

Review of the evidence base for inclusion of avian species on General Licences GL34, GL35 and GL36 in England: consideration of the manuscript '*Predator management on UK grouse moors predicts breeding success of Curlew, a globally near-threatened wader*' and preliminary findings of this study '*Paper 9. Curlew breeding success in relation to grouse moor proximity: estimating abundance, hatching success and fledging success using behavioural data*'

Summary

- APHA report '*Review of the evidence base for inclusion of avian species on General Licences GL34, GL35 and GL36 in England*' evaluated thirteen avian species in respect to the strength of evidence of scientific literature for their inclusion under General Licences GL34-GL36 in England, which allow certain species to be killed or taken for various purposes.
- With the recent provision of two documents: (i) '*Predator management on UK grouse moors predicts breeding success of Curlew, a globally near-threatened wader*'; (ii) the preliminary findings from the first two years of this three year study '*Paper 9. Curlew breeding success in relation to grouse moor proximity: estimating abundance, hatching success and fledging success using behavioural data*', the review was re-visited to ascertain whether inclusion of these documents had any effect on the conclusions pertaining to jackdaw and rook and conservation licence GL34.
- As the data presented in '*Paper 9*' is a sub-set of the full dataset reported in '*Predator management...*', in respect to inclusion in the APHA review, evaluation is confined to the latter report with its complete dataset and associated findings.
- As a stand-alone document, the manuscript ('*Predator management...*') reporting the findings of the overall three-year study, provides evidence that curlew and lapwing productivity was significantly higher on grouse moors (predator control) than on non-grouse moors (no predator control).
- The study reports the association between wader breeding success and a *suite of predators* and does not differentiate the relative effect of individual predator species. High predator effects, therefore, cannot be solely attributed to any individual species, including jackdaw and rook.
- However, the study does highlight that curlew hatching and fledging rates were negatively correlated with a combined index of corvids and fox abundance, which were three to four-fold fewer on grouse moors. Both documents indicate that of the corvids, carrion crow is the principal avian predator species associated with difference in wader breeding success.
- Following the methodology of the APHA review, the individual manuscript study was evaluated for the *size of impact* and the *scientific rigour* – scoring 2 (high impact) and 1 (medium scientific rigour) respectively.
- These scores were added to those of the total body of scientific evidence for the purpose of the conservation of wild birds, to ascertain whether the overall strength of evidence for that species-purpose was affected.
- In the case of jackdaw and the conservation of *all wild birds*, there was no change in the overall strength of evidence – remaining medium-low.
- In the case of jackdaw and the conservation of *red-listed wild birds*, the overall strength of evidence changed from low-medium to medium.
- In the case of rook and the conservation of *all wild birds*, there was no change in the overall strength of evidence – remaining low-medium.

- In the case of rook and the conservation of *red-listed wild birds*, the overall strength of evidence changed from medium to high-medium.
- Due to small sample sizes, however, there is a high degree of uncertainty associated with the revised (and original) strength of evidence for red-listed birds.
- Further, for both jackdaw and rook the majority of interactions with red-listed species involve studies in which the effect of different predators (including fox) are not separated (i.e. a confounding factor) and so, as in the case of the manuscript study in itself, the strength of evidence for an effect specifically of jackdaw and rook on the conservation status of red-listed birds is uncertain.
- As emphasised in the APHA review: *'It is important to note that confounding factors have not contributed in the synthesis of strength of evidence scores, but should be borne in mind when applying the scores to decision-making'*.

Background

Defra have provided APHA with an unpublished non peer-reviewed manuscript from a third party entitled *'Predator management on UK grouse moors predicts breeding success of Curlew, a globally near-threatened wader'* (authors unknown). A further document reporting the preliminary findings from the first two years of this study was also provided *'Paper 9. Curlew breeding success in relation to grouse moor proximity: estimating abundance, hatching success and fledging success using behavioural data'*. The manuscript was not included in the APHA *'Review of the evidence base for inclusion of avian species on General Licences GL34, GL35 and GL36 in England'*. Defra wish to understand whether the manuscript provides evidence to support the inclusion of jackdaw and rook on General Licence GL34, in respect to the conservation of wild birds, sufficient to alter the conclusions of that review.

The manuscript is evaluated in two ways: (i) does the manuscript itself provide strong evidence for an effect of jackdaw and rook on the conservation status of wild birds? (ii) does adding the manuscript to the database of scientific documents used in the APHA *'Review of the evidence base for inclusion of avian species on General Licences GL34, GL35 and GL36 in England'* affect the conclusions of that review in respect to the overall strength of evidence for an effect of jackdaw and rook on the conservation status of wild birds?

