

Dog Management and Owner Perceptions: Implications for Wildlife Conservation in Mudumalai Tiger Reserve, India

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Abstract Free-ranging domestic dogs threaten wild species in natural ecosystems due to disease transmission, competition with wild predators, and predation of wild prey. Despite the deeply commensal nature of the dog-human relationship, it is often not included as a dimension of dog-wildlife conflict. To understand how and why people keep dogs in areas with wildlife presence, as well as people's perceptions of dog-wildlife interaction, we conducted surveys in five villages within Mudumalai Tiger Reserve, India, where animal birth control has been ongoing for almost three decades. Seventy percent (n = 81) of respondents kept dogs, of which most were free-ranging and fed leftover human food. Dogs were primarily kept for security purposes by the majority (n = 40) of dog owners. The majority of respondents also supported sterilization programs (n = 95), believed that dogs did not affect wildlife (n = 48), that dogs did not enter the forest (n = 50), and that leopard lifting of dogs was widespread (n = 67). Almost none of these responses showed any difference with respect to demographic variables (age class, sex, and dog ownership) when tested with Fisher's exact test. While reporting of predation by dogs may have been biased by fear of punitive action, our results indicate that dogs are a valuable security system that protect life and property from wildlife, potentially mitigating human-wildlife conflict. They also indicate that the cause and extent of dog-wildlife encounters require research attention. Both dog management and wildlife conservation strategies should take into account the needs of local residents as well as multidimensional aspects of the dog-human-wildlife interface, such as garbage dumps attracting wildlife to villages, to achieve successful long-term outcomes.

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Introduction

Domestic dogs (*Canis lupus familiaris*) pose a multi-dimensional threat to wildlife in natural ecosystems as they may prey on native wildlife, compete with wild carnivores, or transmit dangerous diseases to wildlife (Young et al. 2011). Negative impacts on wildlife are generally attributed to unconfined dogs that can access natural areas, or free-ranging dogs (FRDs) (Vanak and Gompfer 2009). With reference to the classes defined by Vanak and Gompfer (2009), this includes feral dogs (entirely independent of humans) and rural fully or partially owned dogs (with food and/or shelter provided either privately or communally). Both classes form a significant part of the dog population in developing countries like India,

where the FRD population is one of the highest in the world (Belsare and Vanak 2020), and primarily consists of the native Indian dog, also known as the “pariah” or “desi” Indian dog. Present in the Indian subcontinent for millennia (Kamińska-Jones 2020), their current ubiquity on streets nationwide has fueled intense debate on human safety versus animal welfare (Philip 2026), particularly as the only legal mechanism for dog population management in India is animal birth control. In rural areas with landscapes shared by wild species, the impacts of both owned and unowned native dogs can affect wildlife as well, and neutering programs—if implemented—may do little to solve dog-wildlife conflict.

As such, the uniquely social and commensal

relationship between dogs and the humans that support them is directly relevant to the potential impacts of FRDs on wildlife (dos Santos et al. 2018). The nature of this relationship affects FRDs' diet, social organization, and spatial and foraging ecology (Vanak and Gompper 2009). A high level of human support for FRDs also allows the population to be sustained at artificially inflated levels, amplifying negative impacts beyond those that would occur naturally (Vanak et al. 2014). Such support is higher in rural areas where more households keep dogs and more dogs are likely to be free-ranging (Davlin and VonVille 2012). Therefore, just as incorporating human perspectives into conservation research is important to effectively manage the underlying causes of human-wildlife conflict (Miller et al. 2014; Redpath et al. 2015), research on the close relationship between humans and FRDs is necessary to understand the socio-ecological dynamics that drive dog persistence in wildlife-adjacent areas. This can include documenting social norms surrounding dog-keeping, reasons for dog-keeping in wildlife landscapes, and people's perceptions of dog-wildlife interactions.

Of the limited relevant literature available, the majority is from developed countries, often with a focus on clearly defined dogs like "pet" or "working dog" (Miller et al. 2014), unlike in developing countries where dogs are usually free-ranging and fall under different flexible definitions of ownership (Vanak and Gompper 2009). Wildlife-relevant studies that discuss the FRD-human relationship have previously been carried out in Zimbabwe (Butler and Bingham 2000), Madagascar (Kshirsagar et al. 2020; Valenta et al. 2016) and Chile (Acosta-Jamett et al. 2010; Sepúlveda et al. 2014). To our knowledge, this is the first study focusing on the dog-human-wildlife relationship from India, where the need for this research is all the more pressing due to a large and potentially growing dog-wildlife interface with highly biodiverse ecosystems.

Here, we present the results of a questionnaire survey on dog-keeping carried out in five villages in Mudumalai Tiger Reserve, South India. We discuss the attitudes of local residents towards FRDs in the context of frequent proximity to wild species, and towards dog care and management after 28 years of dog vaccination and sterilization program implementation in the area. Building on a foundation of local knowledge of dog-wildlife interactions, this study sheds new light on the role of FRDs as a

possible mitigator of human-wildlife conflict in South India. We conclude with suggestions for future dog management strategy design.

