



Do collar-mounted predation deterrents restrict wandering in pet domestic cats?



Catherine M. Hall, Kate A. Bryant, Joseph B. Fontaine, Michael C. Calver*

Environment and Conservation Cluster, School of Veterinary and Life Sciences, Murdoch University, Murdoch, Western Australia 6150, Australia

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ABSTRACT

Roaming pet cats kill and harass wildlife, hybridise with wild felids, interbreed with feral populations, spread disease or annoy neighbours, and endanger their own welfare by fighting, being struck by vehicles or ingesting poisons. Confinement of pet cats is unpopular, so alternative methods to curb roaming behaviour would benefit wildlife conservation and pet wellbeing. Some owners whose cats participated in previous trials testing the effectiveness of the collar-mounted predation deterrents the CatBib and the Birdsbesafe collar cover (BBS) in reducing predation by pet cats reported that their cats stayed closer to home when wearing the devices. Therefore we tested whether these devices might curb roaming behaviour of pet cats as an alternative to confinement.

Thirty cats participated. Trials occurred in spring and autumn in Perth, Western Australia (southern hemisphere spring–autumn). Cats wore GPS collars for 10 consecutive days, wearing the GPS collar alone for five days and wearing either a CatBib (16 cats) or BBS (14 cats) as well for a further five days. Treatment order was determined randomly for each cat. We represented cats' home ranges with 95% kernel density estimates (KDE) (100% minimum convex polygon (MCP) provided for comparison with other studies) and 50% KDE (core home range). We also used data for all cats when not wearing either predation deterrent, plus data on a further four cats, to determine the relative effect of sex, age, night confinement, housing density, number of days of rain, total rainfall, and mean maximum temperature on both estimates of home range size.

Neither device reduced home range significantly. The mean home range (95% KDE) was 2.79 ha with the CatBib and 2.46 ha without. Figures for the core home range (50% KDE) were 0.63 ha and 0.71 ha respectively. The mean home range (95% KDE) with the BBS (where the sample included fewer cats from lower housing densities) was 0.58 ha and 0.50 ha without. The means for the core home range (50% KDE) were 0.15 ha and 0.14 ha respectively. When cats were not wearing either device, 95% and 50% KDE were predicted most strongly by housing density, presumably a surrogate for cat density.

Owners may use a CatBib or BBS to curtail their cat's hunting behaviour, but curtailing roaming behaviour needs another solution. Confinement, although unpopular, remains the most effective option where unwanted roaming is a problem.

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1. Introduction

Wandering cats hunt wildlife (Baker et al., 2005; Hervías et al., 2014), compete for prey with higher order consumers (George, 1974), spread disease to humans or wildlife (Torrey and Yolken, 2003; Eymann et al., 2006; Izawa et al., 2009), exert sub-lethal effects such as changes in behaviour and reduced reproductive success via fear of predation (Preisser et al., 2005), hybridise with wild felids (Beaumont et al., 2001) or breed with stray and feral

cats (Jongman, 2007) to maintain feral populations. They may also be a nuisance to neighbours; disturbing dogs, attacking pet birds, spraying, digging in gardens, fighting (including with other pet cats) and walking on cars (Jongman, 2007; Toukhsati et al., 2012). In some cases, legislation includes measures that can be taken against such 'nuisance animals' (Lilith, 2007 and included references) or offended citizens may take action directly (e.g., examples in Grayson and Calver, 2004).

Wandering behaviour also impacts cat welfare. Traffic accidents are one of the highest causes of mortality for pet cats, especially juveniles (Rochlitz et al., 2001; Egenvall et al., 2009). Death or injury of cats in these events had considerable financial and emotional costs to owners in one region of the UK (see Rochlitz, 2004a,b).

* Corresponding author. Fax: +61 9360 6303.

E-mail address: m.calver@murdoch.edu.au (M.C. Calver).

Given the high frequency of road accident trauma for cats elsewhere (Egenvall et al., 2009; Calver et al., 2013) financial and emotional costs are likely to be widespread. It can also be difficult to reunite lost cats with their owners. Lord et al. (2007) found that only 53% of lost cats were recovered, including those that returned on their own. Some animal agencies in the US note that only 2–5% of pet cats are reclaimed by their owners (Humane Society of the United States, 2011). It is possible that some cats are euthanized before their owners contact the agencies because of the expectation that cats may wander and go missing for a few days before returning home (Lord et al., 2007). Wandering of entire (not desexed) cats also results in unwanted litters. New et al. (2004) estimated that 68% of cat litters in the US during 1996 were unplanned by their owners. They estimated that 150,000 kittens were euthanized and 320,000 were surrendered to animal shelters. Loyd et al. (2013) found that many cats exhibit risky behaviours when roaming, such as crossing busy roads, encountering strange cats, eating and drinking substances away from home, exploring drains and entering confined spaces beneath houses.

