

RESEARCH ARTICLE



Hunting behaviour in domestic cats: An exploratory study of risk and responsibility among cat owners

Sarah L. Crowley | Martina Cecchetti | Robbie A. McDonald

Environment and Sustainability
Institute, University of Exeter, Penryn,
Cornwall, UK

Correspondence

Sarah L. Crowley, Environment and
Sustainability Institute, University of Exeter,
Penryn, Cornwall, UK.
Email: s.crowley@exeter.ac.uk

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Abstract

1. The potential impact of domestic cats on wildlife is the subject of growing international interest and concern. While feral cats are often the primary focus of research and debate, in many societies a substantial proportion of domestic cats are owned by private individuals. We present a typology that classifies domestic cats in relation to varying degrees of human control over their reproduction, movement, and provisioning. Understanding the perceptions and practices of cat owners will be key to identifying and mitigating any negative ecological effects of cat hunting behaviour.
2. To investigate how cat owners perceive (a) their pets' hunting behaviour, (b) their responsibilities for managing this, and (c) the mitigation strategies available, we conducted detailed interviews with a diverse sample of cat owners in the United Kingdom.
3. We identified a spectrum of views on hunting behaviour, from owners who perceived hunting as positive (for pest control, or as healthy cat behaviour) to those who were deeply concerned about its consequences for wild animals, their populations, and welfare. However, hunting was widely understood as a normal, natural component of cat behaviour, and owners rarely perceived a strong individual responsibility for preventing or reducing it.
4. Those who did wish to manage hunting perceived several barriers to this, including concern that they were unable to control behaviour effectively without compromising cat welfare, doubt about the efficacy and practicality of popular mitigation measures, and unfamiliarity with alternative options. We recommend that (a) initiatives directed at changing cat owners' behaviour consider the multiple factors and competing priorities that inform their decision-making (particularly cat health and welfare and practicality or cost of interventions); (b) researchers work collaboratively with cat owners and veterinary, cat welfare, and conservation organizations to identify effective solutions, and (c) some degree of accountability for managing problematic hunting behaviour should be promoted as a part of "responsible pet ownership" initiatives.

KEYWORDS

animal management, domestic cat, predation, responsible pet ownership

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1 | INTRODUCTION

Managing the effects of domestic cats (*Felis catus*) on wildlife is an international challenge in conservation science, policy, and practice. The issue is complex; cats undoubtedly have significant detrimental effects on some vulnerable species, especially in island ecosystems (Medina et al., 2011; Nogales et al., 2013), and previous research indicates that, even when killing behaviour is not universal, large numbers of cats inevitably kill large numbers of wild animals (Blancher, 2013; Loss, Will, & Marra, 2013; Woods, McDonald, & Harris, 2003). However, substantial variations in landscape type, cat density, the vulnerability of different species and populations, and cat management measures result in uncertainty in determining the occurrence, type, and severity of impacts.

The majority of research to date has focused on the behaviour and impacts of unowned (i.e. feral or “colony”) cats. More recently, researchers have also begun investigating the role of owned domestic cats in wildlife declines, by attempting to quantify the dynamics and drivers of predatory behaviour in pet cats (Dickman & Newsome, 2015; van Heezik, Smyth, Adams, & Gordon, 2010; Loyd, Hernandez, Carroll, Abernathy, & Marshall, 2013; Thomas, Fellowes, & Baker, 2012; Tschanz, Hegglin, Gloor, & Bontadina, 2011) and sub-lethal effects of cat presence (Bonnington, Gaston, & Evans, 2013; Mahlaba, Monadjem, McCleery, & Belmain, 2017). While management decisions about unowned cats can be made by public authorities, the management of owned cats is primarily the responsibility

of private individuals—cat owners. Efforts to avoid or mitigate any impacts of owned cats on wildlife will require cat owners to (a) identify cat hunting behaviour as a problematic activity, (b) take or accept responsibility for managing that behaviour, and (c) be equipped with the appropriate incentives, knowledge, and capacity to do so effectively. We are therefore interested in whether, and to what extent, cat owners consider hunting behaviour problematic; whether they consider themselves responsible for their pets’ hunting; and if so, what methods they employ, or might employ, to mitigate this. To explore these issues, we conducted detailed, semi-structured interviews with cat owners in the United Kingdom. Qualitative research of this kind is not able or intended to be representative of the population nor to show the prevalence or distribution of certain views among cat owners. Instead, interviews enable us to examine issues surrounding cat husbandry and management in greater depth and detail than large-scale surveys. Through our subsequent analysis, we have identified a series of key issues and challenges that should be taken into account in continuing discussions about cat ownership, husbandry, and management.

1.1 | Cat ownership is defined by control and responsibility

Domestic cats are generally classified as either “owned” or “un-owned.” In practice, however, cat ownership is best conceptualized as a spectrum of control over cat behaviour, with three key areas of human influence: provision of food, control of reproduction,