Methods

Study Area

Mudumalai Tiger Reserve (MTR) is part of the Nilgiri Biosphere Reserve and is situated in the Western Ghats of Tamil Nadu, southern India. MTR displays a vegetation gradient from tropical moist deciduous to dry thorn forest (Suresh et al. 2010) and contains several species of threatened wildlife (e.g., Indian elephant (*Elephas maximus indicus*), Indian leopard (*Panthera pardus fusca*), and dhole (*Cuon alpinus*) (Suresh et al. 1996). The five villages in the study area are Bokkapuram, Masinagudi, Mavanalla, Moyar, and Vazhathottam; of these, Masinagudi has the largest human population by a sizable margin. All villages are located on the Sigur Plateau in MTR, an important wildlife corridor bounded by the barriers of the Moyar Gorge to the north and the Nilgiri Hills to the south (Figure 1).

The Sigur Plateau region has historically been settled by several tribal communities, supporting pastoral, shifting cultivation and hunter-gathering livelihoods (Enters 2000). Presently, livestock herding and forest product collection take place in non-restricted (village boundary) areas inside the protected area, while hunting is illegal. Cattle are still raised for dung production and goats for meat production. Many people in this region are engaged in settled agriculture of cash crops like garlic, beans, and coconut; paddy and fruit are not grown to avoid crop raiding by elephants and wild pigs. Tourism is another major source of income for safari jeep drivers as well as hospitality industry staff. Local residents, primarily men, may also join the Tamil Nadu Forest Department, the state government administrative body that monitors compliance with forest protection laws, as guards or watchers.

Of the five villages in the study area, Mavanalla, Moyar, and Vazhathottam are primarily under agricultural cultivation. The Electricity Board provides additional employment in Moyar, where the Moyar dam generates hydroelectric power. Bokkapuram has a sizable number of resorts and private estates alongside farms, although the majority of these resorts have been closed due to legal disputes (Shaji 2021). Lastly, Masinagudi is the most developed with the least area under agricultural cultivation and is the only village

