2022

Forest of Bowland - Gull Proof Feeder Trial

Supported by funding from the Forest of Bowland AONB's FiPL Fund



Photo: Daniel Bland/RSPB

Summary

This report has been generated from a trial study undertaken by the RSPB in direct response to local concerns around large gull impacts on sheep farming in the Forest of Bowland.

Clearly, as a nature conservation organisation the RSPB wants to find nature friendly solutions, but equally we can only work in Bowland with the farmers and landowners who want to work with us, therefore, we have sought to find a farming solution to assist in dealing with these issues.

In Spring 2022 the RSPB undertook a project to assess the benefits (or otherwise) of the Advantage Feeders AF500 model (AF500) stock feeder which was described by its retailer as 'bird proof'. The aim was to see whether this would deter large gulls from coming into in-bye pasture to feed on supplementary food provided to sheep, thereby reducing the impact on farm finances through a saving on feed costs and a potential reduction in direct impacts on sheep through the transmission of harmful bacteria which may be associated with gull faeces.

Across 8 trial farms in 2 areas of Bowland we saw a clear difference in gull numbers between the trial and control fields when the feeder was in use, with fewer gulls in the field containing the bird-proof feeder on 6 of the 8 farms (the other 2 farms appeared not to be experiencing gull issues). Although this element of the trial appeared to be a success, we were not able to show the financial benefits of this system, which we hope to establish in the future.

Acknowledgements

The Project was funded through a Farming in Protected Landscapes (FiPL) grant from the Forest of Bowland AONB. We would like to thank the AONB Team for their support, help and advice.

Our survey work was largely undertaken by volunteers led by Daniel Bland, without whom we could not have undertaken this study.

The feeders were supplied by Robert Ball of Farmline Machinery Limited, the UK suppliers, who undertook the training of local farmers in operation of the units. Finally, we would like to thank those farmers who allowed us to conduct the study within their fields, who adopted a new way of feeding sheep at a critical time in their annual calendar.

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Introduction

Many local farmers in the Forest of Bowland have raised concerns that large gulls, particularly Lesser Black-backed Gulls (*Larus fuscus graellsii*) are more increasingly using the in-bye to feed. This is most commonly by feeding on sheep feed, but there are also reports of them predating lambs, both of which impact the farmers financially.

These farmers have also raised the issue of predation of wader nests and chicks by 'gulls' this group (in Bowland) encompasses, European Herring Gull (*Larus argentatus*), Greater Black-backed Gull *(Larus marinus)* and Lesser Black-backed Gull (herein called LB, when referring to this species individually). The easy supply of high-protein food (sheep nuts/ewe rolls) put out by farmers at lambing time coincides with the wader breeding season and may thus put their nests and chicks at risk of higher levels of predation by gulls.

LB are Amber Listed within the Birds of Conservation Concern – Fifth Edition (BoCC5 - Stanbury et al., **2021**) report due to a 48% decline of the breeding population in the UK. The Forest of Bowland holds what may be the world's largest breeding colony of this species (actually, several nesting areas in one supercolony), which when last surveyed by Natural England in 2018 held 14,627 AON (Apparently Occupied Nests) which is of international importance and was therefore included as a Proposed Special Protection Area (pSPA) feature within the Bowland Fells SPA revision undertaken by Natural England.

Therefore, dealing with the perceived conflict between these gulls and several other species of conservation concern, including Eurasian Curlew (*Numenius arquata*), Northern Lapwing (*Vanellus vanellus*), Common Redshank (*Tringa totanus*), Eurasian Oystercatcher (*Haematopus ostralegus*), and Common Snipe (*Gallinago gallinago*), is a difficult one that requires creative thinking, and we believe, the trialling of new methods of land/stock management.

The Forest of Bowland AONB holds important numbers of these waders. Although local populations of these species appear to be relatively stable, there is widespread concern that their breeding productivity, which is still widely under-recorded, is limited by multiple factors including intensification of agriculture, loss of suitable feeding and nesting habitat, and predation.

Locally, the RSPB team in Bowland is focussed on looking for proactive solutions that address these issues. This may be seen as an active step towards *an effective strategy for management of large gull 'supercolony' in Bowland* (Lock et al., **2022**).

With funding from a Bowland AONB Farming in Protected Landscapes (FiPL) grant, we sought to research the effect of feeding sheep in a conventional way (e.g., with snackers or ordinary feeders) compared to a feeder that is 'gull proof' according to its retailer. These feeders were trialled during the 2022 lambing season on farms in two areas of Bowland, Bleasdale and Roeburndale, which have reported high levels of both gull predation of wader chicks and gulls feeding on sheep feed.

We set out to answer these questions:

1. Do the feeders work in restricting food availability to gulls?

2. Do gull numbers and behaviour differ in the fields with the AF500 compared to conventional methods?

3. Are the feeders cost effective for the participating farmer (i.e., do the feeders provide a financial benefit to the farmer in terms of less feed being lost to foraging gulls, less food used and better-quality lambs for sale)?

4. What are farmers opinions on using the feeders/ are the feeders practical for farmers to use?

Background

Feeding sheep in the uplands

Typically, during the winter and spring months (December – May) most farmers within the uplands will provide supplementary feed to their livestock. In the context of the trial areas, these stock are predominantly sheep.

In general, the main reason for supplementary feeding is a lack of natural forage available to support their sheep. What forage is available is in a declining nutritional plane. Without supplementary feed, sheep will lose body condition, which may potentially be detrimental to their health, particularly to pregnant ewes. As nutritional demand increases during pregnancy, lambing and lactation (April-May), availability of natural forage is typically at its least, being outside of the growing season, thus the need for and amount of supplementary feed increases.

In addition to feeding ewes, some farmers will utilise supplementary feed to wean and fatten lambs in preparation for market (Figure 1). One method of doing this is to use a creep feeder, which allows lambs to access the feed but prevents ewes from accessing it by means of a fence or gate.



Figure 1: Typical example of supplementary feed in the form of 6mm diameter pellets. ©Daniel Bland/RSPB

Below are typical examples of how sheep and lambs are supplementary fed in the Forest of Bowland. In such methods, feed is often distributed and consumed ad libitum (ad lib) by the sheep until all feed has been eaten.

Supplementary Feeding Methods 1: Ad-lib on the ground

Sheep, gulls, and other birds have unrestricted access to supplementary feed that is distributed onto the ground until the feed is consumed or trodden into the ground. On many farms this attracts large numbers (in some cases hundreds) of gulls as shown in Figure 2 and Figure 3 below, corvid species are also attracted to this food supply, but in smaller numbers.