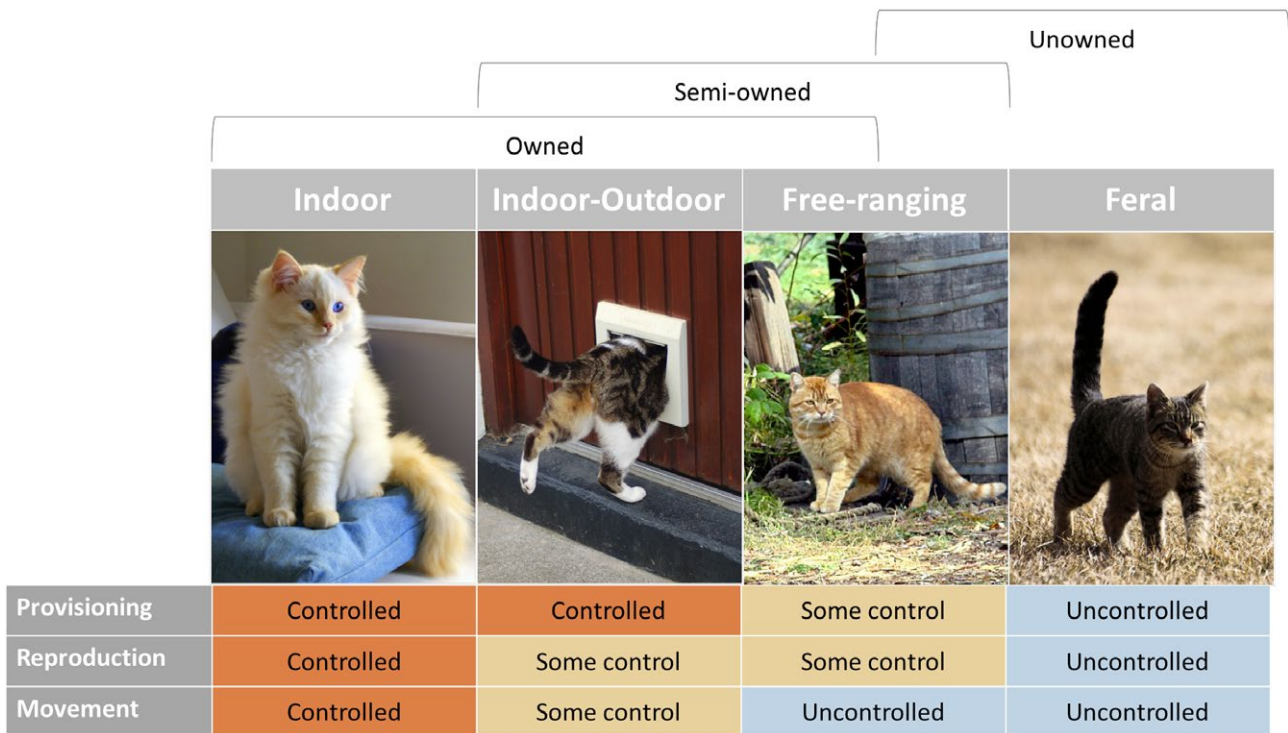


FIGURE 1 Different categories of cat ownership and husbandry practices in relation to human control over provisioning, reproduction, and movement. All images are classified as available for reuse with modification under a Creative Commons Licence. Credits: Cássia Agini (indoor cat), Stephen Hanafin (indoor-outdoor cat), Don Graham (free-ranging cat), Phil Roeder (feral cat)

and control of movement (Figure 1). Self-sustaining feral cats that do not rely on any human provisioning, nor are subject to any form of anthropogenic controls, are at one end of the spectrum. Fully confined cats whose food provision, breeding, and movement are closely controlled by humans are at the other end. The majority of cats fall somewhere between these extremes. Feral cat “colonies” form around a reliable food source, generally provided (either intentionally or unintentionally) by humans. Humans, therefore, exert some control over the provision of food, and potentially reproduction (through neutering programmes). “Indoor-outdoor” cats tend to have closer relationships with individuals or families who provide food and shelter; owners may also control reproduction and/or cat movement (e.g., through garden confinement or keeping cats in overnight). These differing levels of control are associated with varying degrees of attributed or assumed responsibility by owners. Colony cats are often supported by “caretakers” who assume voluntary responsibility for provisioning and in some cases sterilisation, but are unlikely to attempt to confine the cats or cover their veterinary care. Conversely, some owners keep their cats wholly confined due to their perception of responsibility for their cats’ safety at all times. Legislative and regulatory responsibilities vary internationally and regionally (see Section 1.3 below).

1.2 | Cat owner perceptions and management practices

The focus of existing research on people’s perceptions of cat ownership and management varies by region. Research from the USA has primarily concentrated on perceptions and management of feral, colony, and owned “free-ranging” cats (Ash & Adams, 2003; Dombrosky & Wolvleron, 2014; Loyd & Hernandez, 2015; Loyd & Miller, 2010; Peterson, Hartis, Rodriguez, Green, & Lepczyk, 2012; Wald, Jacobson, & Levy, 2013). Feral cat management, and particularly the strategy of trap–neuter–return, is the subject of long-standing and increasingly polarised public debate in North America, with sharp divisions drawn between activists supporting and opposing it (Loss & Marra, 2018; Loss, Will, Longcore, & Marra, 2018; Peterson et al., 2012; Wald et al., 2013). The management of owned domestic cats has received less attention, excepting Gramza, Teel, VandeWoude, and Crooks (2016), who examined Colorado residents’ perceptions of the “bidirectional risks” associated with cat roaming behaviour: threats to cats (e.g., injury, loss), and threats from cats (e.g., wildlife predation). US samples were also included in Hall et al.’s (2016) international comparison of cat owner attitudes, which identified a high rate of permanent confinement (indoor cats) in the USA compared with Australia, New Zealand, and the United Kingdom, and which may partially explain the greater focus on management of unowned and semi-owned cats in North American discourses.

In Australasia, there is heightened interest in cats as predators of native wildlife, and in Australia, the owned cat population is reportedly declining (Hall et al., 2016). The management of predation by feral cats, though not without controversy (Farnworth, Watson, & Adams, 2014; Hillier & Byrne, 2016), is widely considered a necessity

(Doherty et al., 2017). Social research on domestic cat management has therefore been employed as a means of assessing the acceptability of potential regulatory interventions for owned cats (Grayson, Calver, & Styles, 2002; Lilith, Calver, Styles, & Garkaklis, 2006; Kingborough Council [Tasmania] 2017), which in some regions have been enacted in law (e.g., WA Cat Act 2011). Although support for registration and night confinement of cats is relatively high, there is nevertheless resistance to permanent confinement and bans on cat ownership (Grayson et al., 2002; Lilith et al., 2006; Travaglia & Miller, 2017). A series of studies (Toukhsati, Bennett, & Coleman, 2007; Toukhsati, Young, Bennett, & Coleman, 2012; Zito, Vankan, Bennett, Paterson, & Phillips, 2015) has additionally examined the phenomenon of cat “semi-ownership” in Australia and has sought to identify both the prevalence of this and participants’ perceptions of responsibility towards semi-owned cats. This research found that although some people regularly feed cats they do not own, they are unlikely to take responsibility for neutering those animals for a number of reasons, including the assumption that other people own (and are therefore responsible for) them.

These studies have almost invariably employed quantitative surveys, at different scales, to ascertain differences in public perceptions and attitudes between demographic or stakeholder groups (e.g., cat owners and non-owners). This has helped identify patterns and trends in attitudes and behaviours within and between populations. However, such surveys are limited in their ability to extend our understanding as to the reasoning and affective factors informing these perceptions. More recently, researchers in Australia (McLeod, Hine, & Bengsen, 2015) and New Zealand (Harrod, Keown, & Farnworth, 2016) have investigated perceptions and use of specific management interventions—containment and collars, respectively—with the aim of identifying barriers to their use and/or informing behaviour change strategies.

