

1 Birdsbesafe® collar cover reduces bird predation by domestic cats (*Felis catus*)

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7 ABSTRACT

8 The domestic cat (*Felis catus*) is one of the world's most damaging invasive species,
9 especially threatening to local bird populations. This study examined the efficacy of the
10 Birdsbesafe® collar cover at reducing predation rates by household cats on avian
11 populations. The vivid colours of the Birdsbesafe® collar cover are assumed to alert nearby
12 birds to the cat's presence, allowing them to escape safely. Overall, 19 cats were trialled
13 over 8 weeks and the Birdsbesafe® collar cover resulted in a reduction of 78% in the number
14 of birds killed. Further research is required into owner attitudes to collars in order to
15 examine whether these collar-based devices could be widely adopted.

16 INTRODUCTION

17 Domestic cats (*Felis catus*) are often considered one of the most damaging invasive species
18 globally (Lowe *et al.*, 2000), having been transported widely by humans as companions and
19 to control pests (Fitzgerald and Turner, 2000). Cats have had extensive impacts on wildlife
20 populations all over the world (Doherty *et al.*, 2016). Anti-predation devices are recent
21 inventions that have been designed to reduce impacts of domestic cats. Bells fixed to cats'

22 collars can be an effective device at reducing predation rates (e.g. Ruxton et al. 2002, Nelson
23 et al. 2005; Gordon et al. 2010; but see Barratt 1998 for a counter-example).

24 Other measures designed to reduce predation by cats include the CatBib™, a coloured
25 neoprene bib that attaches to a collar and falls over the front of the cat. It is designed to act
26 as a barrier between the cat and bird, increasing the difficulty of catching prey (Cat Goods
27 LLC, 2014). Trials have shown decreases in predation rates from an 81% reduction for birds
28 and 45% for mammals with or without a bell in addition to the CatBib™ (Calver *et al.*, 2007).

29 Further anti-predation devices include the CatAlert™, a sonic beeping device attached to
30 the collar. It aims to alert surrounding wildlife to the cats' presence, thus making it difficult
31 for the cat to successfully surprise, catch and kill prey (Moggies, 2018). Studies have shown
32 this device to either have no significant effect on reducing mammalian kills but reduce
33 avian kills by nearly 50% (Clark, 1999), or have reduced mammalian kills by nearly 40% and
34 birds by over 50% (Nelson et al. 2005).

35 Although each of these devices have been designed to alert birds and have been shown to
36 reduce predation rates, each has accompanying issues such as the possibility that cats
37 adjust their behaviour to bells (Nelson, Evans and Bradbury, 2005) or cat welfare problems
38 (Calver *et al.*, 2007). Thus, the development of an effective and easy-to-apply anti-predation
39 measure has continued to be researched. The most recent device to be introduced is the
40 Birdsbesafe® collar cover. It is a 50cm long, 5cm wide, piece of fabric with a reflective trim
41 along the edges comprised of bright colours. It is designed to exploit birds' colour vision
42 while remaining flexible to allow movement for grooming and eating without constraint. It is
43 recommended that a quick-release collar is used with the Birdsbesafe® collar cover for

44 safety, so the cat can be released when caught by its collar on any obstacles (Birdsbesafe
45 LLC, 2019).

46 To date only two studies, in New York and Australia, have been conducted assessing the
47 effects of the Birdsbesafe® collar cover., Willson et al. (20015) compared six weeks with the
48 birdsbesafe collar cover to a similar period of no collar and found that there was a reduction
49 of around 95% in the number of birds killed in the spring and 70% in the autumn. The
50 Australian study, comparing three weeks with and three weeks without the Birdsbesafe®
51 collar cover applied showed a decrease of 55% in the first year of herpetofauna and birds
52 returned to the owner's home, and a decrease of 25% in the second year (Hall *et al.*, 2015).

