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Reducing the rate of predation on wildlife by pet cats: The efficacy and practicability of collar-mounted pounce protectors

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ABSTRACT

We evaluated whether a collar-worn pounce protector, the CatBib™, reduces the number of vertebrates caught by pet cats and whether its effectiveness was influenced by colour or adding a bell. Fifty-six cats identified as hunters were studied in Perth, Australia over six weeks in November/December 2005 (southern hemisphere spring/summer). Cats spent three weeks wearing a device and three weeks without it and we recorded the number of prey brought home during each period.

Cats caught 65 birds (13 species), 67 herpetofauna (11 species) and 164 mammals (five species). Alone or together with bells CatBibs stopped 81% of cats from catching birds, 33% from catching herpetofauna and 45% from catching mammals. Cats wearing CatBibs or CatBibs and bells caught only 25% of all birds, 43% of all herpetofauna and 36% of all mammals captured. Both colours were equally effective. Adding bells conferred no additional protection. Only one cat did not adjust to the CatBib and there was no long-term evidence that CatBibs altered cats' fighting or wandering behaviour.

Owners volunteered because of one or more of: environmental concern (81%), curiosity (38%), personal (35%) or family (24%) distress caused by hunting. Most owners (70%) said they would continue to use CatBibs although only 17% were doing so eight months later because some cats had stopped hunting or lost their CatBibs. Although confinement of pet cats is the complete solution to preventing predation on wildlife, deterrents such as the CatBib are effective if used consistently.

1. Introduction

The loss of natural habitat to urban expansion is increasing the importance of gardens as wildlife habitat and raising concerns about the interactions of companion animals and wildlife in urban, rural and semi-rural areas (Ruxton et al., 2002; Grayson and Calver, 2004; Lepczyk et al., 2004). In this context, many international studies confirm that pet cats *Felis catus* (Mammalia: Felidae) kill large numbers of wildlife (e.g., Churcher and Lawton, 1987; Barratt, 1998; Gillies and Clout, 2003; Woods et al., 2003; Lepczyk et al., 2004). Although there is vigorous debate over whether this leads to declines in prey populations (e.g. Bomford et al., 1995; Patronek, 1998; Risbey et al., 1999), the precautionary principle argues that uncertainty over the extent of environmental impact should not prevent ameliorative action while further research is undertaken

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(Deville and Harding, 1997; Calver et al., 1999; Grayson and Calver, 2004).

Grayson et al. (2002) and Lilith et al. (2006) found that 70% or more of surveyed cat-owners in different suburbs of Perth, Western Australia, supported introducing regulations requiring sterilisation of pet cats and limitations on the numbers that could be owned by a household. Similar proportions of owners agreed that they would keep their cats inside at night and register and tag them if required, but only a minority of owners were prepared to confine their cats to their property at all times or to support cat exclusion zones. Given that background, effective collar-worn devices that reduced predation by cats roaming freely during the day would complement the other legislative steps if they were enforced.

Several collar-worn devices are marketed to reduce predation by pet cats. Recent studies of their effectiveness suggest that bells reduce prey captures by 34–48% (Ruxton et al., 2002; Woods et al., 2003; Nelson et al., 2005) and that electronic warning devices (battery powered alarms or lights activated when cats pounce) achieve a 38–51% reduction (Nelson et al., 2005). One device not yet tested is the pounce protector, a lightweight neoprene bib worn on a collar. It may function either as a visual warning to prey or a barrier to paws when pouncing, reducing hunting success. This study assessed the effectiveness of the CatBib, a pounce protector marketed by Cat Goods Inc. (Oregon, USA), in reducing predation by pet cats in an Australian suburban context.