Here, we have taken a different, qualitative approach to exploring issues surrounding cat roaming behaviour, predation, and management in the United Kingdom. This research aimed to flesh out, contextualize and develop our understanding of cat owner perceptions and behaviours by exploring participants’ self-reported thoughts and feelings about their responsibilities towards and for their cats.

1.3 | Cat ownership and management in the United Kingdom

Given cultural variations in the sociolegal context of domestic cat management, it is worth outlining current circumstances in the United Kingdom. Recent estimates place the owned UK cat population at 8–11 million (PDSA, 2018; PFMA, 2018). The care and management of cats fall under multiple legislative acts and regulations. The Animal Welfare Act 2006 requires cat owners to be responsible for protecting their pets from unnecessary suffering, pain, injury, or disease. However, owners must also pay due regard to their pets’ need to display normal patterns of behaviour (which, for cats, arguably includes exploratory and hunting behaviour). Owned cats are

TABLE 1 Summary table of participants including key demographic information and details of the amount, sex, and breed of owned cats in the study. A full table with the details of all participants and cats is provided as Supporting Information Table S1

	Participants
Region	
Cornwall/Devon	35
Greater Oxford	13
Area type	
City	13
Rural	8
Village	12
Town	15
Gender	
Female	38
Male	10
Total	48

legally considered property (rather than persons), and thereby offences would be committed if they were stolen, injured, or intentionally killed. Unowned cats, however, are not protected mammals, and so can legally be humanely killed. Finally, cats are not covered by either of the key acts that restrict roaming in other domestic animals—the Road Traffic Act 1988 or Dangerous Dogs Act 1991—and therefore retain a common law “right to roam” (as property, they are also incapable of trespass). Owners are not legally liable for most cat behaviour that may be regarded as problematic (including hunting, defecating in private gardens, entering houses, or fighting with other peoples’ cats). This reflects wider societal attitudes in the United Kingdom that normal cat behaviour includes these activities, that more serious threats of damage to people or property are rare, and that cats cannot “realistically be fenced in” (Nurse & Ryland, 2014).

Two studies have investigated UK cat owner attitudes towards wildlife, both as part of ecological research studying owned cats’ roaming and/or predation behaviour. Thomas et al. (2012) surveyed householders in their urban study area to examine perceptions of the importance of cat predation on wildlife, the acceptability of different management strategies, and how existing practices reflect those perceptions. They found a generally low level of concern about the potential impacts of cats on wildlife and a low level of acceptability for most management strategies; collar-mounted devices were considered the most acceptable. McDonald, Maclean, Evans, and Hodgson (2015) conducted door-to-door surveys to determine whether owners’ perceptions of their cats’ hunting behaviour corresponded to actual prey returns, and to identify whether the extent of predatory behaviour influences owner attitudes to management. The majority of participating owners were able to predict whether or not their cats would return prey, but not how much. Owners tended to disagree with the management options presented (neutering, night confinement, permanent confinement), except neutering,

which was widely accepted; 98% disagreed with permanent confinement. As in Thomas et al.’s (2012) study, a substantial proportion (60%) did not consider cats to be harmful to wildlife. McDonald et al.’s (2015) study did not find owner opinions to be influenced by their cats’ predatory behaviour.

These early findings suggest that, in the United Kingdom, cat impacts on wildlife have low cultural salience compared with Australia, New Zealand, and the USA, and that public support for any form of cat management is relatively low. This is supported by Hall et al.’s (2016) international survey, which found that owners from the United Kingdom were the least likely to consider cats a threat to wildlife (except in nature reserves) and the least likely to support most management options (except neutering). Current advice and guidance on cat husbandry in the United Kingdom reflects this, with unconfined cats accepted as the norm, including among conservation organisations, many of which do not officially report cat hunting behaviour as a significant threat to wildlife (e.g., Royal Society for the Protection of Birds, 2018). Recently, however, researchers have proposed the introduction of cat exclusion “buffer zones” around areas inhabited by vulnerable species (Hanmer, Thomas, & Fellowes, 2017).

2 | METHODS

A key aim of this exploratory study was to identify the perspectives of a diverse group of cat owners implementing a variety of husbandry practices. To achieve this diversity, 48 participants from 37 households were recruited through several different channels. We distributed leaflets in pet shops and veterinary practices in south-west and central Cornwall, and posted an electronic version of the leaflet on community interest (not cat-related) Facebook groups based in Cornwall and Greater Oxford. This enabled us to target cat owners from urban, suburban, and rural areas while not restricting our sample to, for example, the members of cat interest groups or owners whose pets are registered with a vet. To include owners practicing less common management methods (e.g., those with wholly outdoor or spatially confined cats), we purposively recruited additional participants: two households with farm cats and three where “ProtectaPet” (<https://protectapet.com>) fencing had been installed around the property. Table 1 provides summary details about participants and their cats; additional details are provided as Supporting Information Table S1. Although we were not seeking a representative sample, and there are more female cat owners in the United Kingdom (58%; PDSA, 2017), it is worth noting that the majority of our respondents (almost 80%) were female. This is consistent with other studies investigating similar issues (e.g., Wald et al., 2013; Harrod et al., 2016; Hall et al., 2016), though the precise reasons for such a bias in response rate are unknown.