Figure 2: Ad-lib feeding of bagged pellets distributed directly onto the ground ©Daniel Bland/RSPB



Figure 3: Gulls attracted to the food when distributed directly on the ground ©Daniel Bland/RSPB

Supplementary Feeding Methods 2: Towed Snacker

A mechanised system of distributing supplementary feed. The snacker is towed behind an ATV quad bike, UTV utility vehicle, tractor or similar, whilst dropping feed at regular intervals. While less expensive /older designs incorporate an ad-lib system of feeding, many modern snackers feature wheel-driven (land drive) mechanical doors and/or digital counters to display how much feed is dropped each time the door is opened at a set distance across the field to ensure correct feed levels are maintained.

As with the distribution of supplementary feed directly on the ground, gulls and other birds have unrestricted access to the feed area and food may be trodden in.



Figure 4: Towed Snacker ©Daniel Bland/RSPB

Supplementary Feeding Methods 3: Ground feeder (open trough)
Bagged feed (from c.25kg bags) is poured into the open trough, which contains the supplementary feed rather than it being tipped directly onto the ground and potentially wasted. Ewes are still fed ad-lib, but the trough provides less chance that food is simply trodden into the ground by the sheep.



Figure 5: Ground Feeder ©Daniel Bland/RSPB

Supplementary Feeding Methods 4: Creep Feeder
In the creep feeder, supplementary feed is placed into a hopper, and it then falls into a trough, with the laddered aperture preventing access by ewes whilst lambs can feed ad-lib. Due to the open fronted design these do not deter access by gulls or other birds.

Pictured in the background of Figure 6 is an alternative 'hopper' style lamb creep feeder. These work in the same way utilising a laddered aperture to restrict

livestock access. Again, these do not prevent gulls or other birds from accessing feed.



Figure 6: Typical lamb creep feeders ©Daniel Bland/RSPB

Most ad-lib feeding methods used in Bowland offer little control over the amount of supplementary feed each animal consumes, with the only restriction being the amount of feed that is initially put down or into a hopper.

There are two main negative impacts arising from these methods.

- the aggressive behaviour in livestock (bullying) and subsequent variation in condition and live weights across the herd.

- unrestricted access to supplementary feeds for gulls and corvids

'Gulls naturally take part in 'feeding frenzies', where several individuals (often of many species) will gather together to exploit a feeding opportunity, diving down to grab food and attempting to steal it from one another' (Ross-Smith, BTO) and it is this behaviour that is being exhibited by gulls in the Forest of Bowland.

Is there a Gull-proof alternative?

The Advantage Feeders 500 unit

In relation to livestock, the AF500 (500 litre capacity) feeder chosen for the trial works by rationing feed, ensuring stock receive the right level of nutrition, growing healthily with the least amount of supplementary food waste, over or under eating by the stock.



Figure 7: Advantage Feeders 500 Unit ©Daniel Bland/RSPB

The AF500 utilises a unique 3-way restriction system that offers accurate control over the height, depth, and width of the feed access area. The system utilises upper and lower adjuster plates and an adjuster guard (Figure 89).

When the restriction system is set in a limiting position, the animal's tongue can only touch a few pellets of feed with each lick. The animal accesses the feed using saliva to stick the feed to its tongue and bring it into its mouth for consumption.

After approximately 5 minutes, the animals tongue becomes dry, and it can no longer access the supplementary feed. This necessitates the animal to move away from the feeder whilst saliva on the tongue is re-established. The frequency of visits, c.6-8 times a day, creates a system of providing supplement little and often, and importantly (assuming that the feeder is not empty) the supplement is available when the sheep want it, rather than often just once a day. During

discussions before the feeders were purchased, the UK retailer claimed that when properly set up, with or without the adjuster guard, the design of the feeder had been shown to prevent corvids from being able to reach the food and as such he was convinced that the same would apply to large gulls.

From a farmer's perspective the most important aspect of feeding is centred on economics. As opposed to the conventional methods of feeding described above, the AF500 is said to deliver the best quality stock for the lowest input price, allowing the cost of the feeder to easily be recouped and offering a saving on feed costs. In addition, whole barley can be used either on its own or mixed with pellets to further reduce feed bills.



Figure 8: The AF500 without the adjuster plates which limit the flow rate of feed ©Daniel Bland/RSPB

The adjuster plates (Figure 9) regulate the flow of food into the trough shown above, configured without them there is no regulation of feed and therefore no cost saving. Guards on the feeder prevent the 'bulldozing' of feed and bullying of other livestock away from the trough.



Figure 9: AF500 with the adjuster plates fully open ©Daniel Bland/RSPB



Figure 10: AF500 with adjuster plates fully open and guard installed ©Daniel Bland/RSPB

Using the AF500 as a Creep Feeder for lambs

Most conventional trough systems (Figure 11) can be set up as creep feeders to provide supplementary food to lambs. The AF500 can also be used in this way with the addition of the 'Creep Panel', which prevents ewes gaining access to the food. Although it may be regarded that in this configuration gulls may be able to access food, there are two reasons why, according to the UK retailer, this shouldn't happen.

- Creep feeding generally takes place outside of the gull breeding season, when there are fewer birds around
- Just as with the AF500 set up for ewes, the adjuster guard and design of the hopper should prevent gull access



Figure 11: The pivoted creep panel acts as a guard over the trough, denying ewes access to the feed area and the deep troughs prevents food waste ©Daniel Bland/RSPB

Aims

This project recruited and worked with 8 sheep farmers across 2 areas of The Forest of Bowland AONB, Bleasdale and Roeburndale, to trial the use of AF500[4] as a potential method of feeding sheep that was less attractive to gulls.

The trial aimed to assess the AF500 in use against the pre-existing feeding methods, to determine multiple outcomes:

1. Do the feeders work in restricting food availability to gulls?

2. Does gull numbers and behaviour differ in the fields with the AF500 compared to conventional methods?

3. Are the feeders cost effective for the participating farmer (i.e., do the feeders provide a financial benefit to the farmer in terms of less feed being lost to foraging gulls, less food used and better-quality lambs for sale)?

4. What are farmers opinions on using the feeders/ are the feeders practical for farmers to use?

Discussion points that are also of interest include:

- Given the disturbance that gulls can cause to breeding waders, incl. potential predation impacts, does the use of the AF500 benefit breeding farmland wading birds?

- Could there be widespread adoption of this feeding method if the answer to the previous outcomes is positive?