Evaluation

Paper 9. Curlew breeding success in relation to grouse moor proximity: estimating abundance, hatching success and fledging success using behavioural data'

The document reports preliminary findings from the first two years (2016-17) of the three year study (2016-18) reported in *'Predator management on UK grouse moors predicts breeding success of Curlew, a globally near-threatened wader'*. The data presented in *'Paper 9'* is, therefore, a sub-set of the full dataset reported in *'Predator management...'*. In respect to the APHA review, therefore, evaluation of the study is confined the latter report with its complete dataset and associated findings.

However, in respect to *'Paper 9'* and the first two years of the study, some of the findings are of particular note. In respect to wader breeding success and predator abundance, the paper

states ‘... *Carrion crow and overall corvid abundance were highly positively inter-correlated..., but...crow, as opposed to corvids, was the more important negative predictor of both the proportion of curlew pairs perceived to have hatched and the proportion thought to subsequently fledge chicks...*’. That is, of the overall suite of predators present in the study sites, carrion crow was highlighted as the key species; reiterated in the final study report (see below).

‘Predator management on UK grouse moors predicts breeding success of Curlew, a globally near-threatened wader’

The paper compares the breeding success of curlews (and other waders) within 18 blocks of moorland-farmland habitat across several UK upland regions; each block comprised one site with gamekeeper control of predators (managed for red grouse) and one site without predator control.

The list of predators encompassed corvids (rook, jackdaw, carrion crow, raven), gulls (black-headed, common, lesser black-backed and herring), raptors (buzzard, kestrel, hen harrier) and fox. A mean density was derived for carrion crow, and for all corvids, gulls and raptors.

Curlew productivity was five-fold higher on grouse moors (predator control) than on non-grouse moors (no predator control). Curlew breeding success (hatching and fledging success) was negatively correlated with a combined index of corvids and fox abundance, which were three to four-fold fewer on grouse moors. The paper states “*Grouse moors had four-fold fewer carrion crows, half as many corvids and a three-fold lower fox scat index as non-grouse moor, but similar gull and raptor indices*”, thus implying the curlew productivity may be more closely associated with crow and fox numbers than with other corvids, gulls or raptors.

However, the paper does not attempt to evaluate the relative effects of individual predator species. The paper itself states “... *both corvids and foxes were controlled by gamekeepers so we cannot readily disentangle the relative impact of crows and foxes...*”, again implying that the principal predator species associated with difference in breeding success are more likely crow and fox.

Essentially, the study provides evidence that curlew breeding success is associated with the abundance of a *suite of predators* but does not provide evidence on the relative effects of avian and mammal predation; or the relative effects of individual corvid species, including jackdaw and rook. Indeed, rook and jackdaw are only mentioned in the paper once each, as species in the overall list of predators.

Review of the evidence base for inclusion of avian species on General Licences GL34, GL35 and GL36 in England

Following the methodology of the APHA review, the individual manuscript study was evaluated for the *size of impact* and the *scientific rigour* – scoring 2 (high impact) and 1 (medium scientific rigour) respectively.

These scores were added to those of the total body of scientific evidence, in the APHA review, for the purpose of the conservation of wild birds, to ascertain whether the overall strength of evidence for that species-purpose was affected in respect to jackdaw and rook. See APHA review for full methodological details.

Jackdaw

All wild birds (n=22)

Size of Impact	2	0.0	4.6	4.6
	1	4.6	40.8	9.1
	0	0.0	31.7	4.6
		0	1	2
Scientific Rigour				

18.3% of studies were of medium to high scientific rigour and presented medium to high impact.
36.3% of studies were of medium to high scientific rigour and presented nil/low impact.

*Overall, there is **medium-low** strength of evidence for an impact of jackdaw on the **conservation of wild birds*** (no change in overall strength of evidence from review).*

*75% of the interactions (n=4) with high strength of evidence (green cells) had confounding factors – principally the effects of different predator species were not separated (2 interactions) (this includes the manuscript in question). That is, 50% of the interactions with the strongest evidence relate to an effect of a suite of predators and not to jackdaw *per se*. One study (25%) used artificial nests which are not representative of real nests and, therefore, cannot be used to infer natural predation rates.

Red-listed species (n=10)

The document provides an additional two predator-prey interactions for red-listed species – curlew and lapwing; each scoring 2 for size of impact and 1 for scientific rigour, providing a revised impact-rigour matrix:

Size of Impact	2	0.0	20.0	10.0
	1	0.0	20.0	10.0
	0	0.0	20.0	20.0
		0	1	2
Scientific Rigour				

40.0 % interactions were of medium to high scientific rigour and presented medium to high impact.
40.0% interactions were of medium to high scientific rigour and presented nil/low impact.