This study received ethical approval from the University of Exeter (Ref: 2017/2058). Participants were primarily interviewed at their homes (three were interviewed at agreed alternative locations). SLC conducted all interviews, following a semi-structured schedule (see Supporting Information Data S1). Participants read an information

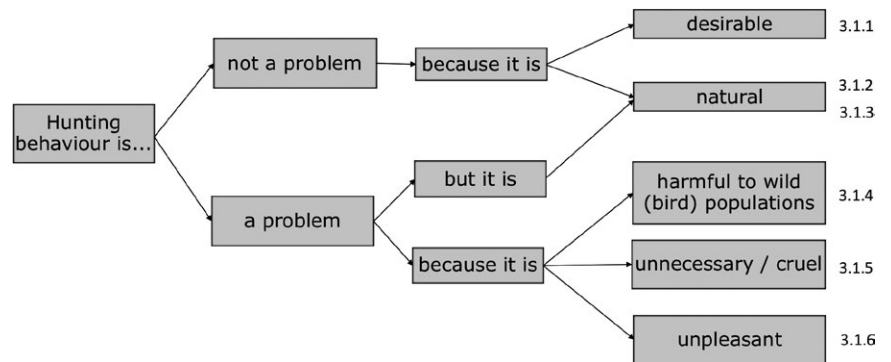


FIGURE 2 Schematic showing range of owners' perspectives on domestic cat hunting behaviour. See text for details and examples

sheet explaining the topic of study and signed consent forms prior to their interview. Participants were informed that they had the right to withdraw at any time. All interviews were audio-recorded and transcribed verbatim. Transcripts were analysed with the assistance of NVivo for Mac (v11). Following an initial read-through, a single coder categorized sections of transcripts by response regarding (a) perceptions of cat hunting behaviour; (b) perceptions of owner responsibility for hunting behaviour; and (c) views and experience of possible mitigation measures. These groups were then further coded into thematic responses and interpreted in relation to the existing literature and wider discussion with owners. Coded identifiers are used here to protect participants' identities.

3 | RESULTS

3.1 | Do cat owners consider hunting behaviour a problem?

We identified six different perspectives on cat hunting behaviour (Figure 2), which are not necessarily mutually exclusive.

3.1.1 | Hunting is not a problem, because it is desirable

Few owners expressed the opinion that cat hunting behaviour was desirable or a positive aspect of cat ownership. The two notable exceptions to this were the owners of farm cats ("I do want them hunting on the farm, keeping the vermin down" [17]) and an owner who felt proud of their cat for their hunting prowess. Hunting was interpreted as an expression of the cat's skill and authenticity: "I was almost thinking, you know, if you bring a pheasant back I'll be really proud of you. Not that I actually wanted him to kill it, but because he was being a cat" (33). Similarly, 19a, though not proud of hunting per se, one owner nevertheless felt a sense of reassurance from their cat's hunting behaviour:

When she did bring in a vole or a mole, I really felt she was settling in to her environment, and she wasn't scared. I thought well that's a good thing, she's out there, doing a bit of hunting. You know, she's feeling comfortable, relaxed and safe. (19a)

3.1.2 | Hunting is not a problem, because it is natural

Another group of owners, while not necessarily viewing hunting behaviour positively, did not perceive it as a problem; it was considered an acceptable, normal, "natural" component of cat behaviour: "It's what animals do, isn't it, hunt other animals? So, no, I'm not bothered by it at all" (24); "I don't actually mind as long as they have not got maggots all over them. It's nature. They are nature" (37a). Multiple participants commented that hunting was "what cats do", and felt that accepting this was part and parcel of cat ownership. Indeed, several went further and suggested that, "You know full well what cats are like when you get a cat, so anybody that keeps them in for [hunting], I also find annoying. Don't get a cat, basically" (07).

3.1.3 | Hunting is a problem, but it is natural

The most prominent viewpoint appears somewhat paradoxical. Many participants did not like their pets' hunting behaviour for reasons including, but not limited to, its potential effects on wildlife. Nevertheless, hunting was tolerated *because* it was perceived as "natural." Here, we need to tease apart different connotations of the term "natural." In most cases, owners' use of the term implied that hunting behaviour is a normal component of cat behaviour; something that cats are driven to do and find rewarding (e.g., "You can't really change what they do and what's part of their genes, I suppose...part of their makeup is to hunt" [20]). In other cases, cat hunting behaviour was considered a normal ecological process, part of a natural order of things: "it's just nature unfortunately" (04). These owners therefore thought cat hunting behaviour legitimate, if undesirable, either because it was part of cats' behavioural repertoire that they "couldn't" or "wouldn't want to" curtail, and/or because they saw cat predation as a natural ecological process that they need not intervene in. Many owners were conflicted, though, by what they perceived as natural behaviour but also a potential problem:

Interviewer: When you think about your cats as hunters or predators, how does that make you feel?

O6: It's a kind of mixture. Like, it's acceptance that that's in their nature to do it, but, you know... I still feel a bit cross with them.

22: I know it's their instinct, it's a hunting instinct, I understand that. Still you think 'oh God no', you know, and you try and rescue them.

Related to this view was a perception that, although hunting by cats could pose a threat to wildlife, in the context of other factors this was (comparatively) minor: "there's lots of things that are affecting wildlife, certainly can't blame it primarily on a cat, can you?" (08).

3.1.4 | Hunting is a problem, because it is cruel and/or unnecessary

A more specific version of this perspective was the view that hunting behaviour, while natural for cats, seemed unnecessary and/or cruel. This reflects recognition that owned domestic cats hunt despite being well fed: "I know it's instinct, but it does annoy you because you know they're not hungry so they're just doing it, I don't know why" (14). One participant further explained that, "I feel that with ours they don't need to hunt it to eat it. It is just play. And I know it's their instincts and nature, but I just don't like death. Animals dying for no reason, being tormented and scared"(23). Participants expressed distaste at the idea of killing for pleasure, several noting the manner in which cats play with and disregard prey: "He doesn't kill them quickly... I know that they don't mean it like that but it's about this uncaring nature" (08). Others were distressed at the suffering of the prey: "I don't like to see anything suffering to be honest, no matter what it is, and when it's dead it's still upsetting because that poor little creature didn't have much of a chance and it just seems a bit pointless because they're not hungry" (20). Here, the concern for wildlife was focused on welfare of the individual prey animal, rather than consideration of a threat to wild populations.

3.1.5 | Hunting is a problem, because it affects wild (bird) populations

Most participants who identified hunting behaviour as problematic due to its potential impacts on wildlife differentiated between types of prey, with participants primarily concerned about their cats catching birds. Several were aware of wider issues surrounding songbird decline and were concerned that cats could contribute to this; a few indicated a particular fondness for, interest in, or "affinity with" birds compared with other prey species, and farming participants noted that birds were not pests: "the birds don't give us any trouble" (17). Others reported feeling differently about birds, but struggled to articulate why: "I don't know why... just something about birds" (05); "a bird is more upsetting but there's not logic in that" (08).

