Community Perceptions and Rapid Assessment of Free-Roaming Dog *(Canis lupus familiaris*) Populations in Tiger Reserves of Telangana, India

by

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A thesis submitted to the Graduate Faculty of
Auburn University
in partial fulfillment of the
requirements for the Degree of
Master of Science

Auburn, Alabama
May 2, 2026

tiger reserves, photographic capture-mark-recapture, population estimation,
community perceptions

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Abstract

Free-roaming dogs (*Canis familiaris*) are increasingly recognized as an emerging global conservation and public health concern, particularly in parts of South Asia, such as India, where humans and wildlife coexist. However, there is limited information on their population sizes, associated human perspectives and activities in villages surrounding tiger reserves. The goal of this study was to evaluate free-roaming dog populations and assess community perceptions of their role and potential impacts on wildlife, particularly tigers, in villages surrounding tiger reserves. I combined ecological and social approaches to assess free-roaming dog populations and related community perceptions in villages surrounding the Amrabad Tiger Reserve (ATR) and Kawal Tiger Reserve (KTR) in Telangana, India in 2025. Dog populations were estimated across 50 villages using photographic capture–mark–recapture (CMR). Under the closed-population assumption, photographic CMR improves the reliability of free-roaming dog population estimates by accounting for imperfect detection compared to direct counts. I used four estimators based on the CMR technique to estimate the population size, including Chapman, SuperDuplicates, Schnabel, and Beck's. Across the 27 ATR villages, the Chapman, SuperDuplicates, Schnabel, and Beck's estimators yielded total population estimates of 2251, 5270, 2202, and 2115 dogs, respectively, whereas across the 23 KTR villages, the corresponding estimates were 1174, 3684, 1011, and 1090 dogs. I also assessed community perceptions of free-roaming dogs using a structured questionnaire survey. Out of 621 respondents, 61% reported providing food or water to dogs, 24% veterinary care, 10% other healthcare, and 12% shelter, while 35% reported no support. Direct interactions between dogs and wildlife were rarely reported across all age groups, with no statistically significant variation observed. In contrast, support for dog management strategies differed significantly across age groups, with the highest support observed among respondents in the 30–49 age group. This

study provides important foundational data on free-roaming dog populations and community perceptions for forest departments and local NGOs. Comparisons among estimators revealed minimal differences in the results across Chapman, Schnabel, and Beck's methods. However, the SuperDuplicates estimator consistently yielded higher estimates, suggesting potential overestimation in field conditions. Integrating population estimates with local attitudes can help further inform better management strategies for free-roaming dog populations in tiger reserves.

Artificial Intelligence (AI) Use Disclosure Statement

In the preparation of this thesis, Artificial Intelligence (AI) tools, including ChatGPT and QuillBot, were used to assist with language refinement, paraphrasing, and rephrasing of text to improve clarity and readability. The author has carefully reviewed and revised all AI-assisted content to ensure accuracy, coherence, and adherence to academic standards. The author takes full responsibility for the intellectual content of this thesis.

Digital Accessibility Disclosure

In the preparation of this thesis, digital accessibility tools such as Microsoft Word Accessibility Checker were used to ensure this document complies with federal accessibility requirements. The author acknowledges full responsibility for the intellectual content of this work and has made a good faith effort to comply with digital accessibility requirements prior to final submission.

Acknowledgments

The beginning of my journey started with my mother's prayer. Coming to Auburn University not only shaped my academic journey but also taught me many lessons about life. Through every challenge and new experience, I found reflection of God's love in my life. I am deeply thankful for the guidance and blessings of my Lord, Jesus Christ, whose grace and strength have sustained me the perseverance to complete this work*, "Be Strong and courageous. Do not be afraid; do not be discouraged, for the Lord your God will be with you wherever you go"* (Joshua 1:9). His strength gave me hope during difficult times and the courage to move forward with confidence. Without His help, I would not have come this far.

I am grateful to my parents, Amith Kumar Malyala and Elizabeth Malyala, for their unconditional love, constant support, and encouragement throughout my academic journey. Their belief in me has been my greatest strength.