*Overall, there is **medium** strength of evidence for an impact of jackdaw on the **conservation of red-listed wild birds*** (previously low-medium in the review).*

*75% interactions (n=4) with high strength of evidence (green cells) had confounding factors - the effects of different predator species were not separated (this includes the manuscript in

question). That is, 75% of the interactions with the strongest evidence relate to an effect of a suite of predators and not to jackdaw *per se*.

In contrast, 50% (n=4) of the interactions with low strength of evidence for an impact (i.e. strong evidence of nil/low impact) (red cells) involved studies with camera-monitored nests (lapwing and black-tailed godwit) that allowed identification of predators to species.

Rook

All birds (n=17)

Size of Impact	2	0.0	11.8	5.9
	1	0.0	23.5	0.0
	0	5.9	52.9	0.0
		0	1	2
Scientific Rigour				

17.7% of studies were of medium-high scientific rigour and presented high impact.
52.9% of studies were of medium scientific rigour and presented nil/low impact.

*Overall, there is **low-medium** strength of evidence for an impact of rook on the **conservation of wild birds*** (no change in overall strength of evidence from review).*

*66.6% interactions (n=3) with high strength of evidence (green cells) had confounding factors - the effects of different predator species were not separated (this includes the manuscript in question). That is, 66.6% of the interactions with the strongest evidence relate to an effect of a suite of predators and not to rook *per se*.

Red-listed species (n=7)

The document provides an additional two predator-prey interactions for red-listed species – curlew and lapwing; each scoring 2 for size of impact and 1 for scientific rigour, providing a revised impact-rigour matrix:

Size of Impact	2	0.0	28.6	14.3
	1	0.0	28.6	0.0
	0	14.3	14.3	0.0
		0	1	2
Scientific Rigour				

42.9% interactions were of medium to high scientific rigour and presented high impact.
14.3% interactions were of medium scientific rigour and presented nil/low impact.

*Overall, there is **high-medium**-strength of evidence for an impact of rook on the **conservation of red-listed wild birds*** (previously medium in the review).*

*All three interactions with high strength of evidence (green cells) had confounding factors - the effects of different predator species were not separated (this includes the manuscript in question). That is, 100% of the interactions with the strongest evidence relate to an effect of a suite of predators and not to rook *per se*.

Overview

The manuscript '*Predator management on UK grouse moors predicts breeding success of Curlew, a globally near-threatened wader*' provides evidence that curlew and lapwing breeding success on UK upland moorland-farmland was higher on sites where corvid and fox abundance was lower, through predator control. The study, however, does not differentiate between the relative effects of different predators, either between corvid and fox, or between individual corvid species, including jackdaw and rook. Therefore, the relative contribution of jackdaw and rook to the higher breeding success of curlew and lapwing observed on moorland-farmland blocks on which predators were controlled is unknown. Indeed, the manuscript and its preliminary findings ('*Paper 9*') indicate that of the corvids, carrion crow is the principal avian predator species associated with difference in wader breeding success.


When adding the study to the overall database of studies used in the APHA review, the overall strength of evidence for a conservation effect on *all wild birds* remains unchanged.

When considering interactions for *red-listed birds*, the strength of evidence score increases for both jackdaw and rook. It is stressed, however, that these revised scores (and indeed the original scores) have a high degree of uncertainty in respect to any effect that can be specifically attributed to jackdaw and rook. For both species the majority of interactions with red-listed species involve studies in which the effect of different predators (including fox) are not separated and so, as in the case of the manuscript study in itself the strength of evidence for an effect of jackdaw and rook on the conservation status of red-listed birds is uncertain.

Another source of uncertainty in the case of red-listed birds is the much reduced sample sizes (relative to the all wild birds analysis), therefore, a single interaction can have a disproportionate effect on the distribution of scores in the matrix and hence overall strength of evidence. This is also the case for all species-purpose interactions in the APHA review with similarly small sample sizes.

The confounding factor of non-differentiation between different predator species is a consistent theme amongst the scientific papers used in the APHA review. Predator removal studies, for example, generally measure the effect of a higher level group, such as 'corvids' or 'predators' (includes mammals) and do not differentiate the relative effects of individual predator species (e.g. carrion crow or magpie). *High predator effects in such studies cannot, therefore, be solely attributed to one individual species.*

The APHA review emphasises '*It is important to note that confounding factors have not contributed in the synthesis of strength of evidence scores, but should be borne in mind when applying the scores to decision-making*'.


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