Methodology

This trial was conducted across eight farms in the Forest of Bowland AONB, four in Roeburndale and four in Bleasdale (Figure 12)

In 2021, Hilary McGuire and Philip Miller began discussions with farmers across Bowland to identify interested participants. Farmers were selected based on meeting the following criteria:

- Those who reported numbers of gulls as a nuisance.
- Those with fields which were either outwith Countryside Stewardship agreements or where the Countryside Stewardship agreement allowed supplementary feeding.
- Those who were willing to engage with the feeders.

The following farms were chosen from 2 clusters:

Bleasdale	Roeburndale
Calderside Farm	Barkin Gate Farm
Fairsnape Farm	Lower Salter Farm
Fell End Farm	Thornbush Farm
Holme House Farm	Winder Farm

Table 1: Farms involved in the trial and their location

Note: the maximum foraging range of Bowland LB during the breeding season is up to 124km (Clewley et al., 2017) so all of the selected farms are well within range for birds from the colony and that there are '*Regional differences in gull diet (e.g., terrestrial-based diet versus marine-based diet, and/or anthropogenic food sources versus 'natural' prey sources), as a result of individual behaviour differences being influenced by different resource landscapes'*. (Quinn, L.R. 2019)

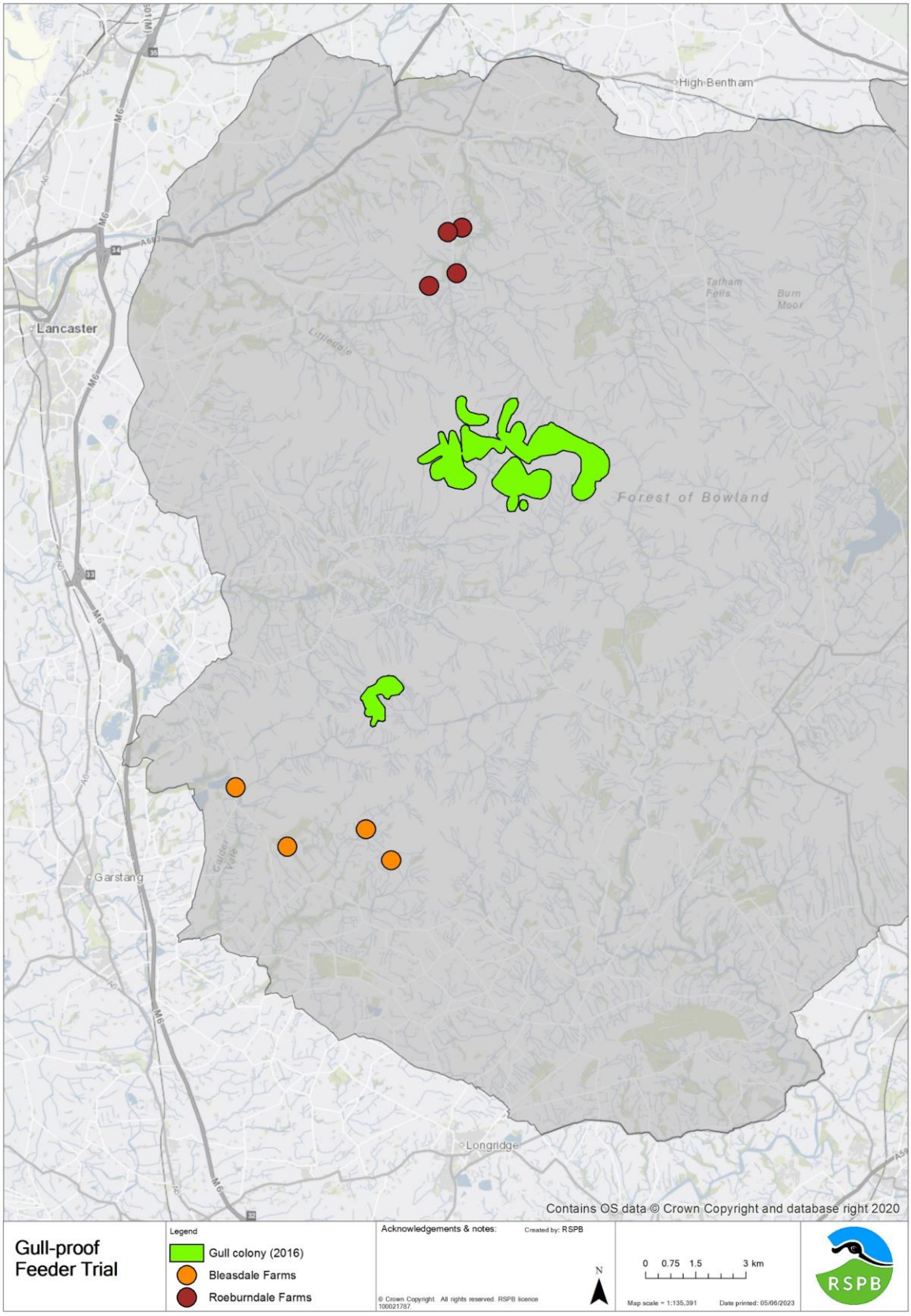

Figure 12: The location of the 8 feeder trial farms split into the two groups and the location of the Gull Colony as recorded (in 2016 by Natural England).

Farmers Workshop and training

A training workshop was provided to farmers at the start of the season on the use of the feeders.



Figure 13: The training workshop for participating farmers ©Daniel Bland/RSPB

All the participating farmers agreed to feed the ewes and lambs in their trial field using the AF500 (timing of deployment varied because of individual farming calendars) and carried on feeding sheep as per their normal practice elsewhere on the farm. They communicated with RSPB staff and volunteers about farm visits, feeding and their observations in using the AF500. Throughout the trial, staff and volunteers maintained proactive discussion with farmers as to the suitability and useability of the feeders.

At the end of the trial, the farmers were invited to provide feedback on the feeders and the trial.

AF500 deployment

The study compared bird abundance and behaviour across a trial field and a control field on each farm. These fields were not always next to each other and were chosen by the participating farmers in consultation with the RSPB.

Trial fields

One field on each farm contained a single AF500 which should, when set up properly, exclude foraging gulls and therefore be gull-proof. It has already been shown to exclude corvids in Shropshire (Robert Ball, pers com.)[5]

Control fields

One field on each farm was surveyed as a control field, where sheep were fed as per the normal practice of the participating farmer. This generally included ad-lib feeding either in an open feeder, or by distributing loose feed onto the ground from either a bag or snacker towed by a quad bike.