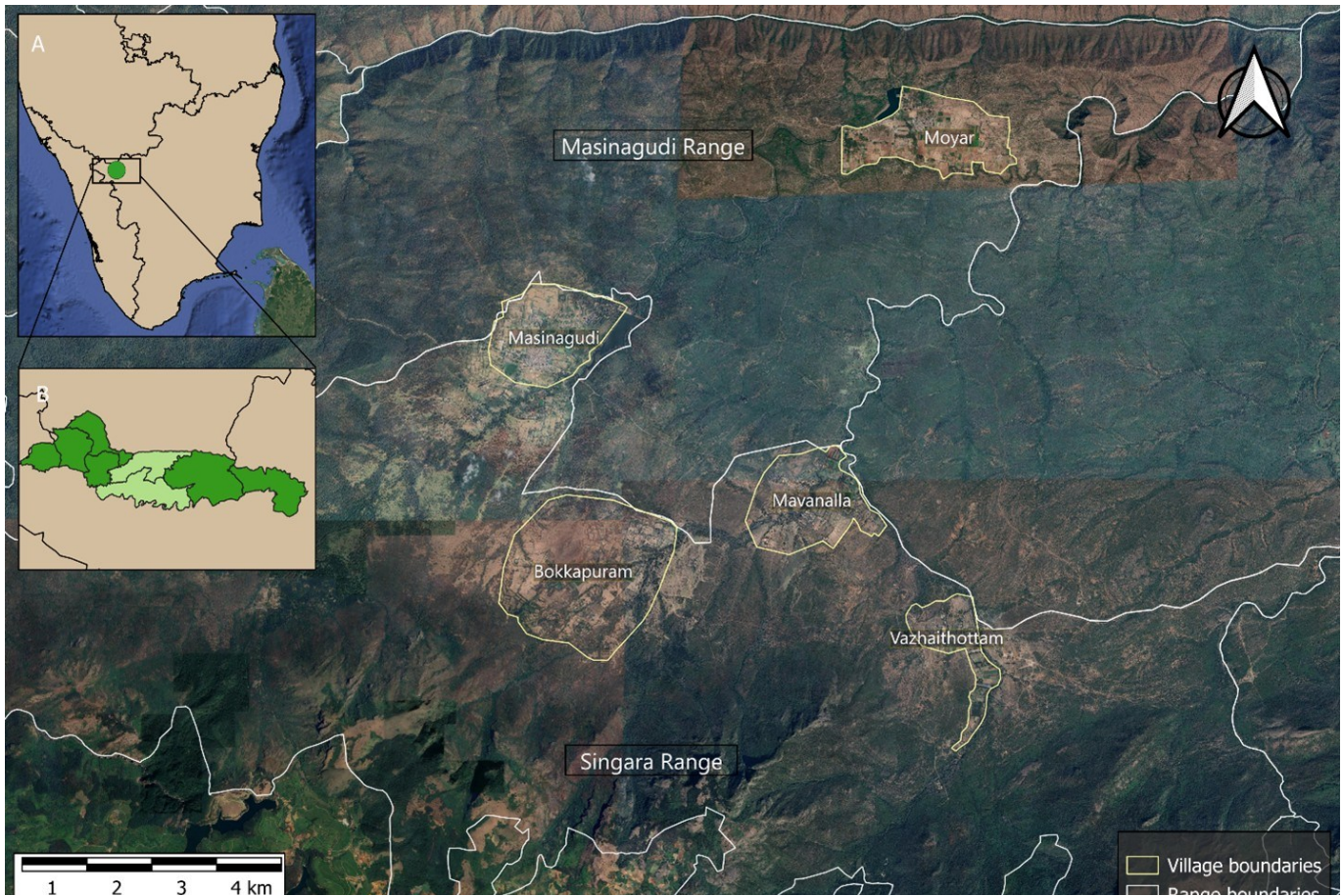


Figure 1 Map of the study area, located on the Sigur Plateau in Mudumalai Tiger Reserve. Inset A shows the MTR's location in peninsular India. Inset B shows MTR's ranges, with the study site ranges marked in light green. The main map shows the boundaries of the five villages within the two ranges.

with various facilities including medical stores, multiple grocery shops, and a petrol pump. It is also the hub of tourist activity.

With respect to domestic animal care, Masinagudi has a government veterinary hospital. Two animal welfare organizations also function in the area—India Project for Animals and Nature (IPAN) and Worldwide Veterinary Service India (WVS-I). WVS-I operates on a larger scale, carrying out dog vaccination and sterilization drives in larger towns outside MTR, while IPAN conducts similar programs in villages inside MTR, logistically supported by WVS-I. IPAN also runs a rescue center for domestic and working animals in need of care (Nigel Otter, conversation with first author, January 16, 2024). Vaccination and sterilization drives have been ongoing in the Masinagudi area since 1997 (Ilona Airikkala-Otter, email message to first author, May 29, 2024).

Methods

We carried out a semi-structured questionnaire survey between January to February, 2024. The questionnaire was adapted from the format used by Sepúlveda et al. (2014) and consisted of up to 12 questions, of which five applied to non-dog owners and all applied to dog owners (Supplementary Material S1). The questionnaire was designed to understand how many people kept dogs, why they kept dogs, how they attended to the feed and medical care of their dogs, and their knowledge of dogs affecting or being affected by wildlife. Surveys were carried out by a team of two women on foot. One team member was local and administered the survey in Tamil, while the other team member recorded the responses in written format.

Each survey took approximately ten minutes to complete. Between 20–25 people were surveyed in each village, with a total sample size of 115



respondents. We selected respondents randomly, with each consecutive respondent chosen after five to ten minutes of walking to cover a representative cross-section of each village's localities. No personal information was recorded apart from the respondent's sex and visible occupation, if they were observed to be engaged in any. The local team member estimated the approximate age of each respondent. The respondent pool comprised a socially and economically diverse cross-section of local society, including shopkeepers, goat herders, safari drivers, farmers, and homemakers.

We note that our sampling was necessarily biased towards densely settled areas rather than outlying farms, since our surveys, carried out on foot, were designed to encounter the maximum number of potential respondents. However, we do not expect that this would influence any aspects of this study apart from the mean number of dogs kept, since farmers often kept two or more dogs. Additionally, we encountered a disproportionate number of women respondents as they were usually at home during the day during survey hours while men were out for work.

Following our survey, we tabulated the responses and assigned them to different answer categories. We then conducted Fisher's exact test to investigate whether age class, sex, and dog-keeping status had any significant effect on the responses we received. We defined age class as "young" for below 50 and "old" for above 50 years of age. We used Fisher's test as the higher number of women respondents resulted in unbalanced responses in each category, as well as less than five responses in some categories.

We conducted the test only for those questions where the answer might change based on the demography of the respondent (for example, "Why do you keep dogs?" and not "How old are your dogs?"). These questions comprised eight of the 12 questions in our survey. We tested the effect of dog keeping as a variable only for questions (four out of the eight) that were asked to both dog owners and non-dog owners. Therefore, we conducted a total of 20 Fisher's tests: eight questions x two demographic factors (age class and sex) and four questions with dog-keeping as a factor.

