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Original Research Article

Ultrasonic deterrents reduce nuisance cat (*Felis catus*) activity on suburban properties

Heather M. Crawford, Joseph B. Fontaine, Michael C. Calver*

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

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ABSTRACT

Urban environments are increasingly important for biodiversity conservation, but pet cats threaten wildlife therein, displaying nuisance behaviour such as hunting, fighting, fouling and urine spraying. In an attempt to empower landholders wishing to reduce cat incursions humanely, we tested the effectiveness of two ultrasonic cat deterrents (CatStop© and On-Guard Mega-Sonic Cat Repeller©).

After confirming in arena trials that cats detect and respond negatively to an ultrasonic device, we tested both deterrents in 18 suburban gardens in Perth, Western Australia. Camera monitoring at foci of cat activity (e.g. fish ponds, property entry/exit points) occurred for two weeks before (Period 1: device off), during (Period 2: device on) and after (Period 3: device off) the activation of deterrents. Data included individual cat demographics and behaviours, number of cat detections per site per day per sampling period, the duration of cat activity, and detection of non-target species.

Seventy-eight unique cats were detected at 17 of 18 garden sites (2–9 cats/garden). Over half the cats could be sexed (56.4%, with 65.1% males). Nearly 53.0% of cats were confirmed to be pets living nearby. Cats that were most active in period 1 ($\geq$100 s total activity duration) were classified as 'residents'; all others were 'peripherals'.

Overall, the ultrasonic deterrents reduced the frequency of incursions into gardens by resident cats by 46%, while the duration of incursions was reduced by 78%. Cat activity declined significantly from period 1 (baseline) to period 2 for resident cats but not peripheral cats (50% reduction; $p = 0.001$), and remained depressed in period 3 for resident cats but not peripheral cats ($p < 0.001$). Peripheral cat activity remained at an unchanging low level across all three periods. Males were slightly more active than females over the experiment ($p = 0.04$), but sexes did not vary in response to deterrents ($p > 0.05$). Cats confirmed as owned (53% of cats) generated more activity than cats of unknown ownership status ($p = 0.03$), probably reflecting proximity of their residences to trial gardens. Both deterrent models had similar effects ($p = 0.89$).

By allowing pets to roam, cat owners are complicit in cat nuisance. This requires public education. Ultrasonic deterrents offer a cost-effective, humane option to reduce incursions by unwanted cats. Ultrasonic deterrents will not prevent all incursions, but they reduce their frequency and duration. Reduced cat activity has flow-on benefits to wildlife across a variety of urban-suburban settings, including gardens and parks.

Abbreviations: CS, CatStop Ultrasonic Cat Deterrent©; OG, On-Guard Mega-Sonic Cat Repeller©; AUD, Australian Dollar.

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

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1. Introduction

Wildlife conservation in cities presents a paradox. On the one hand, as human modification of landscapes intensifies, urban and suburban environments are growing in importance for biodiversity conservation (Ives et al., 2016). Gardens, parks and small reserves provide habitat for resident and migratory wildlife, while encouraging human residents to interact with greenspaces and wildlife (Cox and Gaston, 2016; Daniels and Kirkpatrick, 2006; Fernández-Juricic and Jokimäki, 2001; Nielsen et al., 2014). On the other hand, the most popular pets in cities are dogs (*Canis familiaris*) and cats (*Felis catus*) that may threaten urban wildlife (Baker et al., 2010).

Interactions between pet cats (those fully dependent on a human household but wandering at will), semi-feral cats (partially provisioned by people and including what some authors term 'stray cats' or 'feral cats') and wildlife in cities are especially contentious because of the value placed on cats as companion animals, and the risk posed by their predatory behaviour (Baker et al., 2010; Calver et al., 2011; Mameno et al., 2017). The popularity of cats as companion animals is increasing, with cat ownership approaching that of dog ownership in many countries (AMA, 2016; FEDIAF, 2014) and even surpassing dogs in New Zealand (NZCAC, 2016) and the United States of America (APPA, 2015–2016). Cat densities increase with human density, such that cities support cat numbers >100/km^2 (Liberg et al., 2000). Densities of semi-feral cats are particularly high where there is uncontrolled breeding (e.g. 344–976 cats/km^2 across Tel Aviv, Israel, Finkler et al., 2011a), and ample food subsidies (human garbage, Mirmovitch, 1995; feeding strays, Natoli et al., 1999). People also form bonds with semi-feral cats (Toukhsati et al., 2012; Zasloff and Hart, 1998; Zito et al., 2015), leading to establishment of legal and illegal cat colonies in many cities (Aguilar and Farnworth, 2013; Mameno et al., 2017; Tan et al., 2017).