2. Methods

2.1. *Description of the CatBib and cats' behaviour when wearing it*

The CatBib is made of neoprene, a light, strong, flexible and tear resistant synthetic fabric used in wetsuits (Fig. 1). It attaches to the front of a collar via hook and loop pads (velcro), which can release if the CatBib snags. When positioned correctly, the CatBib hangs in front of the cat's chest. The cat can push it to one side for grooming, after which it swings back to its normal position. Although there is only one size, varying the point of attachment of the CatBib allows some size adjustment for large or small cats. They are available in five colours, two of which (teal and purple) were tested in this study. The retail price is $8.95 (US), without a collar. The manufacturer recommends that the cat wears the CatBib whenever it is outside. During this study owners were asked to ensure that their cats always wore CatBibs when outside during treatment weeks.

Given the novel concept of the CatBib, prior to the main study we fitted cats with CatBibs and videoed their responses over the next 1–2 h. Without impediment, cats ran, jumped, climbed, groomed, and chased moving objects including toy prey. Importantly, they ate normally and had no difficulty picking up and carrying objects including toy prey. While none of these cats participated in the main study, we concluded that cats in the study were most unlikely to be distressed and that if they did manage to catch prey they would be able to carry it home.

Fig. 1 – A correctly fitted CatBib. Photograph © Jiri Lochman, Lochman Transparencies.

2.2. *Study site, experimental design and data collection*

The study took place in Perth, Western Australia over a six-week period in November/December 2005 (southern hemisphere late spring/early summer). The city has a Mediterranean climate and experiences six months of hot, dry weather each year, encouraging the outdoor husbandry of cats. In October 2005, 62 volunteers were accepted from 82 respondents to advertisements in local newspapers seeking assistance from owners of cats that were active hunters. Respondents whose cats did not catch on average one prey every three weeks were declined. Most volunteers came from the outer suburban foothills where cats have ready access to native bushland. All cats were neutered and there were 34 males and 28 females.

We allocated male and female cats randomly to four treatments: teal CatBib only, teal CatBib plus a bell, purple CatBib only and purple CatBib plus a bell. Half the cats in each treatment were fitted with the device for three weeks followed by three weeks without the device, while the others were monitored for three weeks without the device followed by three weeks with it. All collars and CatBibs were fitted initially during a home visit. Cats not already wearing a collar were given at least one week to adjust to the collar before the CatBib was fitted. We used safety collars designed to release promptly if the cat was snagged.

Owners collected any dead prey brought home by their cats and reported instances where live prey were rescued and released. All cases where the prey was dead or was released only after intervention by the owner were recorded as captures. If the owner saw a cat with a prey animal but it escaped without

the owner's intervention, no capture was recorded. Prey bodies were identified to species. Most prey released after owner intervention were classed simply as mammals, birds or herpetofauna (reptiles or frogs) unless the owner provided a clear description identifying the species conclusively.

Fifty-six cats completed the full trial. One cat was excluded because of misunderstandings over the procedures to be followed and another because it did not adjust to the CatBib. Owners withdrew four cats from the study. Two cats belonging to the same owner were withdrawn after one caught a paw in an ill-fitted collar, one required significant veterinary treatment after fight-related injuries and another was withdrawn because a puppy in the household kept tugging on the CatBib.

At the beginning of the study all 62 participating owners were interviewed regarding their reasons for volunteering. The 56 owners whose cats completed the study were also interviewed at the end to assess their experiences with the CatBib. Fifty-five of them (one was unavailable) were contacted again eight months after the trial to determine the longer-term behaviour of their cats and their own experiences and satisfaction.

2.3. Statistical analysis

The number of cats catching prey during the trial were organised into a multi-way contingency table using the categories of Treatment (teal only, teal plus bell, purple only, purple plus bell), Application (treatment on or treatment off) and Prey taxon (birds, mammals and herpetofauna). Sex of cat and sequence of treatment (whether the treatment was applied in the first or second block of three weeks) were not considered because a five-way design left too few cats in each cell of the final table for a frequency-based analysis. The table was analysed using log-linear analysis. This uses a model-fitting approach to determine the most economical combination of main effects and interactions that best describes the data. The significance of effects of interest in the model is tested by removing them from the model and noting changes in the fit of the model to the observed data.