53 The present study assessed the efficacy of this collar cover under northern European
54 conditions; where cat ownership is high, and a recent extensive survey has suggested that
55 their impact on garden birds can be considerable (Pavisse et al. 2019). Unlike bells for
56 example, the Birdsbesafe collar cover works as a visual signal, so might be expected to be
57 sensitive to detail of the background it is seen against and the ambient light levels. Both of
58 these in turn will be influenced by the nature of the environment and prevailing weather
59 conditions. Of particular relevance here we expect housing density (and thus garden size
60 and home-ranges of cats) to be different in our study to previous ones – affecting visual
61 aspects of the vegetative structures against which the signal is commonly seen. We also
62 expect differences in weather, day length, and canopy closure to influence ambient light
63 levels.

64 METHODS

65 The study ran over the autumn/winter period between August-October 2018 in the Isle of Man (UK)
66 and August-December 2018 in Scotland. Participants were recruited through advertisements on

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67 social media, at vets, wildlife parks and through staff at the University of St Andrews. They were only
68 accepted if they considered that their cat brought home, on average, at least one bird per fortnight.
69 Trials lasted for a total of 8 continuous weeks during which participants were randomly assigned to a
70 treatment group. No previous studies have assessed if a normal collar impacts predation rates so it
71 was decided that it could be a control condition for some cats as an alternative to no collar
72 (whichever was normal for that cat). Group 1 wore the birdsbesafe collar for four weeks followed by
73 control conditions for four weeks; this order was reversed in Group 2.

74 All participants were asked to use a quick release collar with the Birdsbesafe® collar cover and to
75 remove bells for the entire study period. If the Birdsbesafe® collar cover was lost during the four
76 weeks, it was replaced as soon as possible and owners were asked to note down any prey that had
77 been caught in the period when the Birdsbesafe® collar cover was not worn.

78 Birds that were eaten completely or not returned home were not accounted for in this study.

79 Owners were asked to report the number of birds that were returned home only and not to attempt
80 to identify them to species. Participants had an optional survey they could fill in, assessing their
81 attitudes towards the Birdsbesafe® collar cover. This included if they would continue to use a
82 Birdsbesafe® collar cover after the study and any behavioural changes observed to their cat(s). The
83 age and sex of the cats were not recorded as multiple households had more than one cat and not all
84 owners could attribute kills to a specific cat. Cat colouration was also excluded from our
85 investigation as it appears to have no impact on predation success of domestic cats (Brown, 2018).

86 All cats in a household were randomised to the same treatment order. In households with multiple
87 cats participating, some owners could not confidently report which cat had caught the prey. Analysis
88 of that data was therefore conducted per household, not per cat. Owners that felt confident they
89 could assign kills to a specific cat in their household had each cat represented separately in analyses.
90 Any fledglings caught were excluded from the analysis as they were less able to escape an impending
91 attack than adult birds. The distribution of predation rates could not be well described by a normal

92 (or any other commonly used) statistical distribution, so a non-parametric Wilcoxon signed-rank test
93 was used to compare predation rates between attachment of the Birdsbesafe® collar cover and the
94 control.

95

96 RESULTS

97 Overall, there were 18 cats from seven households in Fife and 11 cats from six different households
98 in the Isle of Man in our study. However, two households contributing 3 cats in Fife and three
99 households contributing 4 cats from the Isle of Man were removed from the study as they recorded
100 no prey caught. From the Isle of Man households, one participant had one cat that refused to wear
101 the collar out of a total of two. The other cat remained in the study as the owner was certain of their
102 cats' kills. Another participant with 2 cats was removed as they stopped communicating several
103 weeks into the study. This gave final sample sizes of 15 cats from five households in Fife and 4 cats
104 from two households in the Isle of Man leading to a total of 19 cats for Great Britain. Given the small
105 sample size, and that the trial was not motivated by study of fine-scale geographic variation, we
106 analyse this as a combined data-set.

107 The Birdsbesafe® collar cover had a significant effect on the number of birds caught (Wilcoxon
108 signed rank test: $V=45$, $p\text{-value} = 0.008$). There were 8 birds caught whilst wearing the Birdsbesafe®
109 collar cover, compared to 36 birds when it was not applied. This led to an average capture rate for
110 each cat over the four weeks of 0.44 birds whilst wearing the Birdsbesafe® collar cover, and 1.89
111 birds when it was not worn. This equated to a decrease of 77.8% over the four weeks.