Results

Of a total of 115 respondents, 70 (60.9%) were female and 45 (39.1%) were male (Figure 2). A total of 70.4% owned dogs and 29.6% did not. In dog

owning households, the mean number of dogs was 1.98 (range 1–9, SD = 1.35). Of a total of 111 dogs that owners reported keeping, 52.2% were females and 47.8% were males. Over half (50.6%) of dog owners were unsure of their dogs' age; estimates were provided by the remaining owners for 55 dogs, yielding a mean of 4.2 (range 2 months to 18 years, SD = 3.85) (Table 1). However, these numbers are rough estimates, as people do not record their dogs' ages and may be unaware of dogs' natural lifespans. For example, one middle-aged woman said her dog was 25 years old when first asked and was surprised to learn that dogs are unlikely to live beyond 15 years or so. Nearly half (49.4%) of dog-owning respondents mentioned that they kept dogs for security, as dogs would alert them to the presence of wild animals (particularly elephants and leopards) as well as people approaching their homes. The next cited reason was for both security and companionship (28.4% of dog owners), and the least cited reason was only as a pet (22.2% of dog owners).

Dog Ownership and Care

According to the survey, 90.1% of dog owners reported feeding their dogs "human food" or food leftover from human meals. This included rice, *chapati*, *sambar*, egg, curd, and milk, with non-vegetarian food like fish, chicken, or mutton occasionally (when affordable, between once to thrice a week). Of the 9.9% who mentioned commercial dog food, 1.2% (one person) reported feeding their dogs exclusively on dog food. Of the 29.6% of all respondents who did *not* own dogs, 17.4% reported feeding street dogs, either regularly or occasionally, with biscuits, milk, or leftover cooked food. Most owned dogs were free ranging; only 21.0% of dog owners said they confined their dogs, while the other 79.0% of dog owners left them free to roam.

Regarding medical care for dogs, 56.8% of dog owners said they did not provide medical care or had not yet had any reason to do so. A total of 24.7% of dog owners said they utilize services provided by either IPAN or WVS-I, while 13.5% said they utilize veterinary hospital services. A total of 2.5% of dog owners reported using both hospital and NGO services, and a further 2.5% said they treat their dogs when required with medicines recommended by the local pharmacist. The low proportion of owners providing medical care is in contrast to respondents' answers regarding vaccination and sterilization; 70.4% of dog owners reported owning dogs that were both

