although, as figure 8 shows, there are ways in which a stop can be retro-fitted to an existing trap.

Figure 8. Detail of 'stops' fitted to Larsen-mate traps to prevent full closure, one is part of the trap structure; the other is retrofitted.

6.3.9 Remote notification of trap closure (Larsen & small, single compartment traps)

The use of a trap alarm system activated when the trap is sprung, offers the possibility of benefits similar to that of increased trap checking frequency. Such devices can alert a trap user by mobile phone or e-mail that a trap has been triggered. The advantage of this sort of system is that a trapper can quickly visit a trap once it has been triggered, thus minimising the length of time any caught bird spends in the trap. However it also means that the trapper doesn't have to make frequent wasted visits to an empty trap in order to achieve it. Provided the system is failsafe, then it might be justified to allow longer periods between visits to baited traps, but would still require daily visits to those with decoy birds. These devices would be suitable for Larsen traps and possibly Larsen-mates. An additional advantage of a fast response to a catch is that traps would be reset quicker and therefore be operating longer, and would potentially reduce the risk of a predator or a member of the public interfering with a bird.

Devices are relatively expensive (around £200 per unit for one system) but if more frequent trap checks were otherwise mandatory then devices would quickly pay for themselves in saved time and increased trap efficiency. One disadvantage would be the cost of vandalism or theft, (although the chance of catching vandals might increase if they trigger the trap). Arguably, using such a device might offer significant benefits in terms of both welfare of captured birds and efficiency of trapping.

6.3.10 Separate decoy compartment for multi-catch traps

Aggressive interaction between birds in multi-catch traps was occasionally seen in part 3 of this study, with both magpies and jackdaws. These did not seem particularly severe or prolonged, but they indicate that there is potential for welfare issues. During the breeding season, territorial birds may enter a trap containing a decoy bird specifically to drive the strange (decoy) bird away from their territory, and in these circumstances, an attack on the decoy bird may seem likely. In a Larsen trap, the two are separated so there is a much lower chance of injury. It was however found that a majority of crows, and especially magpies showed only mild interest in the decoy bird or no interest at all just prior to entering the Larsen trap. Around 20% of crows showed mild aggression to the decoy bird and a further 20% strong aggression, although this may reflect the proportions of territorial birds that we caught compared with itinerant non-breeders. Less than 10% of magpies showed obvious aggression (mild or strong). There were no instances of crow decoy birds in multi-catch traps, and so have no information on how these birds might interact with a decoy bird.

Nonetheless, there may be a case for having a separate decoy bird compartment in larger multi-catch traps, particularly during the spring when birds may be strongly territorial. The GWCT (2015b) guidance suggests that multi-catch traps are better suited to winter trapping, and while a majority of trappers may operate them this way (perhaps using Larsen traps in Spring, because they can be readily moved around territories), it is still likely that some multi-catch traps will be used to catch a few territorial crows and magpies. Providing a separate compartment for a decoy bird would be relatively straightforward in most multi-catch traps. It may also offer better protection for the decoy from predators, and prevent it from escaping.

6.3.11 Decoy compartment position

Certain trap designs or layouts have historically been used to catch raptors. A common format for such 'hawk traps' is to have a (large) capture compartment located above another (smaller) decoy compartment. Currently many of these types of trap are encompassed by the General Licence definition of a Larsen trap. Explicitly prohibiting traps with one or more capture compartments located directly *above* the decoy compartment would prevent traditional styles of 'hawk trap' being deliberately exploited by people who may wish to catch raptors under the cover of the General Licence. It is unlikely to have any significant impact on the vast majority of legitimate Larsen trap users.

6.4 Trap effectiveness

Some of the changes that could potentially be made for welfare purposes could also influence the effectiveness of traps, either positively or negatively. It is important to bear in mind that damage mitigation can be achieved in some circumstances by removal of large numbers of problem corvids, e.g. where crop damage is taking place by flocks of birds. However, in other circumstances, removal of just a small number of birds, e.g. a few pairs of territorial corvids that attack livestock or raid birds' nests, might also achieve the desired level of mitigation. Therefore trap effectiveness should not be judged solely by the capability of the trap to catch large numbers of target species.

6.4.1 Escapes

Both Larsen-mate and multi-catch traps suffered problems with birds escaping, sometimes with significant impacts on trap efficacy where territorial birds became trap shy, but excluded access to the traps by other corvids. The use of stronger springs, latches and larger/heavier Larsen-mate traps might reduce escapes, but are likely to have negative welfare impacts.

