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The use of camera traps to identify individual colour-marked geese at a moulting site

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ABSTRACT

Movement-activated camera traps were used at an important moulting site of Canada Goose Branta canadensis and British Greylag Goose Anser anser to test whether a greater number of colour-marked individuals would be identified using camera traps than when only traditional methods were used. Four camera traps were in operation during a 100-day period; in total, 1176 colour-mark sightings were generated representing 159 individually colour-marked geese. The field team made 216 resightings of colour-marked birds during the duration of study, including just five individuals that were not identified using camera traps. During the trial, the camera traps generated more resightings and identified more individual geese than had been found in any previous year of the study. The results highlight the potential for using camera traps as a means to increase resighting rates of colour-marked birds.

With an increasing need for more extensive and accurate monitoring of bird populations, recent advances in technological development are assisting studies with the collection of data.

A recent advance that is proving to be of great value is the use of camera traps (i.e. cameras that are movement-activated via an active or passive sensor). Camera traps have become a mainstream tool in conservation and ecology (Rowcliffe & Carbone 2008). During this feasibility study, we trialled the use of camera traps to identify individual colour-marked geese at a moulting site to test whether a greater number of colour-marked individuals would be identified using camera traps than when only traditional methods were used.

During the period 2014–16, data on the return of individually marked birds to the moulting site was obtained predominantly during subsequent annual catches of moulting geese. During this feasibility study, we trialled the use of camera traps to identify individual colour-marked geese at a moulting site to test whether a greater number of colour-marked individuals would be identified using camera traps than when only traditional methods were used. Four camera traps were in operation during a 100-day period; in total, 1176 colour-mark sightings were generated representing 159 individually colour-marked geese. The field team made 216 resightings of colour-marked birds during the duration of study, including just five individuals that were not identified using camera traps. During the trial, the camera traps generated more resightings and identified more individual geese than had been found in any previous year of the study. The results highlight the potential for using camera traps as a means to increase resighting rates of colour-marked birds.
camera traps to identify individually colour-marked geese at one of our study sites. In this study, we tested whether we would obtain a greater number of re-encounters using camera traps compared with years in which only traditional methods (recapturing birds or resighting rings and collars) were used.

**Methods**

Annual roundups of flightless moulting geese for ringing took place at several locations on Windermere, Cumbria, from 2013 to 2016. Flocks of geese were rounded up on the water using motorboats and kayaks and encouraged onto land where a corral had been set up to pen the birds. Birds were then individually taken from the corral by a handler before being processed by a ringing team. All birds were ringed with standard metal rings issued by the British Trust for Ornithology. In total, 1001 Canada Geese received an additional colour ring, with four white characters on a red ring, on the opposite leg and 331 Greylag Geese were fitted with an orange neck collar, marked with three black characters. A further 20 Greylag Geese were also fitted with orange or white leg rings marked with three black characters.

Four camera traps (CT-LTL Acorn LT-5310) were installed 40 m apart at various locations around a three-acre field that is used by the geese for feeding. Two camera traps were placed near to where the birds leave the water and walk onto the field, and two other camera traps were placed randomly around the field to target individuals in the feeding flock. Three of the cameras were fixed to fencing or trees, whilst the remaining one was mounted on a stake and driven into the ground in the middle of the field. The cameras were programmed to take an image each time an object moved in front of the lens, with a delay of 20 seconds before the next image was taken.

The camera traps were left in place for 100 days, from 26 May to 2 September 2017. Visits to the camera traps were made frequently to replace the memory cards and download the images. Batteries were replaced as needed. The images were viewed on a laptop computer and checked for signs of colour-marked birds. Usable images, where one or more colour mark could be seen clearly and was legible, were listed on a spreadsheet, recording the image number, date and time.

The maximum distance away from the camera from which a ring or collar could be read from a photo was estimated as five metres. The distance was calculated by identifying foliage or markers in the photos near to where the goose had been standing, and the distance was measured between the camera and the nearest marker identified. The field of view of the camera traps at the maximum distance that colour marks could be read was six metres wide.

To compare the number of colour-marked individuals identified between the camera traps and standard, in-the-field ring reading during the camera-trap trial, the field team used a Swarovski ATS65 high-definition telescope to read rings and collars before entering the field to manage the camera traps.

**Results**

Data were obtained from the camera traps on a total of 100 days, of which the cameras captured goose activity on 94 days. The remaining six days when no geese were recorded were mainly ones when the geese were displaced from the field by the owners for the cutting of grass or removal of livestock. Resightings were obtained by the field team on a total of 13 days.