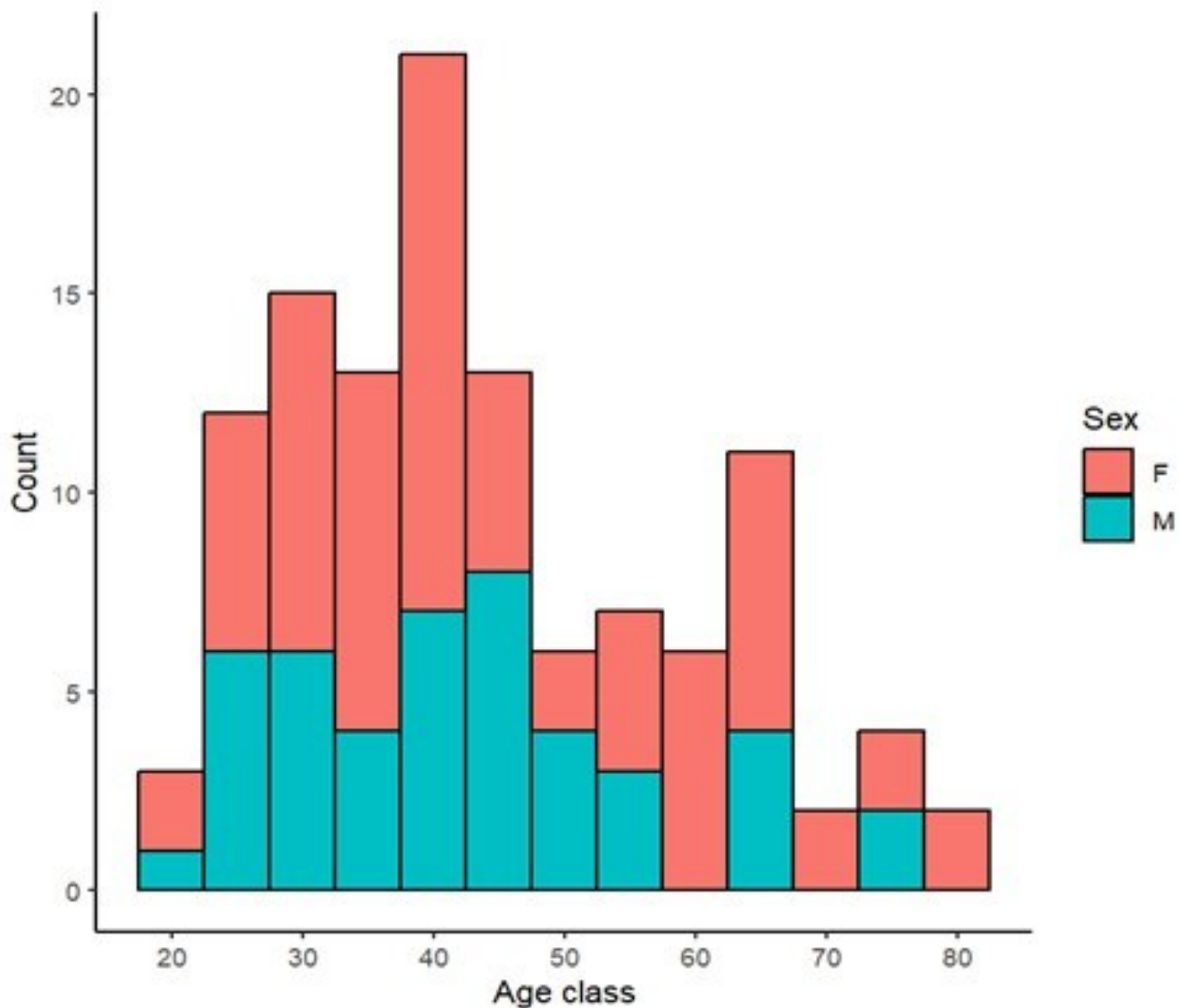


Figure 2 Distribution of survey respondent age and sex classes.

vaccinated and sterilized, 16.0% reported owning dogs that were vaccinated but not sterilized, 7.4% owned multiple dogs of which some were vaccinated and sterilized while some were not (often due to the young age of some dogs) and only 6.2% of dog owners owned dogs of which none were vaccinated or sterilized. It should be noted that the vaccine administered during sterilization was usually only the rabies vaccine, rather than the combination vaccine against canine distemper and other similar diseases. Respondents mentioned that NGO staff came door-to-door to pick up dogs for sterilization or to administer vaccines. Owners took dogs to the NGO

center only if medical care was required for injury or illness, or if the owner was strongly motivated to ensure that sterilization was done. For instance, one dog owning respondent said,

It's better for the dog's health if she is sterilized, otherwise we will have to take care of her puppies. She'll give milk also, and everything on her belly will be hanging down...we don't want her to look indecent/repulsive.

When asked whether they believed sterilization in general was a positive or necessary initiative, 83.5% of all respondents said that it was, citing noise issues, fear

Table 1 Dog demography parameters reported from Mudumalai Tiger Reserve, South India.

Demographic Parameter	Responses
Total dogs owned	111
Mean dogs owned (SD)	1.98 (1.35)
Dog male:female ratio	1:1.1
Females	58
Males	53
Dog age (SD)	4.2 (3.85) ¹

¹Mean calculated with respect to 55 dogs, as age information was not reported by all dog owners.

of being bitten, and the neglect of unwanted puppies. Several people said that their villages were already “full” of dogs, and sterilization was required to keep the population under control. One respondent who did not own a dog said, “There are dogs in every single street. Sometimes people are scared to walk past them in case they bite, small children especially. If operations were not done the situation would be worse.”

According to the survey, 13.9% of respondents said that they were unsure or had no opinion about sterilization, while only 2.6%, all of whom owned dogs, believed that sterilization was detrimental to the health and/or vigor of the dog, particularly the guarding prowess of male dogs, and should not be done. Other health concerns were related to the death of dogs following surgery complications.

Dogs in the Forest and Interactions with Wildlife

Questions about free-ranging dogs going to the forest, dogs affecting wildlife, and wildlife affecting dogs were answered by all respondents. A total of 44.3% of respondents said that dogs did not go to the forest, while 43.5% said that dogs did go to the forest; of these, the majority (35.7% of respondents) said that dogs only went with their owners and livestock during herding, 5.2% said that dogs went alone in addition to this, and 2.6% said that dogs only go alone. Of the remaining respondents, 8.7% said that dogs went infrequently, not recently, or not in their locality, and 3.5% were unsure. A few respondents mentioned that they no longer take their dogs to the forest as Forest Department personnel have begun regulating dog presence in the forest more strictly. Notably, despite common reporting of dogs accompanying livestock to alert owners to wildlife, one respondent who owned several goats did not

allow his dog to do so, saying,

Elephants are the biggest danger when we go to the forest. If our dog comes along with us, he will bark at elephants when he sees them. The elephant will get angry and start to chase him, but the dog will run away fast. Then who will be left behind to face the elephant? We will not be able to escape when it attacks us. So, we keep the dog tied at home when we take goats to graze.