Figure 14:: Sheep feeding from pellets scattered on the ground in a control field ©Daniel Bland / RSPB

Bird surveys

Date and Time

Volunteers conducted a weekly survey lasting 45 minutes for 8-11 weeks in each of the control field and trial field at feeding time, in most cases early morning. To accommodate a delay in the use of the feeders, the initial survey timings (21st March - 15th May) were extended to 21st March to 12th June or until the farmers stopped supplementary feeding their sheep, whichever was sooner. These dates varied slightly from farm to farm due to grass availability. The trial fields were only surveyed when the feeder was present and in use.

Bird Survey Methodology

Training was given to the volunteers on the survey technique and species identification.

A survey pack was given to each surveyor which included a survey sheet to be completed for each of the trial and control fields.

The survey methodology was developed by Will Peach of the RSPB Conservation Science Team based on current best practice.

- Both trial and control fields on the same farm were surveyed on the same day.

- The surveyor recorded all sightings of all species of gulls and corvids, using the standard BTO codes for each species. The surveyor positioned themselves in a suitable fixed vantage position (VP), which was usually up against a field boundary, maximising their visibility over the field while providing some camouflage to the surveyor.

- The effective survey area was the area of the field that the surveyor could confidently observe from their fixed location.

- Before the survey began, surveyors recorded the field identity code, date, survey start time and weather conditions (temperature, rainfall, cloud cover, wind).

- Surveyors also recorded the average grass height across the field as either short (below the ankle), medium (below the knee) or long (above the knee).

- At each survey visit, they took a photo of the area where the sheep were fed and a photo of the entire field and sent these to the research assistant.

- Surveys were only conducted during dry and calm conditions (average windspeed <15 km/h).

- During the 45-min VP survey, the observer kept a running record (a count) of all target bird species that moved onto, and off, the survey area. Birds flying over were not recorded.

- For each bird or flock of birds counted on the field, the surveyor also assigned an activity (Bird behaviour below).

- Gulls and corvid records were later summed as the maximum number of birds within 2m of the survey area during the 45-minute survey

- After the VP survey was completed, the surveyor then walked across the field to flush any missed birds (this step was only needed where the grass was tall enough to obscure any target bird species).

Bird behaviour

During the surveys, we also collected data on the activities of each bird recorded. These data allow for a better understanding of the behaviour of each species, and for analysis of species by activity within both field types across each farm. Birds were assessed as being within 2m of the AF500 (or in the case of the control fields the food location), feeding away from the feeder / food location (in the wider field), or simply loafing, i.e., displaying relaxed behaviour not specifically linked to feeding within the wider field.

Other factors surveyed

Spilt feed - within the trial fields, the surveyor also recorded whether any sheep food had spilt onto the ground around the feeder, thereby making it accessible to gulls. This was recorded as none, some, or lots and our surveyors were asked to take a photo if they were not sure.



Figure 15:: Volunteer surveyor conducts a VP survey. Image © Megan Jones/RSPB

Results

Feeder deployment

The feeders were deployed onto the 8 trial farms in March 2022, a critical time for upland sheep farmers when lambing is imminent.

Only 50% of the participating farmers put the AF500's straight into use feeding ewes and/or hoggs returned from winter grazing. The remaining 50% were hesitant to start feeding their pregnant ewes with the proximity to lambing and the potential unintended risk this might pose to either the condition of the ewe or unborn lamb, so they introduced the feeder after lambing. No issues were reported by the initial 50% who opted to use the feeders straight away. By the end of the survey trial, all feeders were or had been in use.

Bird abundance

To simplify the results, we have pooled the observed species into two groups:

- **Gulls** encompassing, Herring Gull, Greater Black-backed Gull and Lesser Black-backed Gull and,

- **Corvids** encompassing, Carrion Crow, Jackdaw, and Rook.

The latter group, the corvids was included to ascertain whether the UK suppliers' comments about the AF500 being corvid-proof were accurate, other species of corvid which could be expected to be seen in Bowland were absent from the surveyed fields.

During 133 surveys undertaken between March and June 2022 by the RSPB, we recorded a total of 1711 birds from these 2 groups when combining the data from all 16 fields.

Of the recorded birds, 1188 were gulls and 523 were corvids.

Mean number of gulls and corvids - trial vs control

As the number of survey visits varied between control and trial fields on 5 of the 8 participating farms, with a higher number of surveys conducted in control fields (74 compared to 52 in trial fields), we calculated the mean number of birds recorded per survey. The standard error (se) of the mean gives a measure of variation in the number of birds recorded per survey and indicates the level of accuracy of the calculated mean.

The mean number of gulls recorded per survey was significantly lower in the trial fields compared to the control fields (Figure 15), whereas the difference in corvid numbers was less pronounced.