I am especially thankful to my advisor, Dr. Aniruddha Belsare, for his invaluable guidance, patience, and continuous support. His mentorship has been instrumental in shaping this research and my academic growth.

I extend my heartfelt appreciation to Dr. Allie McCreary, Dr. Christopher Lepczyk, and Dr. Robert Gitzen for their insightful feedback, encouragement, and time devoted to improving this thesis.

I would also like to sincerely thank Dr. Janaki Alavalapati, Dr. Priyanka Varghese, and Dr. Reeja Sundaram for their support throughout my academic journey.

I would also like to thank local people, forest department, staff and drivers in Amrabad Tiger Reserve and Kawal Tiger Reserve for their support and cooperation during my research.

My heartfelt thanks to Auburn University, the College of Forestry, Wildlife and Environment and the Forest College and Research Institute, Telangana, India, for providing me with this wonderful opportunity to pursue my academic journey.

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ATR	Amrabad Tiger Reserve
KTR	Kawal Tiger Reserve
CDV	Canine distemper virus
CPV	Canine parvovirus
NTCA	National Tiger Conservation Authority
CMR	Capture-mark-recapture
NSTR	Nagarjunasagar-Srisailam Tiger Reserve
PVTG	Particularly Vulnerable Tribal Group
ABC	Animal Birth Control
IUCN	International Union for Conservation of Nature
NTFP	Non-Timber Forest Products
NGO	non-governmental organization

Chapter 1: Introduction

Free-roaming dogs (*Canis lupus familiaris*) are defined as owned or unowned dogs that roam without direct human supervision. They are among the most abundant and widely distributed carnivores in human-dominated landscapes worldwide (Cunha Silva et al., 2025; Hughes & Macdonald, 2013; Wandeler et al., 1993). Their global population is estimated to approach one billion individuals, with a large proportion occurring in developing regions where dog ownership and management practices are limited (Doherty et al., 2017). The ecological, epidemiological, and social impacts of free-roaming dogs has been a growing attention over the past two decades, particularly in areas where humans and wildlife coexist (Young et al., 2011). In these multi-use landscapes, free-roaming dogs rely on anthropogenic resources while extending their ecological effects in surrounding natural environments (Yen et al., 2019).

The significant conservation threats posed by free-roaming dogs have been associated with negative effects on at least 188 species worldwide, including mammals, birds, and reptiles, and have been implicated in multiple species extinctions (Doherty et al., 2017). These impacts arise through both direct and indirect pathways. Direct impacts include predation (Ritchie et al., 2013), harassment (Cunha Silva et al., 2022; Hughes & Macdonald, 2013b; Wandeler et al., 1993), and disturbance of wildlife that may alter species behavior and increase mortality (Marshall et al., 2022). Indirect impacts includes urination and defecation as indirect mechanisms that may facilitate pathogen transmission (dos Santos et al., 2018; Junsiri et al., 2026; Knobel et al., 2014). The dogs act as reservoirs and vectors for a range of pathogens, including canine distemper virus (CDV), rabies virus, canine parvovirus (CPV), and canine adenovirus (CAV), which can spill over into wildlife populations (Belsare et al., 2014). These spillover pathways are particularly concerning in areas where close contact between free-roaming dogs and wild carnivores may elevate disease risks for vulnerable wildlife populations (Cleaveland et al., 2001). These highlight the importance of understanding the role of free-roaming dogs in disease ecology, particularly in regions where domestic and wildlife coexist (Marshall et al., 2022).