The total numbers of prey caught by each cat when wearing the treatment and when not wearing the treatment were used as dependent variables in repeated measures ANOVA after logarithmic transformation to correct for heteroscedasity. The factors were Treatment (teal only, teal plus bell, purple only, purple plus bell), Sequence (treatment on first, treatment on second), Sex (male and female) and Application (treatment on or treatment off) (the repeated measures factor). Cat age was included as a covariate and the three prey categories (mammals, birds and herpetofauna) were analysed separately in keeping with the recommendation of Hurlbert and White (1993). We did not attempt a week-by-week analysis because this increased the proportion of cells with zeroes. However, to check for the possibility that cats learned to overcome the treatments we ran a one-way repeated measures ANOVA on the logarithm of the total number of prey captured on each of the three weeks when treatments were applied, incorporating the Greenhouse–Geisser correction because there were more than two levels of the repeated measures factor (von Ende, 2001). Cat age was included as a covariate.

Owner responses to interview questions were tabulated and, where appropriate, χ^2 analysis was used to test for associations between factors such as wearing of CatBibs and behavioural change.

3. Results

3.1. Characteristics of cats and cat husbandry

The 62 cats accepted had a mean age of 5 years (females) and 4.5 years (males). Most were not pure breeds, but there were some pure breed Russian Blues and Burmese, one pure breed Persian and one pure breed Abyssinian. Eight lived entirely outdoors, while the others were allowed indoors at least some of the time. Only six cats were occasionally restricted indoors.

3.2. Prey capture and effectiveness of treatments

During the trial, the cats caught 65 birds from 13 species (11 native), 67 herpetofauna from 11 species (all native) and 164 mammals from five species (two native) (Table 1). The southern brown bandicoot (*Isoodon obesulus*) was the only prey of conservation concern (Lower Risk, Near Threatened: Maxwell et al., 1996). All rabbits (*Oryctolagus cuniculus*) caught were juveniles but only two birds were clearly fledglings. Given the study design, we could not tell if any prey were injured when caught. On average, each cat caught 2 mammals, 1.1 birds and 1.2 herpetofauna.

Alone or in conjunction with a bell CatBibs stopped 81% of cats from catching birds, 33% of cats from catching herpetofauna and 45% of cats from catching mammals (Table 2). Log-linear analysis of these data fitted a model with only one main effect (application: whether the treatment was on or off) and no interactions ($\chi^2_{17} = 12.15$, $p = 0.95$). The main effect of application was highly significant ($\chi^2_1 = 13.74$, $p < 0.001$).

Cats wearing CatBibs or CatBibs and bells caught only 25% of all birds, 43% of all herpetofauna and 36% of all mammals captured during the study (Table 3). Repeated measures ANOVA confirmed that treatment application significantly reduced mean prey capture for mammals ($F_{(1,40)} = 5.11$, $p = 0.03$) and birds ($F_{(1,40)} = 10.72$, $p < 0.01$) but not for herpetofauna ($F_{(1,40)} = 0.39$, $p = 0.53$) (Fig. 2). Birds also showed a significant interaction between the effectiveness of the treatment and the order with which it was applied ($F_{(1,40)} = 4.28$, $p = 0.04$). Cats that had their treatment applied first followed by a control period without it showed a smaller difference between the numbers of birds caught in the two periods than cats that had the treatment applied after the control period of three weeks (Fig. 3). No other main effects or interactions were significant. Prey capture was not related to the covariate Age for mammals, birds or herpetofauna ($p > 0.4$ for mammals and birds and $p > 0.07$ for herpetofauna).

The numbers of all prey caught by cats across the three weeks when treatments were applied did not vary, so there was no evidence that cats learned to overcome the treatments ($F_{(2,110)} = 0.14$, p (after Greenhouse–Geisser correction) = 0.85). Age did not influence the number of prey caught each week ($p > 0.3$ in all weeks).