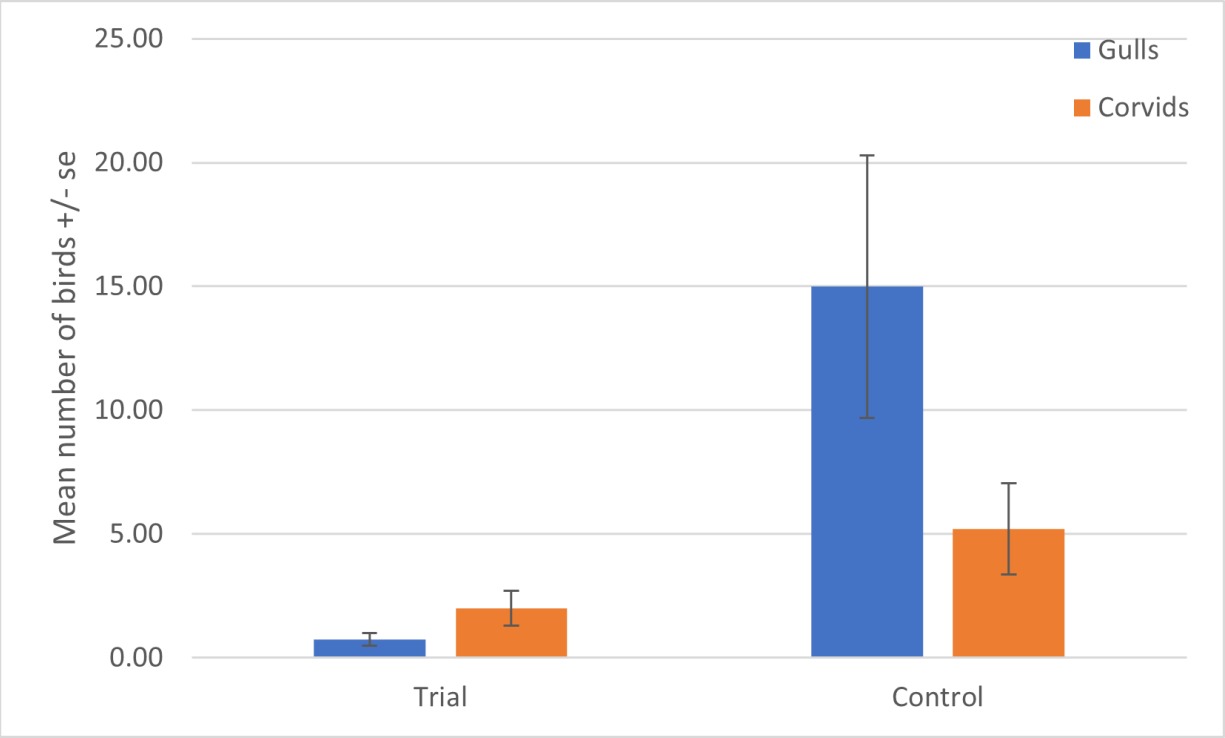

Figure 1616: Mean numbers of gulls and corvids recorded per survey in trial and control fields with the standard error (se) displayed

Bird Activity

Gull activity observed in the surveyed fields

The total number of gulls recorded during all surveys was markedly lower in the trial fields than in the control fields (but note the difference in the number of survey visits).

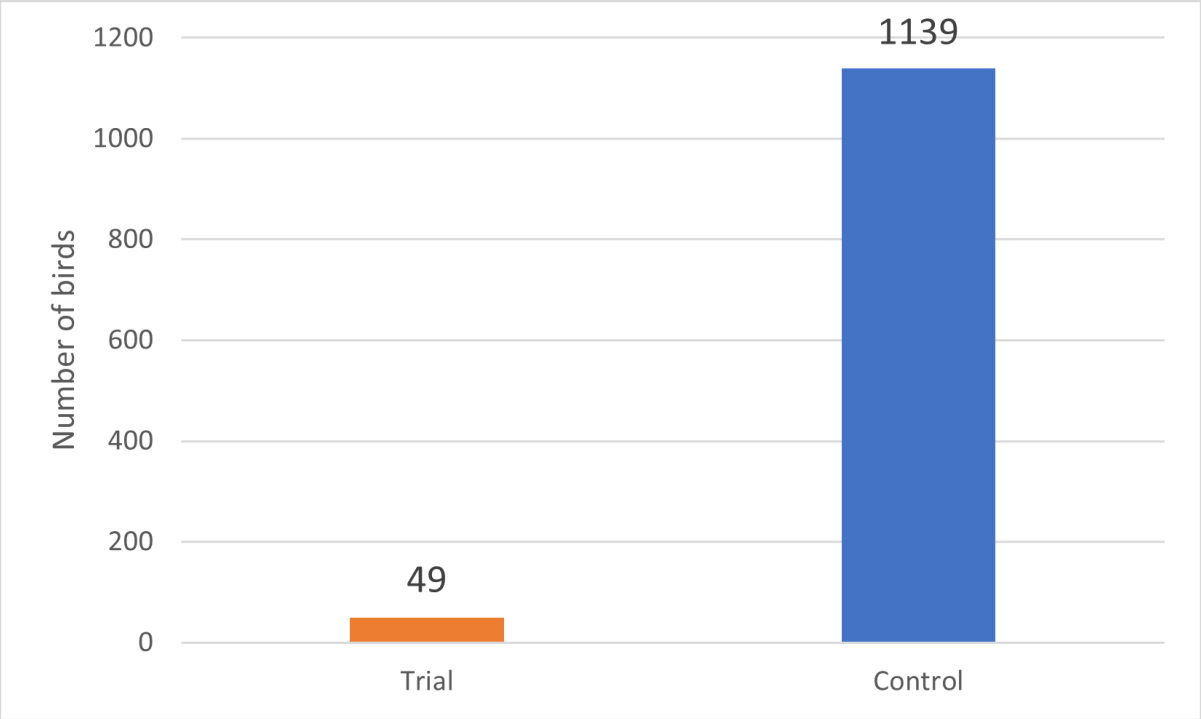

Figure 1717: Total gull numbers recorded in Control (N=74 surveys) and Trial fields (N=52 surveys)[1]

Of the 1188 gulls counted across all surveys, only 49 (4.1%) were recorded in the trial fields (Figure 17).

Of these, 30 birds (2.5% of all gulls) were recorded feeding within 2m of the AF500 (**Error! Reference source not found.**8), however, they were all observed d uring a single survey visit after the farmer had put down some food on the ground next to the feeder to encourage the sheep to use the AF500. Importantly, none of these gulls recorded within 2m of the AF500 were observed to feed from it. Excluding this survey visit, no gulls were observed within 2m of the AF500.

In contrast, 78% of the 1139 gulls recorded in the control fields were feeding within 2m of the provisioned food (Figure 18188).

In terms of recorded gulls, only a single loafing Great Black-backed Gull was recorded, 22 Herring Gull were recorded within 2m of the feed during one survey and a single HG was recorded loafing, all from control fields, the remainder were LB (98% of all gulls).

[1] Based on Robert Ball's comments, the data on corvids should follow the same trend as that for large gulls, these data shown below, do indeed appear to reinforce Robert's comments.