Indian cities are home to large numbers of free-roaming dogs, the majority of which are unowned (Nandi et al., 2026). These dogs can be a common source of human-dog conflict and are responsible for approximately 75% of human dog bite injuries (Thangaraj et al., 2025a). These dogs are ubiquitous across urban, semi-urban, and rural environments and are closely associated with human settlements (Warembourg et al., 2021). They are commonly observed in markets, agricultural landscapes, waste disposal sites, and in close proximity to protected areas (Spotte, 2012; Vanak et al., 2009a; Vanak et al., 2009b). The interaction between free-roaming dogs and wildlife is especially pronounced in India due to its high biodiversity and extensive human-dominated landscapes (Marshall et al., 2022). Studies have indicated that a substantial proportion of dog-related incidents occur within or around protected areas, where interactions between dogs and wildlife are more common (Gutiérrez-Zapata et al., 2024; Home et al., 2018). Such dog-wildlife interactions include predation, competition, and disease transmission, all of which pose significant risks to wildlife conservation. These risks are further supported by documented cases in India, including CDV outbreaks in Asiatic lions (*Panthera leo persica*) in Gujarat (Mourya et al., 2019) and infections reported in Indian foxes (*Vulpes bengalensis*) in Maharashtra (Belsare et al., 2014). Similarly, rabies continues to be endemic across many parts of India, posing an ongoing threat to both wildlife conservation and public health (Thangaraj et al., 2025). This disease risk concern is particularly important for endangered carnivores, including tigers, in India, where large human and associated dog populations occur in and around tiger reserves (Chaudhary, 2016.).

Tigers (*Panthera tigris*) are apex predators and serve as umbrella species whose conservation supports broader ecosystem integrity (Goodrich et al., 2022; Penjor et al., 2024). However, tiger populations have declined significantly due to habitat loss (Joshi et al., 2016; Wikramanayake et al., 2011), fragmentation (Mondal & Nagendra, 2011), poaching (Dinerstein et al., 2007), and human–wildlife conflict (Goodrich, 2010; Sanderson et al., 2023). India currently holds approximately 70% of the global tiger population and has implemented extensive conservation measures, including the establishment of tiger reserves under Project Tiger (Qureshi et al., 2023). Despite these efforts, tiger reserves are not isolated systems and are often surrounded by populated rural communities. These landscapes create complex interfaces where domestic animals, including free-roaming dogs, interact with wildlife. Dogs frequently move between villages and forest edges, increasing the potential for dog-wildlife interactions and disease transmission. In Telangana, Amrabad Tiger Reserve and Kawal Tiger Reserve represent important conservation landscapes characterized by such human–wildlife interactions. However, the role of free-roaming dogs in these systems remains insufficiently understood (Chaudhuri et al., 2024).

Accurate estimation of free-roaming dog populations is essential for effective management (Cunha Silva et al., 2025). However, several challenges complicate population assessment. Detection probability is rarely perfect, and not all individuals present in a population are observed during surveys (Otis et al., 1978; Warembourg et al., 2021; Williams et al., 2002). Free-roaming dogs are mobile and may move across spatial boundaries, while population structure may change over time due to births, deaths, and migration. As a result, direct count methods often underestimate true population size (Vallecillo et al., 2021). Capture–mark-recapture (CMR) approaches provide a more robust framework by accounting for imperfect detection (Cunha Silva et al., 2025). Photographic mark-resight techniques, in particular, offer a non-invasive method for identifying individuals based on natural markings, making them suitable for field conditions where physical capture is impractical (Punjabi et al., 2012). However, different estimators within the CMR technique vary in their assumptions and performance, and their reliability under field conditions requires careful evaluation (Grimm et al., 2014).

In addition to ecological considerations, the management of free-roaming dogs is strongly influenced by human behavior and social context (Ghimire et al., 2025). Dogs are deeply integrated into human communities, and their populations are often sustained by practices such as feeding (Morters et al., 2014). Community perceptions therefore play a central role in shaping both the presence of dogs and the success of management interventions (Hiby et al., 2011). Strategies such as vaccination and sterilization programs depend on public acceptance and participation, and ignoring social dimensions can lead to limited effectiveness or failure of such programs (Ghimire et al., 2025). In many rural and forest-edge communities, dogs may be valued for functions such as guarding or companionship, which can influence attitudes toward management (Corfmat et al., 2023; Sensharma et al., 2025).

Several key knowledge gaps remain in understanding the socio-ecological dynamics of free-roaming dogs in tiger reserves. There is limited quantitative information on dog population size in villages surrounding these protected areas, and the performance of different population estimators has not been systematically evaluated in these contexts. Additionally, the relationship between human behavior, community perceptions, and dog population dynamics remains poorly understood. Most existing studies have addressed ecological or social aspects independently, with limited integration of both components (Bhalla et al., 2021). This lack of integration restricts the development of comprehensive management strategies that address both ecological risks and social realities.