Participants referred to population size of small mammals as a factor affecting their views, but this varied in direction, from "I don't think we'll ever be short of mice" (12) to "little shrews and field mice, some of them are in decline, aren't they?" (15a). The classification of mice, rats, and rabbits as "vermin" was also given as a reason for less concern about these species, and their predation was considered more acceptable given cats' traditional role as pest controllers ("that's what people used to have cats for, wasn't it?" [09]). However,

some participants were equally concerned about birds and small mammals, especially in terms of welfare and defencelessness (see Section 3.1.4 above), and one participant was more generally concerned that cat presence was "unnatural", stating that:

03: [Wildlife has] got more right, I think to be there than the cat.

Interviewer: Why is that?

03: Well, [cats are] domesticated, aren't they? They're not a wild thing... I just think, well if you're going to let your cat out, it will kill animals. And that is...the one thing that I struggle a bit with.

3.1.6 | Hunting is a problem, because it is unpleasant

Some owners reported no specific concern about populations or welfare of wildlife, but still considered hunting problematic because cats brought prey into the home, creating an unpleasant situation for the owner: "Absolutely the worst thing...is the hunting because obviously that's a bit gross and you end up, occasionally, with a live mouse or whatever..." (28). Many participants vividly recalled occasions when their cats had brought dead, mauled, or lively prey home: "The worst ever was a live vole... I woke up with it running through my hair and that was horrible" (34). Again, however, concerns about this were often qualified with recognition that having prey brought in was a constituent part of cat ownership.

3.2 | Owner perceptions of responsibility for their cats' hunting behaviour

We asked about hunting behaviour as part of a series of questions regarding owners' responsibilities to and for their cats. Consequently, some of the responses in this section additionally refer to owner responsibility for other issues associated with cats roaming outdoors, particularly nuisance behaviours (e.g., fighting, toileting) and risks to cat safety. Among our participants, we identified five different perspectives relating to owners' responsibilities for managing their cats' hunting behaviour (Figure 3).

3.2.1 | Cat owners have no responsibility for managing hunting, because hunting does not need to be managed

Participants who did not consider cat hunting behaviour a problem, or who desired hunting behaviour, were correspondingly unlikely to believe themselves—or anyone else—responsible for managing it. Additionally, some owners, though not necessarily happy with their cats' hunting, had not considered whether they held any responsibility for it as owners (e.g., "I hadn't really thought about birds being endangered and therefore [hunting] being a bad thing" [32]).

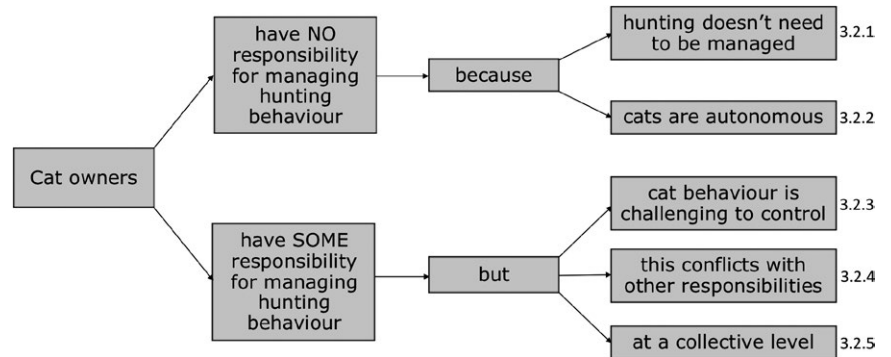


FIGURE 3 Schematic showing variation in participants' views on cat owner responsibilities for managing hunting behaviour in domestic cats. See text for details and examples

3.2.2 | Cat owners have no responsibility for managing hunting behaviour, because cats are autonomous

The most important barrier to assuming responsibility, however, was owners' perceptions that it would be either extremely difficult, or impossible, to control their cats' behaviour. For one group of participants, this barrier was sufficient for them to assume no responsibility for their cat when roaming, for example, "I don't think cat owners should have that much responsibility... it's really difficult, when they go out of your sight you don't know where they are, and you don't know what they are doing" (22). This view was informed by a key perception of cats as somewhat wild and independent, and therefore (compared to dogs and other pets) exempt from tight control: "They're not fully domesticated. I mean, there is quite a lot of wild in a cat" (33). There was also a view—consistent with common law in the United Kingdom—that it is socially acceptable for cats to roam and that hunting and other behaviours were encompassed within that: "I think there's a general perception...that cats are independent by nature and they'll do exactly what they like. In some ways, that's why we like them, because they do that" (09). Indeed, independence and autonomy were regularly given as key reasons for choosing and preferring cats over other, more closely controlled, pets.

3.2.3 | Cat owners have some responsibility for managing hunting, but cat behaviour is challenging to control

Another group of participants was conflicted about this same issue; they did feel some responsibility for their cat's behaviour, but also felt that this was extremely challenging to control effectively: "I think you can take personal responsibility to a point, when you can" (31). This group proposed a range of possible strategies for taking some responsibility, including "restrict[ing] their access to certain things, whether it would be a collar with a bell on it or keep[ing] them in at night when their hunting seems to be worse" (20). Still, many participants did not suggest—or believe—that they could fully curtail this behaviour, as it was generally

assumed that this would involve permanently confining cats, an unpopular management option.

3.2.4 | Cat owners have some responsibility for managing hunting, but this conflicts with other responsibilities

Our findings suggest that the practice of allowing cats to roam is associated with a widespread belief that confining cats has negative welfare implications, particularly in relation to cats' ability to express "natural" or normal behaviours including exploration, outdoor relaxation (e.g., basking in sunshine), and hunting. As noted above, some owners were concerned about their cats' predation on wildlife, which conflicted with their preference for allowing cats to roam: "I suppose it is my responsibility to try and stop that. But it's difficult... I could shut the cat flap at night so he doesn't get out... But then for me I'm denying him his natural instincts" (04). A more prevalent view, however, was that owners were conflicted about allowing roaming due to concern for the cats' safety (particularly as regards road traffic). Owners were, therefore, required to weigh up the risk of roaming against the risks of confinement, which for many participants' was associated with a lower quality of life, for example, "I do feel responsible but there is nothing I can do about that other than not letting it out and I think its freedom is more important" (35); "There's the risk of them getting knocked down...or getting lost when going outside, but I think the quality of life outweighs that risk, for me" (28).