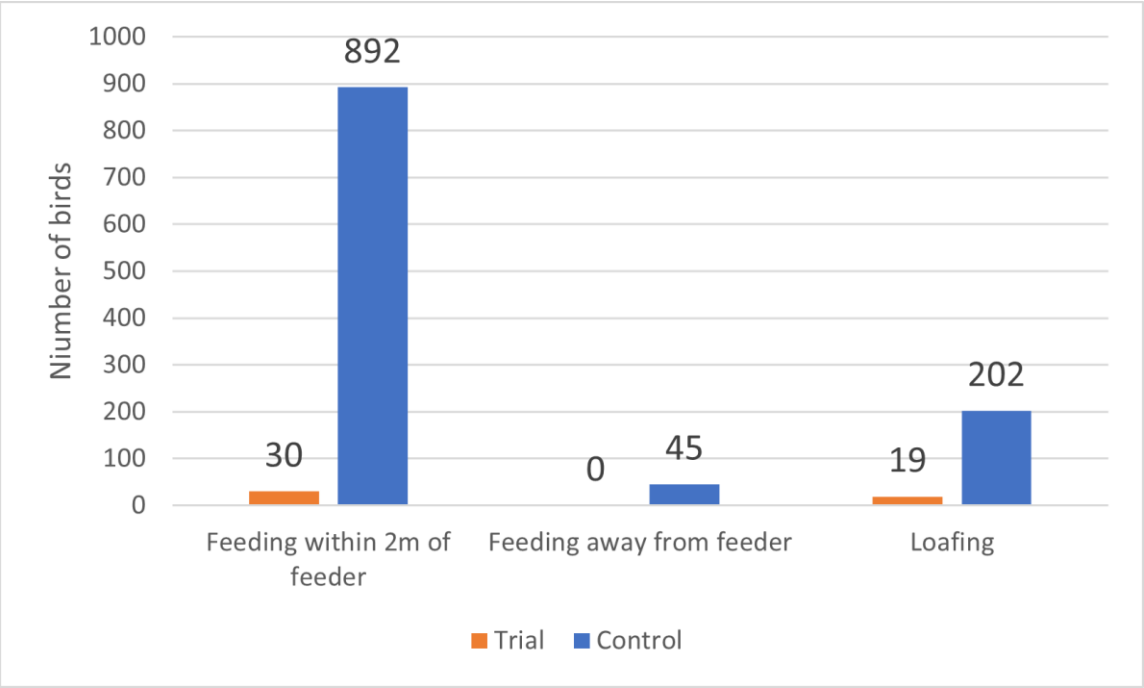

Figure 1818: Total number of gulls recorded by activity type during the survey period.

Corvid Activity observed in the Surveyed Fields

As with the gull data, the total number of corvids was also lower in the trial fields than in the control fields (but note the difference in the number of survey visits).

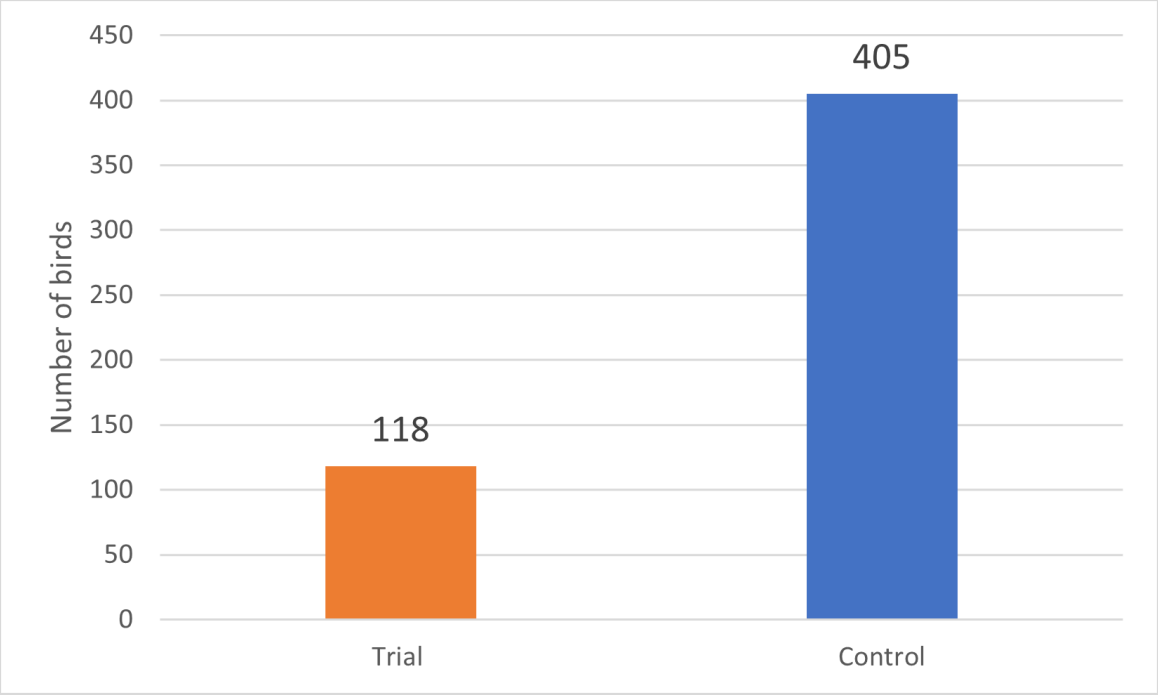

Figure 1919: Total corvid numbers recorded in Control (N=74 surveys) and Trial (N=52 surveys) fields[2]

[2] Based on Robert Ball's comments, the data on corvids should follow the same trend as that for large gulls, these data shown below, do indeed appear to reinforce Robert's comments.

Of the 523 corvids counted across all surveys, 118 (23%) were recorded in the trial fields (Figure 19).

Only 5 birds (0.9% of all corvids), were recorded within 2m of the AF500 (Figure 20), however, none of these birds were observed accessing food from the feeder. In contrast, within the control fields 63.2% of the 405 corvids recorded were feeding within 2m of the provisioned food.