Over the course of the camera-trapping period, 38330 images were downloaded from the four cameras. The geese did not roost in the field, instead choosing to roost on the water, and so 6720 images taken during the hours of darkness were removed without examination to decrease the time needed to scan through the images. Of the remaining 31,610 images, 4321 contained irrelevant images such as grass cutting by the owners of the field, or movements by livestock. There were 27,289 images that showed geese, including unringed individuals and colour-marked geese too far away to be identified. In total, 1101 images could be used to identify individuals and were defined as usable, not including multiple images of the same colour-marked bird. From these, 1176 individual sightings were collected during the trial period (Table 1) and 159 individual colour marks were identified from the

**Table 1.** Ringing totals and re-encounters at the study site in subsequent years for Greylag Geese (first figures) and Canada Geese (after colon). The use of camera traps was initiated in 2017.

<table>
<thead>
<tr>
<th></th>
<th>2013</th>
<th>2014</th>
<th>2015</th>
<th>2016</th>
<th>2017</th>
</tr>
</thead>
<tbody>
<tr>
<td>Geese ringed</td>
<td>8 : 215</td>
<td>80 : 349</td>
<td>90 : 169</td>
<td>173 : 268</td>
<td>0 : 0</td>
</tr>
<tr>
<td>Re-encounters generated by recaptures or resightings in the field</td>
<td>–</td>
<td>1 : 29</td>
<td>13 : 31</td>
<td>15 : 15</td>
<td>28 : 188</td>
</tr>
<tr>
<td>Re-encounters generated using camera traps</td>
<td>–</td>
<td>–</td>
<td>–</td>
<td>–</td>
<td>101 : 1075</td>
</tr>
<tr>
<td>Combined total re-encounters</td>
<td>–</td>
<td>30</td>
<td>44</td>
<td>30</td>
<td>1392</td>
</tr>
<tr>
<td>Individual geese re-encountered</td>
<td>–</td>
<td>1 : 29</td>
<td>13 : 31</td>
<td>15 : 14</td>
<td>19 : 140</td>
</tr>
<tr>
<td>Combined total individuals</td>
<td>–</td>
<td>30</td>
<td>44</td>
<td>29</td>
<td>159</td>
</tr>
</tbody>
</table>
camera-trap images during the 94 days, of which 140 were Canada Goose leg rings, 18 were Greylag Goose collars and one a Greylag Goose leg ring (Table 1). The number of times an individual was identified by a camera-trap image ranged from one to 24 occurrences for Canada Geese and one to 11 for Greylag Geese.

In total, 216 resightings of colour-marked birds were made by the field team, and of these just five colour marks (four leg rings and one collar) were read that were not identified from images during the camera-trapping period.

Discussion

The use of camera traps in this study proved highly effective in identifying colour-marked individuals at the moulting location. During the trial, the camera traps generated more resightings and identified more individual geese than any previous year during the study and during the same year using traditional methods (Table 1). We feel that other studies that use colour marking could benefit from the use of camera traps to generate resightings.

Not only did the use of camera traps decrease the number of visits needed to gather data for the study, it also decreased ring-reader time and effort needed at the site. Whilst checking through images for colour-marked individuals did prove rather time consuming, the number of individuals identified, and the total number of resightings generated overall, outweighed the effort needed to check images. We estimate that the checking of ten single images, zooming in to an image upon noticing a colour mark and eventually the reading of rings or collars took c22 seconds. Given that 31 610 images were checked for colour marks, this produced c21 hours of work in total. In any new study, this workload could be delegated to a team of people to assist.

The site being private and with no public access, resightings have never been reported from this moulting location by members of the public. Therefore the use of cameras greatly added to the number of resightings for the site from May to July. Previously the study relied on recaptured birds to provide information on moul-site fidelity, with occasional rings being read by the ringing team during the catching period. However, as the camera traps were functional over a longer period (94 days) than the total number of days needed for catching (two days), the number of individuals identified at the moulting location was greater than in any previous year (Table 1).

Whilst the camera traps took numerous images of the same individual geese, there were some advantages of multiple images being taken of the same ringed individuals. It proved useful to have several images of the same ring in different positions as the geese walked past, since in some cases, hard to read or similar-looking characters such as H and N or V and Y were correctly identified using multiple images of the same individual. Multiple images also proved useful to document interactions between associating geese, and for counting any goslings accompanying the ringed birds – tasks which are not achievable during the catching and ringing process.