This thesis addresses these gaps by combining ecological and social approaches to study free-roaming dogs in villages surrounding the Amrabad Tiger Reserve and Kawal Tiger Reserve in Telangana, India. The overall aim of this thesis is to use ecological data and social perspectives to better understand the factors influencing populations of free-roaming dogs and their impacts in tiger reserves. To achieve this, the study uses photographic capture-mark-recapture techniques to estimate dog populations and evaluate multiple estimators, including Chapman, Schnabel, Beck, and SuperDuplicates, to find reliable approaches for population assessment under the closed population assumption. The study also examines community perceptions, experiences, and attitudes toward free-roaming dogs and their management in villages surrounding ATR and KTR, with particular focus on household provisioning, such as food or water, veterinary care, other health care, and shelter as well as observations of dog-wildlife interactions and support for management strategies. Furthermore, the study evaluates demographic factors such as gender, and tribal or non-tribal status influence these perceptions, observations, and support for management strategies. These findings aim to support the development of effective management strategies for free-roaming dogs in and around tiger reserves. Specifically, my research seeks to answer the following questions1) How reliably can different population estimators under photographic capture-mark-recapture technique be used to estimate the free-roaming dog populations in villages surrounding the Amrabad and Kawal Tiger Reserves; and, 2) How do community perceptions, household resource provisioning, and demographic factors like age category influence free-roaming dog presence, dog-wildlife interactions and support for management strategies in villages surrounding Amrabad and Kawal Tiger Reserves?

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Chapter 2: Rapid Assessment of Free Roaming Dog *(Canis lupus familiaris)* Populations in Tiger Reserves of Telangana, India

Abstract

Free-roaming domestic dogs *(Canis lupus familiaris)* are increasingly recognized as an emerging global conservation and public health concern, particularly in landscapes where human and wildlife overlap. In these areas, human-associated free-roaming dogs may pose threats to wildlife through disease transmission, competition, disturbance, and predator-prey interactions. However, there is limited information on their population size in villages surrounding tiger reserves. This study aimed to estimate free-roaming dog populations in villages around the Amrabad Tiger Reserve (ATR) and Kawal Tiger Reserve (KTR) in Telangana, India. To address this aim, I applied photographic capture–mark–recapture (CMR) methods to estimate free-roaming dog populations in villages surrounding ATR and KTR. I used Chapman estimator, Schnabel estimator, Beck's, and SuperDuplicates, to estimate population size under a closed population assumption across 50 villages. A descriptive comparison among estimators revealed similar trends across the Chapman, Schnabel, and Beck's methods, while the SuperDuplicates estimator consistently yielded higher estimates. This study demonstrates that photographic capture-mark-recapture surveys can be practically implemented under field conditions in tiger reserves, providing a feasible approach for estimating free-roaming dog populations in villages surrounding tiger reserves. The findings provide baseline information that can support rapid population assessments by forest departments and local NGOs for dog population management strategies in tiger reserve landscapes.

Introduction

Domestic dogs (*Canis familiaris*) are one of the most widely distributed carnivores and share close cultural, social, and economic associations with humans (Hughes & Macdonald, 2013; Larson et al., 2012). A large proportion of these dogs are free-roaming, particularly in developing countries, where they are not actively controlled or restricted by humans (Belsare & Gompper, 2013; Phiriyaphokhai et al., 2025). Free-roaming dogs are increasingly recognized as an emergent threat, especially in landscapes where people and wildlife overlap (Gupta & Gupta, 2019; Jhala et al., 2021). They are among the most widespread terrestrial carnivores globally, with an estimated population of 1 billion and they are known to impact at least 188 species worldwide and have been linked to the extinction of 11 species. (Doherty et al., 2017). Free-roaming dogs can act as reservoirs and transmit pathogens to wildlife (Butler, et al., 2004; Cleaveland et al., 2000; Fiorello et al., 2006). For example, canine distemper virus (CDV) has been linked to declines in Amur tiger (*Panthera tigris altaica*) populations in the Russian Far East, including their mortality reported in 2004, with transmission associated with domestic dogs (Gilbert et al., 2020; Quigley et al., 2010; Seimon et al., 2013).