3.2.5 | Cat owners have some responsibility, as a collective, for mitigating the impacts of hunting by reducing cat numbers

Finally, a few participants viewed the mitigation of hunting behaviour as a collective (rather than individual) responsibility: "you'll read the incredible figure of how many wild creatures that cats will kill and, to a large extent that's because we've got a huge population of cats. So, let's stop breeding the cats..." (10). This position was associated with a perception that, in urban-suburban areas, individual cats were unlikely to substantially effect wildlife populations, but that high densities of cats could place undue pressure on vulnerable wildlife.

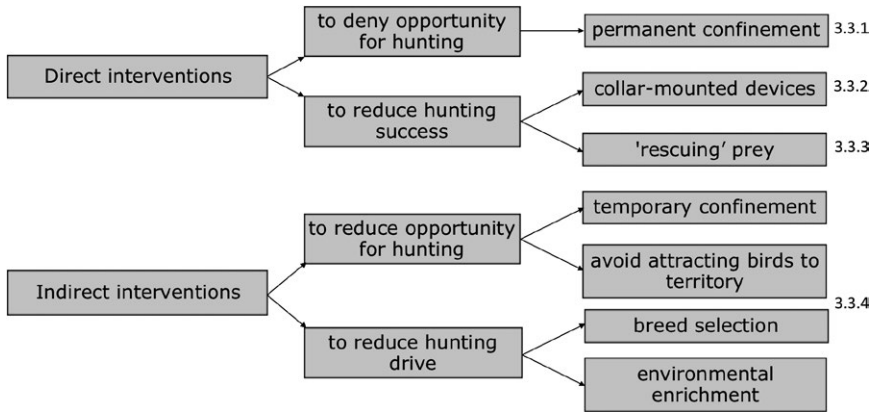


FIGURE 4 Direct and indirect interventions participants report using, or having tried, as means of mitigating hunting behaviour in domestic cats. Although owners reported employing these methods with varying degrees of success, their effectiveness has not necessarily been evaluated from an ecological perspective

3.3 | Cat owners' perceptions of hunting mitigation methods

In this final section, we discuss how participants perceived different kinds of methods for mitigating hunting behaviour in cats, including both well-known strategies (e.g., containment, collar-mounted devices), but also indirect measures such as removing bird feeders to reduce opportunities for predation (Figure 4). Many participants did not perceive their cats' hunting to be sufficiently problematic for them to intervene, both for reasons discussed above and also because owners often perceived that their cat was not killing a significant quantity of wildlife, or a significant enough species, to require intervention. Nevertheless, they often went on to conclude that "if I had a cat that was killing stuff all the time I would make sure it was shut up... at night" (01); and "Wildlife... I guess it is an issue. I guess if they started bringing loads and loads of stuff in...I would keep them in at night" (34). Of those owners who used, or had previously used, mitigation measures, the following strategies were reported.

3.3.1 | Temporal and spatial confinement

Participants who kept their cats in at night sometimes did so to reduce their cat's hunting, although this often served a dual function of minimizing risks from road traffic. One household only kept their cat in at night during spring when they had found hunting of fledglings to be a particular problem. Two households kept cats indoor-only or fully confined (in runs) which, although primarily for the cats' protection, also prevented any hunting. Another three households had fenced their gardens, which enabled their pets to go outside without roaming and reportedly limited their hunting. However, many owners perceived strong ethical and practical barriers to cat confinement and particularly permanent indoor confinement (which was considered unfair or "completely against a cat's nature" [27]). Confinement is also not a realistic option for those people who keep cats for pest control purposes, and who are indeed unlikely to contemplate any measures to mitigate hunting, as this is the primary purpose of their keeping cats. Temporary confinement (e.g., keeping cats in overnight), while not necessarily opposed by owners, was sometimes considered difficult to implement in practice,

with reports of cats previously allowed outdoor access becoming stressed and disruptive if their routines were changed.

3.3.2 | Collar-mounted devices

Owners were broadly aware of the practice of using collar-mounted devices, and particularly bells, as a means of reducing cats' success rate when hunting. Several participants had used collars with bells and believed these to be effective. However, others had trialed collar-mounted devices unsuccessfully, either because cats rejected wearing a collar ("I put it on him and he just went berserk" [04]) or bell ("even if I just ring the bell away from them...They go mad" [29]). There was also concern about the welfare implications of both collars and devices; several owners had experienced, or knew of, incidences of cats being injured by their collar. A few were concerned that the persistent noise made by bells would be stressful for cats. Finally, several owners were not convinced that collars were an effective mitigation method: "If we could just put a bell on her collar and know that she would never be able to hunt again we would do it even though I know it's a bit annoying for her. But it doesn't really seem to work" (30). Owners comfortable using quick-release safety collars nevertheless found this challenging, as collars were reported to be frequently lost or, in some cases, "pinged off" by the cats themselves: "We've put collars on him " (25b) " and he's got them off within seconds" (25a). Some participants also believed that their cats had learned to stalk without the bell sounding, reducing the device's effectiveness.

3.3.3 | "Rescuing" prey

When prey was returned to the home still alive, owners regularly reported attempting to intervene and stop the cat from killing it. Reported drivers for this behaviour were concern for prey welfare and, more pragmatically, wishing to avoid having live animals and/or the mess of "maimed" animals in the house. Participants frequently acknowledged, however, that removing prey did not necessarily guarantee its survival. A couple of owners reported warning or otherwise distracting their cats when they observed them hunting: "I shout at them when I see them stalking" (29); which can be

interpreted as either an effort to directly intervene in cats' hunting behaviour, or as a casual attempt to more generally discourage this behaviour through aversion training.

3.3.4 | Indirect mitigation methods

Providing supplementary food for wild birds is a common practice in the United Kingdom. One regularly reported, indirect mitigation strategy involved owners avoiding attracting birds into their garden by removing, or intentionally not installing, bird feeders or nest boxes. However, a couple of participants conversely explained that they actively fed birds, either as a counterpoint or "balance" against the detrimental effect of cat predation, or due to a belief that "if you feed birds, if you get more birds in your garden [...] they're less likely to be hunted because of the volume of them" (08).

One owner who did not consider her cat a prolific hunter suggested that: "maybe it's because I...play with him a lot and entertain him...I wonder whether if you spend enough time with your pet, that that can possibly make a difference" (11). However, others were sceptical about the potential for toys and other enrichment strategies to effectively replace hunting behaviour: "We give them toys but at the end of the day their toys don't do anything, and they're cats and [hunting is] what cats do" (36). One owner reported researching cat breeds that were less likely to roam and hunt before getting a cat.