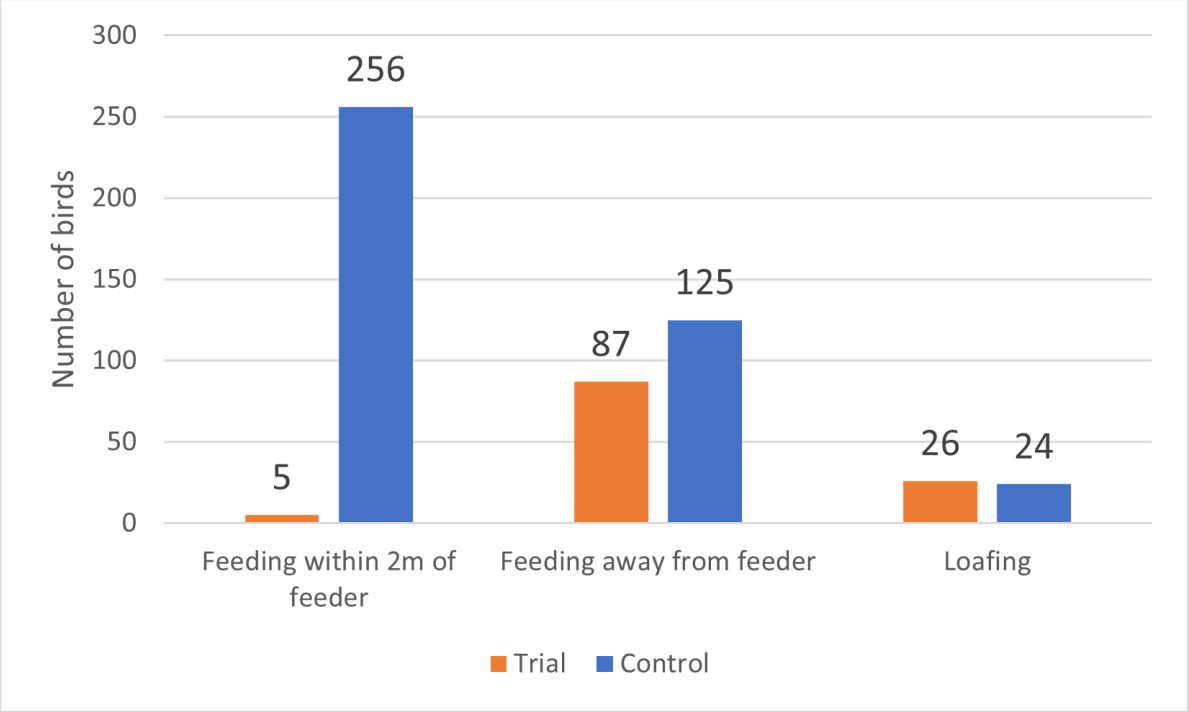

Figure 2020: Total number of corvids recorded by activity type during the survey period

Of the corvids recorded, 220 were Crows, 2 were Rooks, and the remaining 301 were Jackdaws. This can be further broken down as follows; within the trial fields the 5 corvids within 2m of the feeder were a Crow. and 4 Jackdaws, whereas 41 Crows and 46 Jackdaws were feeding away from the feeder and 26 Crows were recorded loafing.

The higher numbers within the control fields are broken down into; 98 Crows and 158 Jackdaws within 2m of the food, 37 Crows and 88 Jackdaws feeding away from the feeder, and 17 Crows, 2 Rooks and 5 Jackdaws loafing.

Discussion

Food accessibility and related changes in bird numbers and behaviour

The AF500 feeders were very successful in restricting food availability to gulls and corvids. No gulls or corvids were seen eating from the feeder, neither during the surveys nor by the farmers at other times. Furthermore, gull numbers in the trial fields (with AF500) were significantly lower than in the control fields, where sheep were fed using conventional methods. This suggests that preventing easy access to food may have deterred the gulls from using the trial fields. In addition, corvid numbers were also lower in the trial fields compared to the control fields.

Of the 49 gulls recorded in the trial fields, 30 were seen during a single survey visit, the farmer had put out loose food next to the feeder to encourage sheep to feed from it, which likely attracted the gulls. This was the only instance of gulls seen feeding within the trial fields, the other 19 birds recorded were loafing. This strongly contrasted with the control fields, which continued existing farm practices for stock feeding, where 892 gulls were recorded feeding within 2m of the provided food, while 45 were foraging away from the feeder and 205 were loafing. This demonstrates that the gulls are drawn in to the easily obtained food supplied by farmers. Similarly, only 5 corvids were recorded feeding on spilt food within 2m of the AF500 in the trial field, whereas 256 corvids were feeding within 2m of the feed in the control fields.

The noise associated with feeding e.g., quad bikes, horns, farmers calling sheep and sheep bleating, appeared to act as a signal to gulls indicating the potential availability of food (farmers/Daniel Bland pers. comm). We observed that single or small groups of gulls were attracted to the feeding area instantly from various distances across the landscape, but that within minutes of the feed being distributed on the ground the number of gulls circling above and feeding on the ground had rapidly increased. This behaviour accords with studies done elsewhere[3] which indicate that gulls respond to human cues and quickly learn to associate certain activities with a supply of food (Goumas et al., 2020). This could also suggest a level of communication between the gulls, which has not yet been studied outside of breeding sites and the urban environment.

In the trial fields, the gulls quickly dispersed after investigating the human activity and the apparent lack of feed, probably in search of easily accessible food in adjacent fields and/or neighbouring farms where conventional feeding ad-lib on the ground continued.

The association between the provision of supplementary food and gull numbers is supported by our observations on Barkin Gate Farm, where the farmers did not supplementary feed the sheep in the control field (owing to the increased cost of feed) but utilised the available grass instead. This seems to have impacted on gull use of the field, as this farm was the only one to return a zero count for the control field.

Caveats

Owing to logistical and funding constraints, we were not able to collect baseline data in the trial and control fields, i.e., before the feeders were deployed. Hence, we cannot exclude the possibility that differences in field characteristics (e.g., field size, vegetation, type of supplementary food, other food sources) may have contributed to the observed variation in gull and corvid numbers. Confirming the direct impact of the feeders on gull numbers and behaviour would require a more robust study design including a before–after comparison in both trial and control fields, ideally over multiple years, which was outside the scope of this limited trial.

Cost effectiveness

Unfortunately, we were unable to obtain financial records from the participating farms to investigate the cost effectiveness of the AF500. This comes from a misunderstanding, as we had underestimated the complexity of obtaining records for each individual feeder, based on the way in which each farm calculates income and expenditure.

These financial records would be important to show whether the feeders are economically viable outside of the trial. For our trial we were (through the FiPL grant) able to provide farms with the AF500's at no cost, however, a wider roll-out of this method would require farmers to invest into these feeders themselves. The manufacturer and UK retailer both claim that the feeders are financially efficient because they optimise food availability to stock and, in the case of Bowland, prevent losing feed to gulls and corvids, which from reports and our own observations clearly has an economic impact on affected farms.

The second financial factor we were unable to gather data on during this limited trial was stock condition. As the manufacturer and UK retailer claim that stock condition is optimised through use of the feeder, it would be desirable to test whether feeder use has an impact on lamb weights or the sale price of lambs at the auctions.

However, feedback from the farmers suggests that in the long-term they could see a cost benefit in the ability to ration feed and reduce waste. In addition,

farmers also suggested potential long-term benefits of improved animal health, nutrient utilisation, reduced vet bills and medication costs, and possible reduction in lamb mortality.

Practical use – farmer feedback

At the end of trial, we discussed the trial with each participating farmer and asked for their feedback on the practical use of the AF500.

Despite training, setting up the adjustor plates of the AF500 to control flow rate and ration feed was initially thought to be complicated, and a case of trial and error. However, once set up the feeders were easy to use and refill and farmers became more confident in the ability of the feeder to ration feed properly. Some participants stated that additional training in calculating feed rates and longer use would help mitigate the initial complexities. The UK retailer's website has a series of videos to explain and help with set-up:
https://advantagefeeders.co.uk/resources/introductory-videos/

As discussed at the training session, ewes were initially hesitant in using the feeder until they also became familiar with its use and its association with feed. To encourage sheep to feed from the feeder, one farmer set the adjustor plates fully open and removed the adjustor guard. Consequently, feed was bulldozed out of the hopper into the trough and the ewes and lambs were effectively still fed ad-lib for a short time.