Table 1 – List of birds, mammals and herpetofauna (reptiles and amphibians) caught by volunteer cats during the 6-week trial

Prey category	Common name	Scientific name
Bird		
	Australian Raven[b]	*Corvus coronoides*
	Australian Ringneck[b]	*Platycercus zonarius*
	Brown Honeyeater[b]	*Lichmera indistincta*
	Common Bronzewing[b]	*Phaps chalcoptera*
	Grey-breasted White-eye[b]	*Zosterops lateralis*
	Laughing Turtle-Dove	*Streptopelia senegalensis*
	Western Little Wattlebird[b]	*Anthochaera lunulata*
	Australian Magpie[b]	*Cracticus tibicen*
	New Holland Honeyeater[b]	*Phylidonyris novaehollandiae*
	Red Wattlebird[b]	*Anthochaera carunculata*
	Regent Parrot[b]	*Polytelis anthopeplus*
	Singing Honeyeater[b]	*Lichenostomus virescens*
	White-browed Scrubwren[b]	*Sericornis frontalis*
Herpetofauna		
	Callose-palmed Shinning-skink[b]	*Cryptoblepharus plagiocephalus*
	Dwarf Bearded Dragon[b]	*Pogona minor*
	Legless lizard[b]	Family Pygopodidae
	Marbled Gecko[b]	*Christinus marmoratus*
	Shingle-back[b]	*Tiliqua rugosa*
	Slender Tree Frog[b]	*Litoria adelaidensis*
	Western Three-lined Skink[b]	*Acritoscincus trilineata*
	Thick-tailed Gecko[b]	*Underwoodisaurus milii*
	West-coast Laterite Ctenotus[b]	*Ctenotus fallens*
	Western Green and Golden Bell Frog[b]	*Litoria moorei*
	Western Limestone Ctenotus[b]	*Ctenotus australis*
Mammals		
	Black Rat	*Rattus rattus*
	House Mouse	*Mus musculus*
	Lesser Long-eared Bat[b]	*Nyctophilus geoffroyi*
	Rabbit (juveniles)	*Oryctolagus cuniculus*
	Southern Brown Bandicoot[ab]	*Isoodon obesulus*

Common and scientific names for the birds are taken from Johnstone (2001). Scientific names of the herpetofauna and the mammals are taken from Aplin and Smith (2001) and How et al. (2001), respectively, while the common names for these groups are from Clayton et al. (2006).
a Species of conservation concern.
b Native species.

3.3. *Cat behaviour, owner interviews and animal welfare issues*

3.3.1. *Cat behaviour*

Most cats (89%) adapted almost immediately to the CatBib, 10% took up to a week and the only cat that did not adjust was withdrawn from the trial. Seven cats lost their CatBib at least once during the trial and one lost its CatBib six times. Fighting was common, with two cats wearing CatBibs and nine cats not wearing CatBibs suffering fight-related injuries (scratches, bites, abscesses) over the six-week trial. Fighting was not significantly associated with wearing a CatBib ($p = 0.09$, two-tailed Fisher's exact test). Four cats, only one of which was wearing a CatBib, disappeared from their homes for at least two days at some point during the trial. Wandering was not significantly associated with wearing a CatBib ($p = 0.61$, two-tailed Fisher's exact test).

Data were available for 52 cats eight months later (six cats did not complete the trial, three had died and one owner was unavailable). One of the 17 cats still wearing a CatBib was reported as fighting compared to nine of the 35 cats not wearing a CatBib, but there was no significant association ($p = 0.26$, two-tailed Fisher's exact test). One of the 17 cats still wearing a CatBib was reported as wandering compared to seven of the 35 cats not wearing a CatBib but the association was not significant ($p = 0.41$, two-tailed Fisher's exact test). Eight cats had lost their CatBibs.

3.3.2. *Owner interviews*

Owners of the 62 cats commencing the study volunteered because of one or more of: concern for the environment (51), curiosity (24), personal (15) or family (22) distress because of their cat's hunting. Most owners had tried one or more methods to reduce their cat's hunting before joining the trial: 36 confined the cat at night, 51 placed a bell on the collar, six experimented with changes in diet and 13 scolded the cat verbally or splashed it with water. Of the 56 owners whose cats completed the trial, 25 believed that the CatBib worked, 25 believed that it did not and the remainder were unsure. Nevertheless, 39 (70%) planned to use the CatBib in future.