4 | DISCUSSION

4.1 | Hunting as a problematic behaviour

For cat owners to consider mitigating their pets' hunting behaviour, they first need to perceive it as either an actual or potential problem. We identified a spectrum of views among our participants, from those who saw hunting as desirable to those who found it deeply concerning. A key perspective, however, was acceptance of hunting as a normal, "natural" behaviour that, regardless of owners' feelings about it, was understood as a constituent element of cat ownership. If prospective cat owners were strongly concerned about wildlife impacts, therefore, they may be less likely to obtain a cat; conversely, acceptance of hunting behaviour may be more common among cat owners. This would be consistent with existing research indicating that non-owners are more likely to consider domestic cats a threat to wildlife (Grayson et al., 2002; Lilith et al., 2006; Hall et al., 2016). However, non-owners have also been found to be more likely to have negative attitudes to cats in general (Toukhsati et al., 2012), so whether or not hunting behaviour specifically is a genuine or widespread barrier to cat ownership remains unknown.

Although some owners had broader concerns about cats' potential (in general) to negatively impact wildlife, participants often did not consider their *own* cats to be prolific enough, or targeting the relevant species, to be a problem. It may therefore be that only owners whose cats are prolific hunters, or who have particular, competing interests in wildlife (and especially bird) conservation

and/or welfare are likely to consider hunting behaviour sufficiently problematic to intervene. Some of our participants, having been alerted to the potential threat to wildlife by word of mouth or media reports, had subsequently researched the issue but had found little evidence to convince them that their cat posed a risk worthy of intervention.

Concern for the welfare of individual wild animals may, in some cases, be a stronger driver of intervention than concern for wildlife populations at larger scales. Even if owners do not see their cats as having a particular effect on populations, they are often forced to observe cats causing prey to suffer and may empathise. For many, however, predation by cats is thought of as "natural", not only in terms of cat behaviour but also as a self-regulating ecological process. Very few participants raised or (when prompted) had considered the potential effects of cat density or conceptualised domestic cats as particularly distinct from native wildlife. Most participants therefore considered hunting behaviour an acceptable, if not necessarily desirable, aspect of cat behaviour. Furthermore, there were indications that cats' independence and "wildness" are *part of their appeal*; cats were considered more autonomous than dogs, and participants regularly referred to the comparative lack of commitment and attention they felt cats required. This autonomy partially relies on cats' territorial behaviour and accompanying ability to self-exercise and self-entertain through roaming. Predation on wildlife is dependent on access to the outdoors, and it is therefore difficult to disentangle the perceived benefits of roaming from the apparent risks of hunting.

4.2 | Responsibility for managing behaviour

In the United Kingdom, any impacts of domestic cats on wildlife will likely be related to cat density and overall numbers. Consequently, unless they are particularly successful or enthusiastic hunters or are roaming in sensitive habitats (e.g., nature reserves), individual cats are unlikely to strongly impact wildlife populations. Minimising cat impacts might therefore be considered a shared, rather than simply an individual, responsibility. However, as with other environmental issues that arise from detrimental cumulative actions (e.g., waste, energy consumption), individuals may not feel that changing their personal behaviour can make a palpable difference. Furthermore, there are high degrees of individual variation in cat roaming and hunting behaviour. Our findings suggest that where owners recognise their cat as a prolific hunter (and are concerned about hunting), they may be more inclined to take mitigating action. However, if owners do not see their pet's behaviour as unusual or problematic, they may be less likely to voluntarily assume responsibility for managing it. This phenomenon is heightened by the broader societal acceptance, in the United Kingdom, of unconstrained roaming by owned cats (McDonald et al., 2015; Thomas et al., 2012), even when compared to culturally similar countries such as the USA and Australia (Hall et al., 2016).

Many owners did, however, perceive themselves as at least partly responsible for reducing their cats' potential to cause private nuisance, particularly if this involved risks to others' pets or property (i.e., cat-cat aggression or cats entering people's homes). In these

instances, owners were more willing to take reparative responsibility for their cats' behaviour (e.g., by covering costs of veterinary bills or damage). However, this was generally driven by a desire to maintain good community relationships, rather than a sense of moral responsibility for their cats' behaviour, indicating the potential importance of social norms and expectations as influences on owner behaviour. There was less concern about cats urinating and defecating in gardens, something most participants thought unrealistic to control (the onus was generally placed on garden owners to humanely protect their property from cats). Cultural factors are relevant again here, as the presence of cats in gardens and public spaces, while not always appreciated, retains a high level of social acceptability in the United Kingdom (compared with the USA, where most public ordinances relating to cats are implemented to manage such private nuisance behaviours: Hall et al., 2016).

4.3 | Mitigation strategies

Cat safety—and particularly road safety—was a stronger driver for owners to restrict their cats' roaming than wildlife impacts, as most participants *did* feel responsible for protecting the health and well-being of their cats. It is therefore worth recognizing that, in some cases, cat owners may be unintentionally managing hunting behaviour as a consequence of their protective behaviour towards their cats; that is, owners do not necessarily need to perceive hunting as a problem, or assume personal responsibility for managing it, to practice cat confinement. Simultaneously, however, many owners recognised that exploration, territorial roaming, and hunting are normal cat behaviours and wished to avoid restricting these. A common conclusion among participants was that the benefits provided to cats by roaming outweighed the potential risks of injury, death, or loss (despite such risks being relatively high, especially for young cats: O'Neill, Church, McGreevy, Thomson, & Brodbelt, 2015). Consequently, although Australasian and North American campaigns advocate cat containment as a measure of improving animal welfare, this is not as straightforward a driver as it may seem, and is complicated by the welfare implications of permanent confinement. Indoor cats are more likely to suffer from obesity and stress-induced pathologies, especially if insufficient enrichment is provided (Alho, Pontes, & Pomba, 2016). This and other, more practical barriers to confinement (such as the challenges of changing adult cats' routines) are rarely considered by advocates of restricting cat roaming, but are significant in informing the decisions of cat owners. It should also be noted that risks to cats in North America, for example, include rabies and predation of cats by wildlife, neither of which are pertinent to many cat owners in the United Kingdom (though some report concerns about predation by red foxes *Vulpes vulpes*).