India has one of the highest populations of free-roaming dogs (Belsare & Gompper, 2013; Gompper, 2014b). These dogs can interact with wildlife in numerous ways including serving as predators (MacFarland et al., 1974), prey (Butler et al., 2014), competitors (Butler, et al., 2004), disease carriers (Belsare et al., 2014; Pedersen et al., 2007) and hybridizers with other canid species (Butler et al., 2004; Gompper, 2014a; Vanak et al., 2009a). In India, nearly 48% of dog-wildlife conflicts occurs within and protected areas (Home et al., 2018). These frequent interactions increase the risk of pathogen spillovers from free-roaming dogs to wildlife, as evidenced by canine distemper virus (CDV) outbreaks affected 68 Asiatic lions (*Panthera leo* *persica*) in Gujarat (Mourya et al., 2019) and Indian foxes (*Vulpes bengalensis*) in the Great Indian Bustard Wildlife Sanctuary, Maharashtra (Belsare et al., 2014; Vanak et al., 2009b). In addition, free-roaming dogs can also serves as host to other diseases like canine parvovirus (CPV), canine adenovirus (CAV), which pose a serious threat to carnivore species globally (Belsare et al., 2014; Pedersen et al., 2007)

These interactions and disease risks are particularly concerned for large carnivores such as tigers (*Panthera tigris*, Linnaeus 1758). Tigers are umbrella species and important indicators of ecosystem health and are currently classified as Endangered by the International Union for Conservation of Nature (IUCN; Gilbert et al., 2023; Goodrich et al., 2022). Historically distributed across much of Asia, tigers now occur in only thirteen countries including Bangladesh, Bhutan, Cambodia, China, India, Indonesia, Laos, Malaysia, Myanmar, Nepal, Russia, Thailand, and Vietnam (Seidensticker, 2010). The decline of tiger populations has been primarily driven by habitat loss (Joshi et al., 2016), fragmentation (Sanderson et al., 2010), poaching (Chapron et al., 2008; Nowell, 2000), depletion of prey species (Karanth & Stith, 1999), and human–wildlife conflict (Bekoff, 2001; Treves & Karanth, 2003; Woodroffe & Ginsberg, 1998). Among all tiger-range countries, India supports approximately 70% of the world's tiger population (Singh & Sen, 2022). Beyond their ecological importance as apex predators, tigers also hold deep cultural and spiritual significance in India and are often associated with religious symbolism and traditional beliefs (Sinha, 1995).

Recognizing the need for urgent conservation measures, India launched "Project Tiger" in 1973 to protect the declining tiger population. This initiative was further strengthened with the establishment of the National Tiger Conservation Authority (NTCA) in 2005, which plays a central role in the management, monitoring, and funding of tiger reserves across the country

(Lamba et al., 2023). By 2023 India had established 55 tiger reserves distributed across various ecological regions, providing essential habitats for the conservation of tigers (Govindarajulu et al., n.d.). However, tiger reserves are also closely linked to the livelihoods of surrounding communities that depend on forest resources for agriculture, livestock grazing, and the collection of non-timber forest products (NTFPs), which increases human–wildlife interactions (Kolipaka et al., 2015; Tripathi, 2016). Such human-dominated interfaces also support domestic animals, particularly dogs that are closely associated with human communities, which often leads to interactions with wildlife (Gompper, 2014a; Home et al., 2018; Hughes & Macdonald, 2013; Vanak et al., 2009b). These dogs are often unvaccinated, freely roaming, and can serve as reservoirs and vectors of infectious diseases that may spill over into wildlife populations (Gubbi et al., 2017; Quigley et al., 2010). Therefore, estimating the population size of free-roaming dogs in these areas is essential for understanding both their ecological and epidemiological impacts.