When asked about dogs affecting wildlife, 41.7% of respondents said that dogs did not impact wildlife at all, while 27.0% respondents said that dogs only chased and/or barked at wildlife (mostly spotted deer, but also elephants, monkeys, and pigs) when they entered villages. According to the survey, 17.3% of respondents said that dogs do hunt and kill deer, of which six people said that dogs visited the forest alone or in packs, while the rest ($n = 14$) mentioned the presence of owners and/or livestock. Seven percent of respondents were unsure about dogs affecting wildlife, and another 7.0% said that dogs did hunt or chase wildlife but did so infrequently, not recently, or elsewhere. Lastly, regarding wildlife affecting dogs, 58.3% of respondents said that leopards lifted dogs, 29.6% said that wildlife had no effect, 8.7% reported leopard lifting elsewhere or earlier, 2.6% were unsure, and 0.9% mentioned wild pigs attacking dogs. Response statistics for all questions are summarized in Table 2. Survey response data are available in the Supplementary Material S2.

Statistical Analysis

We tested the effect of respondent demographics: age class (young versus old), sex (male versus female), and dog-keeping status (owner versus non-owner) on the responses we received. Of the 20 Fisher’s tests we carried out, none were significant except for the effect of sex on reporting the impact of wild species on dogs, where women reported no impact more than men (Table 3).

Discussion

This study investigated residents’ attitudes towards dogs, dog-keeping, and dog-wildlife interaction in Sigur Plateau villages in MTR. The majority of owned dogs were free-ranging, similar to several other rural areas across the world (Acosta-Jamett et al. 2010; Butler et al. 2004; Young et al. 2011); however, unlike

previous studies (e.g., Acosta-Jamett et al. 2010), the sex ratio of owned dogs was nearly equal with a slight bias in favor of females, and the proportion of vaccinated and sterilized dogs was high due to the long-term functioning of animal welfare NGOs in the area. Though people were broadly positive towards dogs, with non-owners also regularly feeding stray dogs, they supported the sterilization program as a larger local dog population could be a dangerous nuisance, indicating that long-term engagement by IPAN and WVS-I in the area has been successful and is positively regarded. Owners also often expressed affection and concern for their dogs during surveys, including requesting the survey team for advice on medical care for injured or ill dogs. However, such medical care was usually *not* provided for most dogs by their owners, basic dog-related knowledge was sometimes unknown, and vaccination was done only when NGO staff visited the village. Educational initiatives to improve awareness of dog health and the benefits of routine care, such as annual vaccine boosters, would therefore potentially be a locally empowering contribution to dog management.

Dog owners primarily kept dogs to alert them to the approach of wild animals or strangers. The secondary reason was a combination of security and companionship, and the least cited reason was companionship alone. These findings are consistent with those of similar studies in Madagascar (Kshirsagar et al. 2020; Valenta et al. 2016), Chile (Acosta-Jamett et al. 2010), and Zimbabwe (Butler and Bingham 2000). The native wildlife of MTR includes bonnet macaques, gray langurs, and wild pigs, which may raid crops; large carnivores, which may attack humans and prey on valuable livestock for which government-mandated compensation is not easily secured (Karanth et al. 2018); elephants, which pose a threat to human life, property, and livelihood by extensive crop raiding; and venomous snakes, which may hide in human homes. In a region where people must be mindful of wildlife encounters on a daily basis, regardless of age, sex, or occupation, we found that people consider dog-keeping to be of value as a protection system that not only warns owners of the presence of wild animals, but may even kill smaller dangerous wildlife such as venomous snakes, as one respondent reported his dog doing.

Although most people said that dogs did not go to the forest and did not interact with wildlife, or only chased wild animals that entered villages, we received

a few mixed and seemingly contradictory responses regarding dogs hunting that deserve attention. Of the 20 people who reported such active hunting by dogs, when asked the separate question about dogs going to the forest, they had different responses, saying that dogs went in the company of their owners or when accompanying livestock ($n = 10$), that they ventured into the forest alone ($n = 3$), that they went into the forest infrequently, long ago, or elsewhere ($n = 3$), or that said that they did not go into the forest at all ($n = 4$). With respect to dogs hunting in the company of their owners, this may be part of long-standing indigenous tradition, as it is in Indonesia, Brazil, and Mexico (Supplementary Material S3). While dogs have been used for hunting in Indian forests (Gubbi and Linkie 2012), there is a lack of detailed ethnographic analyses to clarify how widespread these practices are in different regions across the country, although they are presumably curtailed in general, as wildlife hunting is illegal in India. In Tiger Reserves (areas of high conservation priority) and this Reserve in particular, punitive action would certainly be incurred if a dog was caught hunting. A few respondents even mentioned that Forest Department personnel have shot stray FRDs for killing deer. It therefore seemed that local residents who take their dogs hunting did so clandestinely, and respondents may not have mentioned such occurrences during the survey to avoid potential negative consequences.