Small entrances on multi-catch traps would almost certainly reduce the likelihood of escapes but may not prevent it altogether, particularly where smaller corvids can escape through an aperture designed to encourage the larger corvids to enter. Additional anti-escape barriers such as hanging rods (Rowley, 1968) or wires suspended from the 'ladder' might also help to reduce escapes. The GWCT (2015a) guidance on multi-catch traps mentions hanging wires and a 1m long curtain of rabbit netting as alternatives. This study did not compare different types of multi-catch trap (e.g. ladder vs. funnel) so it remains unknown if a different design might be more effective at preventing escape.

Increasing the frequency of trap checks might also reduce escapes, although in part 3 of this study the average escape time was 1hr 32min and all escapees were out by 4hrs and 20mins, suggesting that birds likely to escape do so relatively quickly, and therefore unless visits to check traps are very frequent, there may be only minor gains to be had.. Smaller entrance sizes might also deter raptors from entering, either to reduce by-catch but also to prevent harassment of trapped/decoy birds.

6.4.2 Baits & decoys

Data arising from this study supports the use of decoy birds as an effective and relatively species specific method to target the capture of certain corvid species, especially during the breeding season for territorial birds such as the crow species and magpies. Furthermore, the use of decoys was more effective for magpies and hooded crows at any time of the year. However, there was also evidence to suggest that baits alone may be more effective as an attractant than decoy species at different times of the year, in particular during the summer for carrion crows and rooks, although where multiple captures occur (multi-catch and Larsen traps), the influence of first caught birds acting as decoys, should not be dismissed.

There was some evidence, albeit from a small number of birds, to suggest that meat baits are particularly attractive to buzzards, although occasionally, buzzards might also enter traps when a decoy bird is present. However, further research is almost certainly required before removing the use of meat baits from the General Licences altogether in favour of decoys or alternative bait types bearing in mind the following. Attractiveness of the target species to the bait type and how this may vary with time of year and habitat (moorland corvids, who rely on carrion at certain times of year, may not enter traps in search of grain); ease of bait availability by different trap users; longevity under different environmental conditions; the degree to which a bait type fulfils the dietary requirements of target decoy species; possible side effects of certain baits such as high water intake in captured species; attractiveness of the bait to non-target species such as rodents and small passerines which have the ability to not only rapidly remove bait from a trap altogether, but whose local populations may be supported at an undesirable level by the use of certain baits; and ease with which certain bait types can be presented to the target species without risk of significant take by non-target species.

Furthermore, evidence of repeated captures of buzzards (part 2 and 3 of this series of reports) suggests that raptors are not necessarily deterred or harmed by the capture process in these traps. Trap rates of raptors may not decline significantly while decoy birds continue to be used. While deterring raptors from these traps is desirable, a reduction in trapping rates may perhaps be achieved by other means, such as reducing the door sizes. It is unlikely that raptors catches can be prevented altogether from these traps.

6.4.3 Trap type

The small, single compartment cage traps have the potential to be efficacious for trapping target bird species, although the small sample size on which this is based means that further investigation is desirable. Nonetheless, their simplicity and size offers a certain amount of flexibility to trap operators that may be difficult to achieve with Larsen traps and certainly with the multi-catch traps, and could continue to be used on the General Licences.

Larsen and multi-catch traps both offer different trapping capabilities; they can potentially catch much higher numbers of target bird species than the small, single compartment traps, and may be used in very different circumstances to target both territorial and/or flocking target species. The potential catch rates and adaptability of both these trap types makes them particularly valuable as corvid traps.

6.4.4 Distance from cover

For the majority of target species, trap efficacy was high when traps were set either under cover or within 10 metres of cover (cover was defined as any natural feature, including trees, shrubs or bushes). However, concerns have been raised regarding the abuse of corvid traps, used to target woodland raptors, when placed within woodland (RSPB, 2015). Unfortunately part 2 of this study did not ask trap operators how far into cover the traps were set, although the evidence suggests that at least for carrion crows, setting traps close to cover was at least as effective and trapping within cover. Any restrictions on where traps may be set in relation to cover (or woodland), would need to consider both of these issues.

6.5 Summary statement

This series of reports has examined the nature and use of corvid cage traps in Scotland, using surveys of practitioners and closely monitored field trials. The results go some way to reassure authorities that corvid trapping practices generally satisfy General Licence intentions, permitting the reasonable control of corvid birds without serious conservation or animal welfare issues. While the research has highlighted some concerns, for instance, welfare issues associated with predation of trapped or decoy birds, it has equally provided reassurance regarding other concerns, such as the frequency of non-target captures and the risk of serious injury to both target and non-target birds caught. The issues requiring immediate attention include the need to maintain and update the trap register and to raise awareness of the General Licences amongst both practitioners and the public. Also the need to produce an industry and government approved Code of Practice or guidance, which could bring about improvements and consistency to general practice, including approaches to tackling predator issues if and when they arise.