To address risks associated with free-roaming dogs, India has implemented dog population management strategies such as Animal Birth Control (ABC) programs, which involve the capture, sterilization, vaccination, and release of dogs back into their original territories (Hiby et al., 2011). Mass vaccination campaigns targeting dogs are widely recognized as the most effective approach for controlling rabies transmission, and epidemiological studies suggest that vaccination coverage of approximately 70% of the dog population is required to prevent outbreaks (Das et al., 2022). However, the success of such interventions depends on reliable information about dog population size and demographic characteristics in tiger reserves (Knobel et al., 2005; Morters et al., 2014; Slater, 2001).

Reliable estimation of free-roaming dog populations is critical first step for both understanding for their ecological impacts and informing management decisions in tiger reserves. Because direct counts often underestimate abundance due to imperfect detection, capture–mark–recapture (CMR)-based approaches provide more reliable estimation. Among available approaches, closed-population photographic CMR methods are particularly suitable for village-level surveys and have been widely applied to free-roaming dog studies. Therefore, this study compares different population estimators under photographic capture-mark-recapture techniques to estimate the free-roaming dog populations in villages surrounding the Amrabad and Kawal Tiger Reserves

Materials and Methods

Study Area

This study was conducted in two ecologically significant tiger reserves located in Telangana state, India: Amrabad Tiger Reserve (ATR) and Kawal Tiger Reserve (KTR) (Fig 2.1). Amrabad Tiger Reserve (ATR; 2611.4 km^2) is located in southern region of Telangana, spans the Nagar Kurnool and Nalgonda districts. It was initially designated as a Wildlife Sanctuary in 1983, later included under Project Tiger in 1993 and officially declared as a Tiger Reserve in 2014. Amrabad Tiger Reserve was earlier a part of the larger Nagarjunasagar-Srisailam Tiger Reserve (NSTR) that covers the states of Andhra Pradesh and Telangana. With the bifurcation of Andhra Pradesh in 2014, the Telangana part of the reserve was named as Amrabad Tiger Reserve. ATR ranges in elevation from about 150 m to 1000 m above sea level and is predominantly covered by tropical dry deciduous forest. This reserve has a diverse range of wildlife species and home to Chenchu tribes, an indigenous community recognized as a Particularly Vulnerable Tribal Group (PVTG).

Kawal Tiger Reserve (KTR; 1015.35 km^2) is located in northeastern region of Telangana and lies within Jannaram mandal of Mancherial District (Old Adilabad district). The area was first established as a wildlife sanctuary in 1965 and later recognized as a Tiger Reserve in 2012. The Kawal Tiger Reserve is connected by a wildlife corridor to the Tadoba-Andhari Tiger Reserve in Maharashtra and the Indravati Tiger Reserve in Chhattisgarh, allowing for tiger movement between these areas. The elevation within the reserve ranges from about 200 m to 900 m above sea level and is primarily covered by tropical dry deciduous forest, supporting a diverse range of wildlife.

Study Design

I designed the study to estimate the population of free-roaming dogs in and around selected villages of ATR and KTR using photographic capture-mark-recapture approach. I conducted field surveys from June through September 2025. I photographed individual free-roaming dogs, including adults, sub-adults, and juveniles, using a Nikon COOLPIX L21 camera which is equipped with an 8 megapixel sensor and a fixed 3.6* Optical zoom NIKKOR lens (36-136 mm equivalent focal length). I photographed dogs from multiple angles, specifically attempting to capture the dorsal and lateral views so as to facilitate accurate identification of individual dogs based on distinct morphological characteristics such as coat color, markings, scars, ear shape, and tail features (Cunha Silva et al., 2026). No dogs were physically captured or handled.

I surveyed a total of 27 villages in ATR and 23 villages in KTR. I developed the sampling design using online maps and secondary information to identify villages located within the selected study zones of both reserves. Preliminary village lists and location information were compiled prior to fieldwork. Upon entering the field, the final selection was refined with guidance from the Forest Department, and some villages were added or removed based on ground accessibility, logistical feasibility, and field relevance to the study objectives.