With respect to dogs hunting wildlife *without* venturing into the forest, this seemed like a paradox; however, multiple respondents mentioned that wild animals were attracted to open garbage heaps, and one respondent reported that the more deer had been gathering at village boundaries at night in recent years. If prey species were taking advantage of the human shield effect (Berger 2007) by approaching villages to avoid predators, dogs may have gone beyond chasing or barking to kill them without ever entering the forest. Additionally, since these dogs were free-ranging and resided in villages embedded within the forest, with a relatively large interface at the boundary, they could frequent such areas to hunt at any time of the day or night. Overall, however, most people said that while dogs might bark at or chase wild animals that ventured close to people, as was their function in the household, killing was an unusual or infrequent occurrence. The wild species mentioned as chased and/or hunted was almost always spotted deer, while other animals were said to be only chased. Other native wildlife that could be affected by dogs but were



not mentioned include black-naped hares, which dogs may hunt, and dholes, the only local wild canid that

dogs may compete with or transmit disease to, as they have done elsewhere (Young et al. 2011).

Table 2 Dog ownership statistics reported from Mudumalai Tiger Reserve, South India. Percentages are rounded to the nearest decimal point.

Variable	Number	Percentage
Respondents surveyed	115	Respondents surveyed
Females	70	Females
Males	45	Males
Dog ownership		
Yes	81	70.40%
No	34	29.60%
Owners with vaccinated (V) and sterilized (S) dogs ¹		
All dogs V + S	57	70.40%
Only V	13	16.00%
Only some V/S	6	7.40%
No dogs V or S	5	6.20%
Owners with free-ranging dogs ¹		
Yes	64	79.00%
No	17	21.00%
Dog sterilization opinion		
Supportive	96	83.50%
Unsure	16	13.90%
Not supportive	3	2.60%
Food provided to dogs		
Human food	73	63.50%
Biscuits/milk/leftovers for strays	20	17.40%
No food	14	12.20%
Commercial dog food	8	7.00%
Reason for dog ownership ¹		
Security	40	49.40%
Security and companionship	23	28.40%
Companionship	18	22.20%
Dog medical care ¹		
No medical care provided	46	56.80%
Care provided by NGOs	20	24.70%
Care provided by veterinary hospital	11	13.60%
Both NGO and hospital services	2	2.50%
Care recommended by pharmacy	2	2.50%
Dog presence in the forest		
No presence	51	44.30%
Presence only with owners and/or livestock	41	35.70%
Presence infrequently/elsewhere/not recently	10	8.70%
Presence with owners/livestock and alone	6	5.20%
Unsure	4	3.50%
Presence alone	3	2.60%
Dogs affecting wildlife		
No impact	48	41.70%
Chasing/barking only	31	27.00%
Hunting/killing wildlife	20	17.30%
Unsure	8	7.00%
Hunting infrequently/elsewhere/not recently	8	7.00%
Wildlife affecting dogs		
Leopard predation	67	58.30%
No impact	34	29.60%
Leopard predation infrequently/elsewhere/not recently	10	8.70%
Unsure	3	2.60%
Wild pig attack	1	0.90%

¹Percentage calculated with respect to total number of dog owners (81) as the questions were relevant only to dog owners.

**Table 3** Fisher's exact test results examining the effect of demographic variables on survey responses.

Demographic Parameter	Variable	P-value	
Age class (younger than 50 versus older than 50)	Dog-keeping status	0.3895	
	Reason for dog-keeping	0.4685	
	Dog kept confined	0.8569	
	Sterilization/vaccination status	0.4233	
	Dog sterilization opinion	0.5991	
	Dog presence in the forest	0.2042	
	Dogs affecting wildlife	0.7724	
	Wildlife affecting dogs	0.09446	
	Sex (male versus female)	Dog-keeping status	0.6773
		Reason for dog-keeping	0.8353
Dog kept confined		0.5594	
Sterilization/vaccination status		0.3982	
Dog sterilization opinion		0.4663	
Dog presence in the forest		0.1724	
Dogs affecting wildlife		0.7438	
Wildlife affecting dogs		0.00001491*	
Dog-keeping (owner versus non-owner)		Dog sterilization opinion	0.4457
		Dog presence in the forest	0.98
	Dogs affecting wildlife	0.7887	
	Wildlife affecting dogs	0.2155	

While the possibility of significant underreporting of active hunting with or by dogs should be kept in mind, the majority of dog owners ($n = 40$) asserted that their own dogs' role was to raise the alarm when wild animals (particularly elephants) approached, rather than directly interacting with wild predators or prey in any way. This is in contrast to the findings of Sepúlveda et al. 2014, where dogs in Chile were actively encouraged by their owners to chase off wild predators. This primary role of FRDs as a valuable sentinel may be similar across wildlife-adjacent areas in India, where alternative security measures, such as erecting security fences, can be expensive unless paid for by the local government. In comparison, the cost of maintaining dogs may not go beyond the household's leftover food and occasional medical care.