Regardless of ownership status, roaming cats threaten wildlife through predation (Hall et al., 2015; Loss et al., 2013; Loyd et al., 2013a; McRuer et al., 2017), disease transmission (Hellard et al., 2011) or sub-lethal effects such as avoidance-through-fear (Beckerman et al., 2007; Bonnington et al., 2013; Dauphiné and Cooper, 2009). Cats also threaten human health by transmitting pathogens and parasites (e.g. *Toxoplasma gondii*, Dabritz and Conrad, 2010; *Toxocara cati*, Alonso et al., 2001; rabies and plague, Taetzsch et al., 2018; Yamaguchi et al., 1996); endanger their own welfare from road accident trauma (Rochlitz, 2003a, 2003b), accidental poisoning (Xavier et al., 2002), disease transmission (Feline Immunodeficiency Virus, Natoli et al., 2005), fighting (Calver et al., 2007; Finkler et al., 2011b), larger predators such as coyotes (*Canis latrans*, Gehrt and Riley, 2010), exploring dangerous locations (Loyd et al., 2013b) and encountering human persecution (Vnuk et al., 2016). Cats also cause significant nuisance for property owners, cat owners and non-cat owners alike (e.g. urine spraying, caterwauling, Uetake et al., 2014).

Despite extensive research into these issues, state and municipal authorities may be unwilling to legislate total confinement of pet cats because of perceptions of cruelty (Sandøe et al., 2017), or because some restrictions are unpopular with small but vocal groups of cat-lovers (Marra and Santella, 2016). With regard to semi-feral cats, lethal control is accepted in some scenarios (Lohr et al., 2013; Lohr and Lepczyk, 2014; Lohr et al., 2014) but can be controversial in others (Mameno et al., 2017; Peterson et al., 2012), while Trap-Neuter-Release is also divisive, because although no cats are killed, desexed cats remain in the environment and the success of the method in reducing cat numbers is disputed (for alternative views, see Longcore et al., 2009, Spehar and Wolf, 2018). Therefore, individual householders seeking to reduce nuisance or enhance wildlife protection by discouraging cat incursions onto their properties need affordable, humane strategies that mitigate human-feline conflict at the local, individual citizen level.

Commercially available ultrasonic deterrents may be appropriate for use against encroaching cats in domestic suburban gardens. Cats have evolved an extremely broad hearing range and are particularly sensitive to high-frequency sounds (6.6 octaves, 0.5–32 kiloHertz, Heffner and Heffner, 1985), similar to vocalisations made by their rodent prey (Portfors, 2007). Consequently, cats triggering the motion sensors of ultrasonic deterrents receive a blast of ultrasonic sound intended to evoke alarm and flight. Nelson et al. (2006) found that the Catwatch© ultrasonic device reduced the probability of incursions by approximately 32.0% and the duration of incursions by up to 38.0% in a United Kingdom suburban setting. Mills et al. (2000) reported that the Pestaway Champ© ultrasonic device did not cause physical or enduring pain, although they found no evidence of a deterrent effect in a test arena setting.

With the explicit goal of empowering private property owners with a low-cost humane solution to nuisance cat activity, including cases where nuisance cats hunt wildlife, ultrasonic deterrents were trialled in two stages. Firstly, in a controlled setting we established whether: 1) cats detected the ultrasonic sound produced by a commercial deterrent, and 2) cat reactions were positive, neutral or negative. Secondly, trials against roaming cats were carried out in domestic gardens of landholders who reported regular nuisance cat activity. Garden trials utilised a Before-During-After experimental design to confirm whether: 3) cats reduced their activity in gardens when deterrents were activated. We extended the work of Nelson et al. (2006) by following their suggestions for improving the placement of devices, as well as using motion-sensitive cameras to automate continuous monitoring of cat incursions as an alternative to landholder perceptions of cat activity over specified short monitoring periods.

2. Methods

2.1. Study area

All studies were carried out in the city of Perth, capital of the state of Western Australia, and fourth largest city in Australia (ABS, 2016a). A population of 2.02 million inhabits a land area of 6,420 km^2 (ABS, 2016b). Suburban developments are extensive with 77.1% of people living in houses, 16.0% in townhouses and 6.9% in apartments/other.