Moult in waterfowl is considered a critical period of the annual life cycle (Kahlert et al 1996). Geese, for example, are flightless for four to five weeks, during which flight feathers are shed and regrown simultaneously (Lebret & Timmerman 1968), and due to their restricted mobility geese are more susceptible to predators during this period (Kahlert et al 1996). This makes the geese more alert and nervous when feeding on land: on their arrival at the study site for ring reading and managing the cameras, the field team often observed the geese heading for the safety of the water. This often made reading leg ring by telescope difficult, due to the rings being underwater. As the use of camera traps decreased the amount of observer time needed at the study location, disturbance to the feeding flock also decreased.

During the duration of the colour-marking study a network was formed of ring readers, who reported colour-marked geese at sites during other times of the year. Ring readers were encouraged to submit daily sightings of colour-marked geese away from

<table>
<thead>
<tr>
<th>Bird ID</th>
<th>Date</th>
<th>Location</th>
<th>Method</th>
</tr>
</thead>
<tbody>
<tr>
<td>SJI</td>
<td>26 June 2016</td>
<td>Windermere</td>
<td>Capture</td>
</tr>
<tr>
<td></td>
<td>5 June 2017</td>
<td>Windermere</td>
<td>Resighting</td>
</tr>
<tr>
<td></td>
<td>6 June 2017</td>
<td>Martin Mere, Lancashire (83 km S)</td>
<td>Camera trap</td>
</tr>
<tr>
<td></td>
<td>22 July 2017</td>
<td>Windermere</td>
<td>Camera trap</td>
</tr>
<tr>
<td></td>
<td>22 July 2017</td>
<td>Martin Mere, Lancashire</td>
<td>Resighting</td>
</tr>
<tr>
<td>SNT</td>
<td>26 June 2016</td>
<td>Windermere</td>
<td>Capture</td>
</tr>
<tr>
<td></td>
<td>30 May 2016</td>
<td>Leighton Moss, Lancashire (16 km S)</td>
<td>Resighting</td>
</tr>
<tr>
<td></td>
<td>31 May 2016</td>
<td>Windermere</td>
<td>Camera trap</td>
</tr>
<tr>
<td></td>
<td>25 June 2016</td>
<td>Windermere</td>
<td>Resighting</td>
</tr>
<tr>
<td></td>
<td>1 September 2017</td>
<td>Sandside, Milnthorpe, Cumbria (17 km SE)</td>
<td>Camera trap</td>
</tr>
</tbody>
</table>
Windermere in the hope that a combination of ring-reader activity and images from the camera traps would help document arrival and departure dates of the geese at Windermere and their duration of stay. This worked well and for some individuals the precise arrival and departure dates were determined. For example, the Greylag ringed ‘SJI’ at Windermere during the moult catch in 2016 was resighted at Martin Mere in Lancashire (83 km south of Windermere) regularly throughout the winter and observed there by telescope on 5 June 2017; on the following day (6 June) it was identified by camera trap at the moulting site on Windermere (Table 2). During the camera-trap trial, this bird was identified ten times with the last observed date by camera trap being the morning of 22 July 2017; later that same day, the bird was again identified by telescope back at Martin Mere, having spent a total of 47 days at Windermere.

Other studies of individually colour-marked birds could well benefit from the use of camera traps to identify individuals at predictable locations of occurrence. Camera traps placed at known roosting sites, feeding sites, such as feeding stations, and even breeding colonies could significantly increase the number of resightings. It is important to note, however, that colour-ring projects should not rely entirely on sightings made by members of the public. Project coordinators and ringers should be willing also to collect resighting data themselves and look at ways in which the rate of resighting could be increased. Because some letters on the rings are harder than others to distinguish, thought should be given to the characters used on rings, before any colour-marking study is initiated, to minimise ring-reading discrepancies (see Mitchell & Trinder 2008).

Overall, 5% of Greylag Geese and 14% of Canada Geese colour marked at the four catch locations at Windermere were identified by camera traps at the camera-trapping study site. Routine ring reading at all the moulting locations at Windermere identified 18.4% of all the Canada Geese marked and 21.8% of the Greylag Geese. As for the remaining colour-marked birds not identified during the season, we know through resightings that some birds were breeding at other sites; some switched moulting locations entirely and moulted away from Windermere. Over the duration of the study, a number of birds of both species were also reported dead.

It would be useful to have camera traps placed at all known moulting locations at Windermere, so that resighting data could also be collected on birds marked at other locations and for capturing information on birds that may have switched moulting locations.

Given that such a high percentage of individuals that used the moulting site in which we trialled the study were identified by the camera traps and that just five colour marks were read by telescope that had not been identified by camera traps, we feel comfortable to rely on the future use of camera traps at this location to contribute resighting data to the study. However, it would be worthwhile to compare data collected by camera traps with an intensively collected data set that is thought to have recorded all birds known to be alive and present at the same time.

Acknowledgements

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