Despite these issues, cat owners are often reluctant to confine their cats at all times (Grayson et al., 2002; Dabritz et al., 2006; Liliith, 2007; Sims et al., 2008). While the incidence of confinement of pet cats may be as high as 76% in Singapore (Gunaseelan et al., 2013), this compares to 50–60% in the USA as a whole (Rochlitz, 2005), and less than 10% in Australia (REARK, 1994a,b; McHarg et al., 1995; Perry, 1999; Liliith et al., 2006) and the UK (Sims et al., 2008). Estimates of the home ranges of free-roaming pet cats vary from 0.24 ha (Kays and DeWan, 2004) to 0.92 ha (Meek, 2003) to 2.63 ha (Morgan et al., 2009), with substantial variation between individuals (Barratt, 1997). Cats living in rural areas or adjacent to remnant bushland have larger home ranges than cats in highly urbanised environments (Liliith et al., 2008; van Heezik et al., 2010), probably because of fewer contacts with other cats than in more densely populated areas. If an inexpensive collar-mounted device could reduce roaming, then predation, disease transmission and general nuisance attributed to pet cats could be reduced, as well as the risks of road accidents, fighting and unwanted litters. While owners may have reservations about the safety of collars (Lord et al., 2010), the risk of serious injury or death is low for correctly fitted and maintained safety collars (Brinkley, 2007; Lord et al., 2010; Calver et al., 2013).

The collar-mounted pounce protector the CatBib marketed by Cat Goods LLC, Portland, OR, USA (Cat Goods Inc, 2000) and the Birdsbesafe® cat collar cover marketed by Birdsbesafe LLC, Duxbury, VT, USA (Birdsbesafe LLC, 2009) (hereafter BBS) may be devices that reduce roaming. The CatBib reduces the number of vertebrate prey caught by pet cats, presumably by physically interfering with coordination of the paws during prey capture (Calver et al., 2007). However, it may be that cats wearing CatBibs are not travelling to areas where they encounter wildlife. Calver et al. (2007) found that the number of cats reported as wandering (missing from home for at least two days) while wearing a CatBib was less than that of cats that were not. Although the result was not statistically significant, the authors suggested it might indicate a change in the roaming behaviour for some cats while wearing the device that warrants a more rigorous test of the hypothesis than anecdotal reports. The BBS is a bright collar cover that reduces the number of bird and lizard prey by providing a visual warning of the cat's presence, allowing prey to escape (Hall et al., 2015; Willson et al., 2015). During the Hall et al. (2015) study, 20% of owners anecdotally reported that cats wearing the BBS changed their roaming behaviour either by staying closer to home or staying out more than normal. If evidence of changes in roaming behaviour can be found, the CatBib and the BBS could potentially offer an affordable option to owners to reduce their cats' wandering behaviour without confining them, as well as protecting wildlife from predation.

Therefore, this study used GPS radio-tracking to determine the home range size of 30 cats with and without a BBS or CatBib across a range of settings (rural–suburban–urban), evaluating evidence for shifts in roaming behaviour because of wearing the device, device type, and setting. We further evaluated environmental covariates of home range with a broader sample of cats to determine important factors predicting home range size. Findings underpin prior studies by investigating the mechanisms by which anti-predation devices function, potentially improving pet welfare and conservation outcomes.

2. Methods

2.1. Ethics statement

The study was conducted under permit R2468/12 of the Murdoch University Animal Ethics Committee and permit 2012/055 of the Murdoch University Human Research Ethics Committee.

2.2. Study site

The study was conducted from October 2012 to May 2013 and September 2013 to April 2014 (southern hemisphere spring–autumn) in Perth, Western Australia. This city experiences a Mediterranean climate with hot, dry summers and cool, wet winters. The study was not conducted through winter, based on the assumption that many cats would not spend as much time outside or travel as far in cold, wet conditions (Goszczyński et al., 2009).

2.3. Selection of cats, trial design and environmental variables

Thirty-five cats were involved in the study after their owners were recruited through personal contact with the authors or were suggested by another owner already recruited to the study. A cat was only accepted if the combined weight of the GPS collar and CatBib or BBS was less than 5% of its weight (i.e. the cat weighed over 3 kg).

All GPS collars, CatBibs and BBS were fitted during a home visit in which the importance of correct fit for safety was emphasised to owners. Twenty-nine cats were fitted with GPS collars for 10 consecutive days. Each cat alternated between five days wearing the GPS collar alone and five days wearing either a CatBib (15 cats) or BBS (14 cats) in addition to the GPS collar. The order was determined randomly for each cat. A further cat (Boo) in the CatBib group did not complete 10 days consecutively because he contracted an eye infection during the study and data collection was paused until after he recovered. Seven cats wore the CatBib first and nine wore it second, while the respective numbers for the BBS were seven and seven. This design ensured that all cats spent a period with and without the CatBib/BBS, as well as controlling for possible effects of the sequence of treatments.

A further five cats were withdrawn from the study before they had completed the trial because the owners felt the cats were unhappy. Four of these cats had completed part of the trial with the GPS collar only and these data were used for some of the analyses (see below). Data from one cat were excluded because she only completed four days with the GPS collar and BBS.

All cats were desexed prior to the study. Of the 16 cats that trialled the CatBib, 13 were male and three were female. The average age was seven and the range one to 18 years old. Of the 14 cats that completed the trial with the BBS, eight were male and six were female. The average age was six years and ranged from two to 12 years old. Of the four cats that were used for roaming predictor analysis only, all were male and the average age was two, ranging from one to four years old (Table 1). Based on owners' assessments, nine cats were defined as hunters (i.e. bring at least one prey item home

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