Table 2 – Number of cats catching prey with and without the treatment applied

Treatment	Prey	Application	
		Treatment on	Treatment off
Teal CatBib	Bird	2	8
	Herpetofauna	3	4
	Mammal	3	6
Teal CatBib + Bell	Bird	1	9
	Herpetofauna	1	4
	Mammal	3	9
Purple CatBib	Bird	1	5
	Herpetofauna	2	3
	Mammal	3	6
Purple CatBib + Bell	Bird	1	4
	Herpetofauna	4	4
	Mammal	7	8
Total (all treatments)	Bird	5	26
	Herpetofauna	10	15
	Mammal	16	29

Table 3 – Total number of prey caught by cats in each treatment

Treatment	Prey	Application		
		Treatment on	Treatment off	Total
Teal CatBib	Bird	10	15	25
	Herpetofauna	15	19	34
	Mammal	22	31	53
	Total	*47*	*65*	*112*
Teal CatBib + bell	Bird	2	17	19
	Herpetofauna	2	6	8
	Mammal	12	29	41
	Total	*16*	*52*	*68*
Purple CatBib	Bird	2	11	13
	Herpetofauna	6	6	12
	Mammal	11	20	31
	Total	*19*	*37*	*56*
Purple CatBib + bell	Bird	2	6	8
	Herpetofauna	6	7	13
	Mammal	14	25	39
	Total	*22*	*38*	*60*
Total prey caught (all treatments)	Bird	16	49	65
	Herpetofauna	29	38	67
	Mammal	59	105	164
	Total	*104*	*192*	*296*

Follow-up interviews eight months later with the 55 available owners whose cats completed the trial found that 32 (58%) were satisfied that the CatBib reduced hunting behaviour. Seventeen of them were still using the CatBib, seven said that their cats had stopped hunting but they would use the

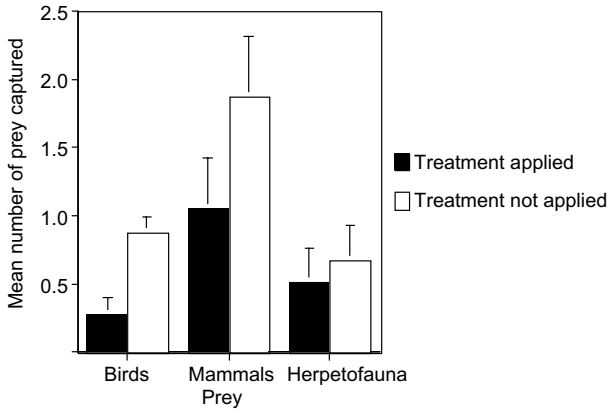

Fig. 2 – Mean numbers (with standard error bars) of three different prey taxa caught by cats when wearing or not wearing treatments.

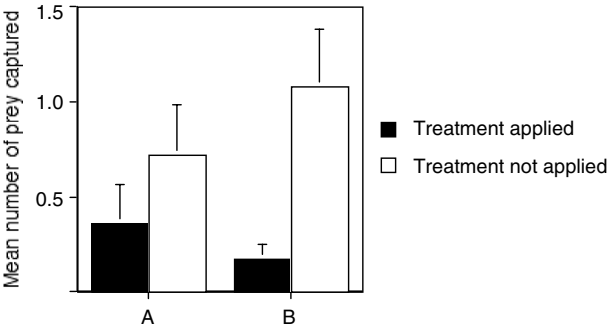

Fig. 3 – Mean numbers (with standard error bars) of birds caught by cats when wearing or not wearing treatments: A, treatment first and control second; B, control first and treatment second.

CatBib again if the problem recurred and eight reported their cats had lost their CatBibs and they wanted to replace them. Of the owners who had discontinued use, six said they did not like the CatBib and 14 said it did not work. The remaining three cats had died.