These FRDs could therefore help mitigate human-wildlife conflict, providing humans with an increased sense of long-term safety and security by alerting their owners to unperceived danger, reducing the potential for sudden encounters with wildlife. This has previously been observed in Bangladesh, where native dogs communicated the presence of tigers to people in the forest (Khan 2009). This alerting may also contribute to wildlife conservation by helping prevent livestock kills, resulting in incidents of conflict between livestock owners and wild predators, such as retaliatory poisoning, decreasing significantly

(Sepúlveda et al. 2014). While we cannot confirm whether such mitigation or contributions are taking place based on this study alone, dogs have functioned similarly elsewhere, such as in Australia, Patagonia, Romania, and South Africa (Supplementary Material S3), and so the likelihood is strong. However, these previous studies have typically focused on guarding dogs of a specific breed. The guarding ability of native dogs in particular, and the subsequent effect on human-wildlife conflict, deserves equal research attention.

Wildlife affecting dogs was the only response category where we found a significant difference in answers with respect to sex, with more women than men reporting that wildlife had no impact on dogs. This may be because dogs often accompany members of the household who routinely leave the house for work, who tend to be men; it may also be that men have more access to general knowledge about wildlife and/or dog movements than women. However, we note that we did not formally correct for multiple comparisons within the same dataset and would therefore interpret this single significant finding with caution, as we cannot definitively account for it. We encourage more in-depth research in the future to examine such sociological questions. Those who reported wildlife affecting dogs said that leopard lifting was widespread and occurred regularly, and many dog owners, as well as people who did not own



dogs when interviewed, had lost previous dogs to leopards. The presence of leopards thus seemed to exert a predation pressure that could affect the maximum size of the dog population and possibly their roaming behavior as well. While leopard predation of dogs was widely reported during the colonial period in India, little formal work has been done to quantify the effect of their presence on free-ranging dog ecology (Butler et al. 2014). Further study would serve to clarify these nuances, as well as to investigate potential escalations of human-wildlife conflict triggered by leopards approaching settlements to hunt dogs, which may offset any gains made by dogs helping prevent livestock depredation.

Overall, across the Sigur Plateau in Mudumalai Tiger Reserve, dogs are simultaneously affectionate commensals, potentially dangerous irritants, and valued sentinels. Several factors interact to influence how and why people keep dogs, including preventing depredations by wildlife, general affection and tolerance for dogs, increasing wildlife presence near villages in recent years, and perhaps an undocumented tradition of hunting with dogs. These factors are important to contextualize how dogs and wildlife interact in the landscape and to design effective management strategies. For example, confining dogs at night, a seemingly simple way to curb dog roaming behavior, could meet with resistance from owners who require their dog to patrol and protect their property the most at night. Owners may also argue that their dog does not visit the forest and therefore does nothing wrong by instinctively chasing deer that enter village areas. Therefore, studies focused on quantifying the true impact that dogs have on both prey and predator species of wildlife, as well as designing management strategies, must take the local socio-ecological context into account while addressing dog-related conservation issues.

Dog management strategies also should ideally be multi-dimensional to be successful in the long term. We recommend financial and administrative support for stringent waste management to minimize incidents of wildlife entering villages in search of food. This may be carried out by the Panchayat with support from the District Collector's office, alongside the long-term continuation of animal birth control and vaccination by IPAN and WVS-I, potentially financed by the relevant State government bodies. We also recommend educational initiatives about dog welfare—such as the importance of routine medical

care, training dogs not to wander excessively, and feeding them a nutritionally appropriate diet—as well as a microchip program to promote individual responsibility for dogs' movements at the village-forest interface, spearheaded by IPAN and WVS-I.

Conclusion

Dog-keeping is a common practice in the Sigur Plateau region of Mudumalai Tiger Reserve. Dogs are mostly free-ranging, fed human leftovers, and kept to alert people to wildlife. Though sometimes considered a dangerous nuisance, they are valued by their owners as they help protect human lives, livestock and property, and therefore potentially help mitigate human-wildlife conflict. Rates of sterilization and vaccination are high due to the work of local animal welfare NGOs, and people are broadly positive towards dogs as well as towards animal birth control to keep the population in check. Reported dog impacts on wildlife and use of forest space are low, although this may be biased due to the illegality of dogs entering the forest. Leopard predation on dogs is widespread and may exercise a controlling effect on the population size. Overall, dogs play a vital role in this wildlife-adjacent area and cannot be easily removed, making it all the more necessary to support the work carried out by animal welfare NGOs, in conjunction with waste management, microchipping, and education on dog welfare, to manage the population consistently and effectively.

Positionality Statement

Of the two authors of this paper, only the first author (SVK) was involved in documenting survey responses, transcribing and categorizing them, and analyzing them. While the first author could communicate in the local language to a certain extent, other sociological factors, primarily financial and educational privilege, marked her as “other” during surveys. The survey actually being administered by a member of the local community would not have significantly alleviated these barriers. We therefore acknowledge that participants were aware they were providing information to an outsider, which may have affected the information people were willing to share. We do not believe her positionality affected the analysis of results, as almost all responses were either observational or factual.

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Declarations

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