The options provided above will hopefully form a basis to discuss the need for any change to the regulatory framework, including specifically the General Licence, and ways in which corvid trapping practises may be developed and improved. A summary of the issues that have been identified in these reports, and recommendations for their implementation, including priority and approach, is provided in Annex 1.

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ANNEX 1: SUMMARY OF OPTIONS AND RECOMMENDATIONS

Section in report	Action (issue)	Recommended approach where action required: Amend General Licences	Code of Practice	Guidance, education, publicity	Further information required
	General Licences, registration & data collection				
6.1.1	Update & maintain trap register (fit for purpose; permit communication with all trap users if required)	Y	Y	Y	
6.1.2	Address lack of awareness by practitioners & public (prevent accidental illegal activity; reduce vandalism)		Y	Y	
6.1.4	Publish industry & government approved best practice guidelines (help resolve 6.1.2 above)		Y	Y	
6.1.6	Allow other versions of small, single compartment cage traps (reduce risk of inadvertant illegal use)	Y			
6.1.3	Consider revisions to layout of the General Licences to ease interpretation (reduce risk of inadvertant illegal activity)	Y			
6.1.5	Increase requirements for data & returns (increase knowledge of widescale population impacts)	(Y)	(Y)	(Y)	Y
6.1.7	Investigate distribution of carrion crows, hooded crows and hybrids (appropriate guidance important if conditions vary by species)			(Y)	Y
6.1.8	Assess suitability of General Licences for jays given low capture rates (important only if evidence of jay population in decline)	(Y)			Y
	Changing practices				
6.2.7	Produce guidance on management of predator issues (increase welfare; also see below)		Y	Y	Y
6.2.2	Clarify requirement that non-lethal options are considered & list options (enhance welfare & efficacy)		Y	Y	
6.2.3	Encourage more frequent checking of traps where practicable (enhance welfare & efficacy)		Y	Y	
6.2.1	Encourage trap operators to review their practices to look for improvements (enhance welfare & efficacy)		Y	Y	
6.2.4	Consider advice to remove decoy birds overnight where mammalian predators are a concern (enhance welfare)		Y	Y	
6.2.5	Consider feasibility of providing food & water for captured birds (enhance welfare; consideration in context to 6.2.3?)		Y	Y	
6.2.6	Seasonal restrictions due to dependent young (enhance welfare: **MUST be considered in wider pest management context)**	(Y)	(Y)	(Y)	Y

Highest priority	Low priority
High priority	Lowest priority
Medium priority	

Section in report	Action (issue)	Recommended approach where action required: Amend General Licences	Code of Practice	Guidance, education, publicity	Further information required
	Modifications to traps				
6.3.3	Changes to mesh type (reduce minor injury risk; reduce some by-catch; may increase or reduce predator issues) (also see 6.2.7)		Y	Y	
6.3.4	Requirements for improvements to shelter (enhance welfare; has potential to reduce efficacy)		Y	Y	
6.3.8	Minimum size of gap on closure between jaws of clam-style traps (increase welfare where low risk of entanglement)	Y	Y	Y	
6.3.9	Explore wider use of fail-safe electronic trap closure notification systems (potential for significant increase in welfare & efficacy)		(Y)	(Y)	Y
6.3.1	Strengthen sides of Larsen and small, single compartment cage traps to prevent access by predators (welfare benefits; see 6.2.7)		(Y)	(Y)	Y
6.3.2	Raising small traps off ground to deter predators (welfare benefits; see 6.2.7; has potential to reduce efficacy for some species)		(Y)	(Y)	Y
6.3.5	Amend requirements for perches for trapped birds (minor welfare benefits)		Y	Y	
6.3.10	Consider separate decoy compartment for multi-catch traps (possible welfare benefits)		Y	Y	
6.3.6	Requirements for larger capture compartment on small, single compartment traps (arguable welfare benefits, but reduces utility)			(Y)	Y
6.3.7	Specify maximum spring strength on traps using springs, if feasible (welfare benefits, but efficacy may be reduced)			(Y)	Y
6.3.11	Prohibit 'raptor-type' traps with decoy compartment directly beneath capture compartment (possibly reduce illegal activity)	Y			
	Trap effectiveness				
6.4.2	Consider restrictions on use of certain bait types & decoys (lower risk of raptor catch but lower efficacy; variable impacts for decoys)		(Y)	(Y)	Y
6.4.1	Increase adaptations to multicapture traps to deter escapes from traps (significantly increase efficacy; may reduce raptor by-catch)			(Y)	Y
6.4.4	Consider need for restrictions on placing traps in cover (reduce abuse risks but may lower trap efficacy)		(Y)	(Y)	Y
6.4.3	Encourage appropriate use of all trap types (increase efficacy)			Y	

Highest priority	Low priority
High priority	Lowest priority
Medium priority	

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