112 Responses were returned from 7 of the 12 owners who completed the study. Around 64% of cats
113 adjusted to the collar cover in less than a day, with only one cat taking several weeks and another
114 refusing to wear the collar cover. Overall, 86% (6 owners) of participants stated that they would
115 continue to use the Birdsbesafe® collar cover in the future. However, one participant stated that

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116 although they wished to use the Birdsbesafe® collar cover, they would not continue to replace it due
117 to its cost and it repeatedly becoming lost. This occurred because of the quick-release collars
118 underneath releasing, which caused the collar to become lost and the Birdsbesafe® collar cover
119 inevitably as well. Three owners stated that they liked the visibility that the collar cover offered to
120 drivers of motor vehicles. The owner who did not wish to use the Birdsbesafe® collar cover after the
121 study cited the main reason to be the recurrent loss of the collar. This was unsurprising given that
122 during the trial, 11 of the 13 original participants all experienced losses of the collar. There were no
123 reports of any discomfort requiring veterinary attention during the study period.

124 DISCUSSION

125 Our study suggests that the Birdsbesafe® collar cover could be effective at reducing predation rates
126 on birds by owned domestic cats under North European conditions. Our estimate that this measure
127 reduced predation by 78% is not dissimilar to the 50% and 83% reported in previous studies of this
128 collar cover (Hall et al., 2015; Willson et al. , 2015). It is important to note, however, that the
129 decrease observed in this study applies only to birds that the cat has brought home. All prey caught
130 will not be returned, as some may be eaten at the point of capture or be too big to carry home.
131 However, given that there were no large changes in behaviour observed by any of the owners, there
132 appears no evidence that wearing the Birdsbesafe® collar cover would influence their cats' decision
133 to bring their prey home. Future studies (perhaps using on-board cameras) could usefully test this
134 directly. There is no doubt that studies like ours that use prey returned home to estimate predation
135 rates by owned domestic cats will provide conservative estimates, but how conservative these are
136 remains unclear. The short duration over which the studies run may influence results; For example,
137 seasonality is known to impact predation rates. Our estimates can be considered conservative in
138 that we disregarded fledgling birds from our study, which occurred in autumn/winter. Seasonal
139 variation in presence of migrant birds may also be relevant. Although our small sample size and short
140 trial duration were sufficient to suggest a strong reduction in predation due to the application of a

141 collar cover, a larger-scale study would allow more confident estimation of the strength of this
142 effect. Further, a longer-duration study would allow evaluation of whether the effectiveness of the
143 collar cover declines as a result of cats changing their foraging behaviours to mitigate their effects.
144 Larger scale studies might also explore effects of sex, neutering and age possible co-variates.
145 Although our results add to the evidence that the Birdsbesafe collar cover can be effective, there are
146 challenges to achieving widespread uptake. At present the retail price of this product (£7.99 in the
147 UK) is considerably more expensive than a bell (Birdsbesafe LLC, 2019).

148 Both bells and the Birdsbesafe® collar cover require mounting on a collar, and there is insufficient
149 information on the opinions of cat owners towards collars and the prevalence of their use (Harrod et
150 al. 2015). It is likely that some owners may consider that microchipping removes the need for a
151 collar-based identity tag. Further, owners may consider discomfort to the cat, recurrent losses of
152 breakaway collars, or injury or snagging if the collar fails to release as reasons not to use a collar. , in
153 international comparisons, UK residents were least likely to view cats killing wildlife as a serious
154 problem, and least willing to support legislation to reduce cat-impacts on wildlife (Hall et al. 2016).
155 This suggests that—in addition to the other factors mentioned already—owner attitudes in the UK
156 may represent a significant impediment to the widespread uptake of Birdsbesafe collar covers in
157 that country. As such, studies assessing attitudes towards collars and changing perceptions would be
158 welcomed to allow understanding of whether collar-based devices would be applicable in the future.

159

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