Use of collars may be limited by residual concerns about their safety (despite the relative infrequency with which quick-release collars have been found to cause injury; Calver, Adams, Clark, & Pollock, 2013), practical concerns about the expense of consistently replacing quick-release collars, lack of acceptance by cats, or perceived inefficacy at preventing hunting. There is clearly a need for more robust yet

reliably safe quick-release collars to be developed, and although collar-mounted devices can reduce hunting efficiency (Calver, Thomas, Bradley, & McCutcheon, 2007; Gordon, Matthaei, & Heezik, 2010; Hall, Fontaine, Bryant, & Calver, 2015; Nelson, Evans, & Bradbury, 2005; Ruxton, Thomas, & Wright, 2002; Willson, Okunlola, & Novak, 2015), further work to compare the effectiveness and safety of different devices would be beneficial. There are also multiple other strategies, some less direct, by which cat hunting behaviour might be reduced or mitigated, and which are comparatively under-researched. These include enhanced enrichment (to satisfy behavioural drivers of hunting), different models of temporary confinement (e.g., overnight, dusk/dawn, daytime), breed and early-life effects, and dietary factors. In addition to researching the effectiveness of these alternative management strategies, social research should be simultaneously conducted to identify incentives and barriers to their implementation (e.g., McLeod et al., 2015; Harrod et al., 2016).

5 | CONCLUSION

We have (a) highlighted the diversity of UK cat owners' perceptions of their pets' hunting behaviour and their responsibility, or otherwise, for it; and (b) identified and explored some of the key issues surrounding incentives and barriers to managing this behaviour. Particularly, we have identified that although owners are often unhappy about their cats' hunting, they may feel unable to control it effectively without compromising cat welfare. It is therefore important that any initiatives intended to alter behaviour consider that cat owners have to deal with multiple, complex factors, and competing priorities in their decision-making. When it comes to husbandry decisions, immediate concerns about cat safety and welfare—an owner's legal as well as moral responsibility—are likely to take precedence over broader, more abstract ethical responsibilities to wildlife. Consequently, proposed management interventions, as well as being effective, should ideally improve, and at worst not compromise, cat safety and welfare. It is also vital that research to develop and trial management interventions is conducted in partnership with cat owners, who will be key to their uptake and effective implementation (for a similar argument from a New Zealand perspective, see Kikillus, Chambers, Farnworth, & Hare, 2017). Given the diversity of views identified in this exploratory study, further research is also warranted to better understand the prevalence of, and relationships between, different cat owner perspectives on this issue.

Globally, domestic cats, and particularly feral populations, are considered a significant threat to vulnerable wildlife (Medina et al., 2011; Loss et al., 2013; Doherty et al., 2017; IUCN ISSG, 2018). However, there is substantial variation in how cats are perceived in different sociocultural contexts. The United Kingdom provides a particularly interesting example because (despite feral cats being formally classified as non-native) domestic cats are not generally characterized as an introduced species, and indeed are often treated akin to native, wild fauna. There is widespread acceptance of roaming cats in gardens and public spaces, and conflicts

surrounding individual cat management tend to revolve around nuisance behaviours rather than predation per se. Nevertheless, cultural norms are subject to change. The United Kingdom's cat population has already undergone substantial changes in husbandry over the past century, including both a steady increase in overall population numbers and, reportedly, a growing proportion of cats being kept partially or wholly indoors (20%: PDSA, 2016, and see International Cat Care, 2017). This corresponds with the development of commercial cat food, cat litter, and the growth of cats as companions, as opposed to free labour on rural properties. These shifts potentially have both positive and negative implications for cat impacts on wildlife. The growing cat population may place more pressure on vulnerable species, particularly where outdoor cats are found in high densities, but there has also been an increase in owner attachment to and investment in pet cats. A high proportion of owned cats in the United Kingdom are now neutered, for example (Hall et al., 2016; Sánchez-Vizcaíno et al., 2017), which theoretically helps minimize the incidence of unwanted kittens and the establishment of feral populations. One area in which uncontrolled breeding is still an issue is among farm cats. Animal welfare and conservation charities both advocate concerted efforts to reduce unneutered and interbreeding farm populations, and there is valuable potential for collaboration and capacity building in this area. Greater collaboration between welfare, veterinary, and conservation organizations may also help identify constructive and practical measures that owners can take to reduce the risk domestic cats pose to vulnerable wildlife.

In the United Kingdom, any regulatory interventions in cat ownership or management on the sole grounds of reducing hunting behaviour would run counter to currently widespread societal values and could place unnecessary restrictions on owners whose cats either do not hunt or are valued for pest control. However, action to mitigate hunting behaviour should be encouraged as a positive, valuable, and practical component of responsible pet ownership. Despite their different priorities, cat welfare, veterinary, and conservation organizations often agree on the importance of neutering, vaccinations, worming, and microchipping. Ensuring that these responsible ownership practices become social norms may serve to (a) reduce the number of stray and unwanted cats, (b) reduce the risk and incidence of disease, including zoonoses, and (c) encourage owners to recognize and take responsibility for their cats (shifting attitudes away from an underlying perception of cats as comparatively commitment-free, or even disposable). Particularly, compulsory microchipping (which has recently been legislated for dogs, and of which many participants were supportive) would constitute a step towards formalizing owners' responsibilities for their cats, regardless of their whereabouts and activities. Although not contributing directly to mitigation of predation, promoting responsible pet ownership encourages a culture of greater attentiveness and accountability, the benefits of which may extend to wider issues including ecological and environmental health. Encouraging owners to take responsibility for their cats will therefore be key to both improving cat welfare and minimizing cats' nuisance and wildlife impacts.

COMPETING INTERESTS

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AUTHOR CONTRIBUTIONS

S.C. and R.M. conceived the ideas and designed the methodology; S.C. collected and analysed the data and led the writing of the manuscript. R.M. and M.C. contributed critically to the drafts and all authors gave final approval for publication.

DATA ACCESSIBILITY

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ORCID

Sarah L. Crowley  <https://orcid.org/0000-0002-4854-0925>

Martina Cecchetti  <https://orcid.org/0000-0003-3962-8834>

Robbie A. McDonald  <https://orcid.org/0000-0002-6922-3195>

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SUPPORTING INFORMATION

Additional supporting information may be found online in the Supporting Information section at the end of the article.

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