In ATR, 13 villages (48%) were located in the core zone where villages are protected with minimal human interference (Post & Pandav, 2013), and 14 villages (52%) were located in the buffer zone where villages located within the peripheral area surrounding the critical tiger habitat, with a lesser degree of habitat protection allows human activities while maintaining ecological integrity of the reserve core (Kolipaka et al., 2015; Post & Pandav, 2013). In KTR, 7 villages (30%) were located in the core zone, whereas 16 villages (70%) were located in the buffer zone (Table 2.1). Due to logistical and accessibility constraints, field surveys in ATR were concentrated primarily in the western part of the reserve, whereas surveys in KTR were mainly distributed across the southern and eastern portion of the reserve landscape.

I classified these villages into three categories based on household size: small (<400 households), medium (400–800 households), and large (>800 households) across both reserves (Table 2.1). This classification was used to compare dogs/household and dogs/person across villages of core zone and buffer zone in both reserves. In villages with fewer than 20 households, I photographed all dogs and conducted house-to-house surveys of all households in the village. In villages with more than 20 households, I ran photographic surveys along predetermined routes for 30 minutes on non-consecutive days, and each village was surveyed on four occasions (E1, E2, E3, and E4). I adjusted this survey approach based on village household size to maintain comparable photographic coverage.

I estimated population size using multiple photographic capture-mark-recapture estimators, including the Chapman, Schnabel, Beck and SuperDuplicates. The SuperDuplictes estimator was applied using the Shiny application (https://Chao.shinyapps.io/SuperDuplicates/;

Silva eta al., 2025). For the Chapman and SuperDuplicates estimators, I combined the four occasions into two sampling events (E1+E2 and E3+E4). In contrast, I used all four survey occasions without combination for the Schnabel and Beck estimators, which incorporate multiple sampling events into the population estimation.

Data Analysis

I created an encounter history for each identified dog to record captures and recaptures across survey occasions. I used four estimators within the capture–mark–recapture technique to compare population estimates and identify suitable methods for estimating free-roaming dog abundance across 50 villages differing in household size and located in the core and buffer zones of the two tiger reserves. All estimators were applied under the closed population assumption, where no births, deaths, immigration, or emigration were assumed to occur during the short survey period within each village. For the Schnabel and Beck estimators, I retained encounter histories from all four sampling occasions (E1–E4) because both methods are designed to use repeated capture–recapture information from multiple survey occasions, allowing cumulative abundance estimation across repeated visits. Using all four occasions enabled these estimators to incorporate repeated detection histories and generate population estimates. In contrast, the Chapman and SuperDuplicates estimators used two combined sampling events. This allowed population estimates to be calculated from the same two-event structure in each village for fair comparison.

I also collected village-level human population and household data with the help of the forest departments to calculate household-to-dog and human-to-dog ratios. These ratios were calculated separately for the core and buffer of ATR and KTR using the total Schnabel population estimate for each zone. The core zone is a highly protected area with minimal human disturbance (Post & Pandav, 2013), whereas the buffer zone surrounds the core area and permits limited human activities while maintaining the ecological integrity of the reserve (Kolipaka et al., 2015; Post & Pandav, 2013). The Schnabel estimates is specifically suited for closed populations sampled across multiple occasions, it provided an appropriate cumulative abundance estimate for deriving zone-level demographic ratios from the four repeated surveys conducted in this study (Wada et al., 2025). This provided a basis for comparing free-roaming dog abundance in relation to household number and human population size across the two tiger reserves.

Results

Dog population estimation in ATR and KTR

A total of 759 uniquely identified free-roaming dogs were recorded across the surveyed villages in Amrabad Tiger Reserve (ATR), while 450 dogs were recorded in Kawal Tiger Reserve (KTR). The number of uniquely identified dogs varied among villages in both reserves (Tables 2.2, Table 2.3). In all villages, capture–mark–recapture estimators produced population estimates that were higher than the minimum number of uniquely identified dogs.