One farmer reported that their Swaledale ewe had got stuck on the creep panel of the feeder, with the horn caught by the upstand in the panel. This was an isolated case and was resolved quickly when tending to the livestock.

In general, the feeders were reported to be easy to relocate around the field using an ATV, e.g., a quad bike. The AF500 model we chose to use is on skids, but larger models come on a trailer. As with any other static feeder, the AF500 should be regularly relocated to prevent poaching. Farmers reported the main issue with the feeders was relocating them to other fields, especially those dispersed. This required the feeder to be lifted and transported by tractor, which may not be practical in winter nor an option available to all farmers.

In a couple of instances, it was reported that the feed got wet from either driving rain or excess silva and clogged up the adjustor plates, reducing access to feed. Tools are provided with each feeder to aid maintenance and cleaning, and with longer-term use practical issues of maintenance, if required, became part of the daily feeding / checking routine.

In general, feedback on the design, cost, and use of the AF500 was positive. Long-term value in feed costs, utilisation of minerals and animal health were seen as a benefit. Most participating farmers saw the potential long-term benefit of using

such feeders at a wider scale and were supportive of further trials. After the trial, all participants reported that they would be continuing to use the feeders as they could see the benefits to sheep health.

Conclusion

Our results demonstrate that the AF500 feeder is gull and corvid proof, as claimed by the UK retailer, and its use was associated with lower numbers and different behaviour of gulls (and corvids) in the trial fields with the AF500 compared to control fields.

In the control fields, both gulls and corvids continued to exhibit what appears to have become normal behaviour in Bowland, with large numbers of birds being attracted to the freely provisioned supplementary food, often triggered by the sounds of human activity. Attracting gulls into fields by freely provisioning supplementary foods is, we believe, one of the major reasons why there is an increase in interactions between gulls and sheep, especially lambs, as well as potential disturbance and opportunistic predation of wader chicks.

In general, the sheep did an effective job at removing the feed from the ground with very little, if any, residual left afterwards. Feeding would typically last c.15-20 minutes, after which sheep, gulls and any corvids would dissipate not to return. Reducing access to this free food can therefore be assumed to reduce the likelihood of gulls coming into the in-bye fields and thus the risk of predation on lambs and wader chicks. If rolled out at scale across Bowland, this change in supplementary feeding methodology may have the potential to reduce the predation pressure from gulls on the in-bye, however, we might also see a shift in gull feeding behaviour onto an alternative food source.

The ready access to significant quantities of freely available food may also be a major contributing factor in the increase in size of the gull colony itself. Gulls and corvids are well known for their intelligence, adaptability, and opportunism; both vocal and behavioural forms of communication are well-studied in corvids and suspected in gulls, although little to no research has been done in gulls outside of the urban environment. Therefore, it is likely that 'word' of this food supply is steadily spreading through the colony through learnt behaviour. What we do not know is whether the gulls are feeding themselves, as the high protein food may give them more energy quickly to enable more efficient foraging for gull chick food, or whether the gulls are feeding this regurgitated high protein feed to their chicks, which both may increase their breeding success.

Whilst only one of several potential factors driving gull numbers, reducing the ready supply of easily accessible food could have the effect of 'naturally' reducing the potential for the colony to increase so rapidly.

Although a wider use of the AF500 or similar models may not be a stand-alone solution to gull issues on Bowland farms, we are optimistic it can be part of the solution. As such we will advocate its take-up to farmers we are engaging with and share our findings widely with partners, both within and out with the Forest of Bowland. Based on discussions with participating farmers and the retailer's information, we expect the AF500's to be cost effective, however we were unable to test this during this trial.

Further Work

An extended feeder trial

Apart from advocacy to farmers in Bowland around the use of the AF500's, the next step is to trial the system at a whole farm scale. Utilising AF500's (or another AF unit if more suitable) at farm scale for at least a full calendar year would allow the full range of feeding options to be examined by the participating farm, and for the true cost effectiveness of the system to be estimated in the field. So far two farmers, one who was involved in this trial, and one who was not, have expressed an interest in being a trial farm for this purpose.

This trail should take place over at least a 3-year period, which will allow the collection of baseline data so that we can more accurately assess the impact of the feeders on gull behaviour and any related benefits for nesting success of breeding waders, although the latter might still be biased by more traditional feeding styles on the surrounding land.

Within the first year we would record the existing feeding methodologies and gather the necessary financial data – including feed cost and usage, input vs output (sale) costs of lambs and sheep - to enable a later comparison with the AF units. At the same time, we would undertake a full farm baseline survey of gull numbers and behaviour, as well as wader numbers and productivity. To ensure a properly conducted BACI (Before-After Control-Impact) study we would also require a control farm to show that any observed changes on the trial farm are related to the use of the AF500's, and not just an overall regional trend.

Within years 2 and 3 we would monitor the change to the AF units on the trial farm and continue the bird surveys as well as the collection of financial data.
This will allow us to assess the financial benefits (or otherwise) to farmers of a wholesale change to AF units, including changes in feed costs and potential benefits to sheep health based on the sale price at auction as claimed by the retailer, and gain an understanding of the timeframe over which these benefits may be seen. In addition, we will assess whether the change in feeding method at a farm scale has an impact on local gull numbers.

Over this extended timeframe, the continuation of the wader surveys may also start to yield information on the impact of foraging gulls on wader productivity. If gull predation is limiting productivity of farmland waders in Bowland, we

might expect wader productivity, and possibly with a delay also breeding numbers, to increase with a decrease in foraging gulls, if gulls were show as the only predator of wader chicks on the trial farms.

Further gull studies

In addition to an extended feeder trial, it would be interesting to run a study on gull diet, and that of their chicks, through genetic (DNA-based) analysis of faeces. This will provide a non-invasive snapshot of how the gulls utilise the high protein sheep feed and may give some indication about other major food source such as refuse sites or marine prey. It will also show whether wader chicks make up a significant proportion of the gulls' diet and help to assess the potential impact of gulls on breeding waders in Bowland.

To support this work, it would be useful to undertake another satellite tagging study, with a focus on foraging trips between the gull colony and the in-bye grassland. Combined with a wider survey of sheep feeding practices in Bowland, this could help to identify whether bird movements are related to supplementary feeding practices.

These additional studies will help to improve our understanding of the potential impact of gulls on farm economics and wader productivity in Bowland.

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