3.3.3. *Animal welfare issues*

During the study the only animal welfare issue related clearly to the CatBib arose when a cat caught a paw in an ill-fitting collar. Another cat had a similar accident in the eight months after the study ended and needed significant veterinary treatment. By contrast, a high number of unrelated animal welfare issues were reported arising from cats fighting and wandering both during the study and in the eight months afterwards. In the long-term one cat lost a front leg in a road accident, two were poisoned and one broke both her canines in a fall from a roof. Of the 10 cats reported as fighting in the eight months after the study, one suffered muscular injuries, two received veterinary treatment for abscesses and one owner self-treated her cat's abscesses.

4. Discussion

4.1. *Number and type of prey caught*

Previous studies of predation by pet cats in Australia, New Zealand, the United States and the United Kingdom have shown very high variability in the hunting activity of individual cats and considerable variation in the number and type of prey caught depending on local opportunity (e.g. Churcher and Lawton, 1987; Barratt, 1997, 1998; Gillies and Clout, 2003; Woods et al., 2003). For example, cats in rural areas may take more prey than their suburban counterparts (Paton, 1991) and cats in warmer climates often take more lizards than cats from temperate regions (Perry, 1999).

The 56 cats completing this study were known hunters monitored for only six weeks in late spring/early summer. Therefore, it is inappropriate to regard the 296 prey caught (an average of 0.9 prey/cat/week) as representative of the likely impact of the pet cat population in Perth on suburban wildlife. However, the data do indicate the range of prey taxa potentially at risk in this environment.

4.2. *Effectiveness of the CatBib*

CatBibs alone or in conjunction with bells reduced markedly the numbers of cats catching prey and the absolute numbers of mammals, birds and herpetofauna caught (although the herpetofauna results were not statistically significant). There was no evidence that CatBibs of different colours differed in effectiveness, that adding bells conferred additional protection or that the effectiveness of treatments declined with time. Interviews with owners suggested that some cats stopped hunting after a period wearing a CatBib and there was statistical evidence of such an effect in relation to captures of birds. Hunting behaviour might decline without positive reinforcement.

Comparisons of the relative effectiveness of CatBibs, bells and electronic warning devices must be made cautiously because no researcher has tested them all simultaneously and not all studies report significance testing for specific taxa of prey. However, the reductions in total numbers of prey caught by cats wearing CatBibs or CatBibs and bells in this study are similar to or better than those reported for the other devices in the United Kingdom by Ruxton et al. (2002),Woods et al. (2003) and Nelson et al. (2005). The 67% reduction in the numbers of birds caught by cats fitted with a CatBib or a CatBib and a bell compares favourably to the figures of 37% for bells alone and 49% for electronic warning devices alone (based on Table 2 of Nelson et al., 2005), 46% for bells alone (Ruxton et al., 2002) and no change for bells alone (Woods et al., 2003). The 44% reduction in the numbers of mammals caught by cats fitted with a CatBib or a CatBib and a bell is similar to the figures of 34% for bells alone and 38% for electronic warning devices alone (Nelson et al., 2005), 51% for bells alone (Ruxton et al., 2002) and c. 44% for bells alone (estimated from Fig. 5 of Woods et al., 2003). The 24% reduction for herpetofauna (albeit not statistically significant) when using the CatBib may be superior to the 9% reduction in the number of amphibians caught by cats wearing bells (Ruxton et al., 2002) and no change for herpetofauna caught by cats wearing bells (Woods et al., 2003). Nelson et al. (2005) did not have an adequate sample size to assess impacts on herpetofauna with either bells or electronic warning devices.

4.3. *Pet welfare and behavioural changes*

Pet welfare is an important consideration for owners contemplating using a deterrent device. Most of the 62 cats that began the study (88%) adapted almost immediately to the CatBib, 10% took up to two days and only one cat did not adjust. While no safety issues caused by the CatBibs themselves were reported, two cats caught paws in their collars at some stage despite use of safety collars and careful instructions to owners on the importance of maintaining a correct fit. This is an unavoidable safety consideration with all collar-worn devices and owners should be aware of the risk and how to minimise it (Nelson et al., 2005 also endorse using safety collars). Far more welfare issues arose from outdoor husbandry of the cats. Over six weeks 11 of the 62 cats that began the study were injured in fights. In the eight months from the end of the study, two of the 55 cats were killed and six injured in situations attributable to roaming. While there was no statistically significant evidence that cats wearing CatBibs were less likely to fight and wander, the data do point in that direction and further investigation is warranted.

4.4. *Motivation to use a deterrent device*

Motivation to use a deterrent device may be high in Australia, where cat ownership is declining in contrast to the increased popularity of pet cats in Europe and the United States (REARK, 1994; Perry, 1999; Chaseling, 2001; McGreevy et al., 2002; Baldock et al., 2003). One significant reason may be a widely held view in Australia that pet cats are bad for wildlife either by roaming and hunting in remnant bushland or by excluding wildlife from domestic gardens (Baldock et al., 2003; Grayson et al., 2002; Lilith et al., 2006). Owners may therefore feel social pressure to be responsible with regard to wildlife. This is supported by the strong response to our advertisements for volunteers and the concern many volunteers expressed for the environment.

While we are unaware of surveys of cat-owners' attitudes in the United States, the United Kingdom or New Zealand, there are several studies of the predatory or roaming behaviour of pet cats in all three countries (e.g. Churcher and Lawton, 1987; Gillies and Clout, 2003; Woods et al., 2003; Kays and DeWan, 2004; Lepczyk et al., 2004). Furthermore, the first studies of the effectiveness of deterrent devices were done in the United Kingdom and the CatBib tested in this paper was developed and marketed in the United States. Therefore there is likely to be strong owner motivation to ameliorate predation in the United States and the United Kingdom and possibly New Zealand as well.

Given the likely high motivation of the owners involved in our study, the acceptance of the CatBib was modest. Thirty-two of the 55 owners (58%) interviewed eight months after the study were positive and the CatBib was an acceptable solution for them. The others rejected it either because they felt it did not work or they did not like it.

4.5. *What is the place of deterrent devices in wildlife conservation?*

Ruxton et al. (2002), Nelson et al. (2005) and Woods et al. (2003) were positive about the potential of deterrent devices to reduce predation by pet cats. We see no reason to doubt these claims and add that pounce protectors represent another valid choice for owners. Alone or in combination, these deterrent devices may lead to reductions of 50% or more in the numbers of prey taken by pet cats and may stop some cats from hunting altogether. They cause no significant cat welfare issues beyond the risk inherent in wearing a safety collar, so we believe that their use should be encouraged.

Nevertheless, deterrent devices are not a panacea for several reasons. Firstly, predation may not be a major cause of wildlife decline in suburbia although it is a convenient scapegoat (Fitzgerald, 1990; Nattrass, 1992; Patronek, 1998; Chaseling, 2001). Attention to other issues such as housing density, road design and retention and management of remnant native vegetation may bring greater benefits than encouraging owners to use deterrent devices (e.g. Grayson et al., 2007). Secondly, the potential impacts of pet cats on wildlife include the transmission of pathogens, including *Toxoplasma gondii* (Dabritz et al., 2006; Eymann et al., 2006) and *Sarcocystis neurona* (Stanek et al., 2003). This risk can only be ameliorated if pet cats are confined.

Despite the unpopularity of confinement in surveys of cat owners (Grayson et al., 2002; Lilith et al., 2006), it offers considerable cat welfare benefits including protection from fighting and road accidents (Rochlitz, 2003a,b, 2004), as well as reducing risks from predators such as red foxes (*Vulpes vulpes*) and coyotes (*Canis latrans*) in some areas. Our study gave us an insight into the scope of injuries to roaming cats so there is a powerful cat welfare argument for confinement, let alone the wildlife protection benefits.

On balance, we believe that deterrent devices such as the CatBib and other options should be encouraged as effective and reasonably safe measures to reduce predation on wildlife by free-ranging pet cats while research continues to establish the full range of causes of wildlife decline in suburbia. Although confining cats may be unpopular, this more effective measure could be promoted by emphasising its benefits for cat welfare.

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