Across ATR reserve, Bhairapur (ATR) showed the lowest population estimates, whereas Padara (ATR) showed the highest population estimates. For example, Chapman estimates ranged from 21 in Bhairapur to 371 in Padara, Schnabel estimates ranged from 21 in Bhairapur to 317 in Amrabad, and Beck estimates ranged from 19 in Bhairapur to 300 in Padara. The SuperDuplicates method produced the highest estimates across all villages, ranging from 60 in Bhairapur to 867 in Padara (Table 2.2, Fig 2.2). A similar pattern was observed in KTR, where villages such as Chapman estimates ranged from 8 to 208 in Kistapur, Schnabel estimates ranged from 8 in Charigam to 197 in Kistapur, and Beck estimates ranged from 7 in Charigam to 189 in Kistapur. The SuperDuplicates method produced the highest estimated across all villages, ranging from 36 in Charigam to 487 in Kistapur (Fig 2.3,Table 2.3).

Dogs per household and dogs per person

The number of dogs showed variation in relation to both the number of households and human population across the two tiger reserves. In ATR, the number of dogs showed a weak relationship with the number of households, and this relationship was not statistically significant ($p = 0.0567$), indicating that the number of households did not strongly influence dog abundance. In contrast, in KTR, the number of dogs increased significantly with the number of households ($p = 0.0035$) suggesting that villages with more households tended to have higher dog abundance.

The number of dogs also showed a strong and significant relationship with human population in both reserves. In ATR, the number of dogs increased significantly with increasing human population ($p = 0.0012$), and a similar pattern was observed in KTR ($p = 0.0056$). These results indicate that villages with higher human populations consistently had higher dog abundance in both reserves, while the influence of household number was stronger in KTR and weaker in ATR.

Discussion

In ATR and KTR, a total of 759 and 450 uniquely identified dogs were recorded, respectively, indicating differences in dog populations between the two reserves. Such variation is likely influenced by differences in human population size, household numbers, and availability of human food resources, which are known to strongly affect free-roaming dog abundance

(Vanak et al., 2009b; Hughes & Macdonald, 2013). Across both reserves, population estimates varied among villages and across estimators, with all capture–mark–recapture methods producing higher values than the minimum number of uniquely identified individuals. This result is expected, as these methods account for imperfect detection and unobserved individuals. The SuperDuplicates method consistently produced the highest estimates across villages, often leading to overestimation.

Considerable spatial variation was observed within both reserves. In ATR, Bhairapur showed the lowest population estimates, whereas Padara showed the highest, while in KTR, Charigam exhibited the lowest estimates and Kistapur the highest. These differences likely reflect variation in village size, human population, and resource availability. Larger villages with higher human populations may support greater numbers of dogs due to increased food availability from waste and direct provisioning (Vanak et al., 2009a; Young et al., 2011).

The variation in dogs per household and dogs per person further supports the role of human-associated factors in shaping dog populations. In ATR, dogs per household were higher in the core zone than in the buffer zone, whereas in KTR, slightly higher values were observed in the buffer zone. Similarly, dogs per person varied between zones, indicating differences in the relationship between dog populations and human density. In areas with lower human density, a relatively stable dog population may result in higher numbers of dogs per person, whereas in more densely populated areas, this value was small (Hughes & Macdonald, 2013).

Overall, the findings demonstrate that free-roaming dog populations are not uniformly distributed across landscapes but are strongly influenced by local socio-environmental conditions. This finding is particularly important in the context of tiger and other wildlife conservation, as free-roaming dogs can affect wildlife through predation, competition, and disease transmission, especially in ecologically sensitive areas such as tiger reserves (Young et al., 2011; Vanak et al., 2009a). While this study does not propose management strategies, it provides important baseline information for understanding the ecological context of free-roaming dogs in relation to human settlements.

Conclusion

The findings of this study have practical implications for the management of free-roaming dog populations in and around ATR and KTR. The results demonstrate that minimum observed counts alone are likely to underestimate actual population size, while repeated survey approaches provide more reliable estimates. This finding suggests that future monitoring efforts should incorporate repeated survey designs to improve the accuracy of population assessments (Wada et al., 2025).

The observed variation in dog populations across the village suggests that management approaches cannot be uniformly applied across the reserves. Differences in dog abundance appear to be associated with human population size and household size, emphasizing the role of community people in shaping free-roaming dog populations. The studies have similarly shown that food availability, waste management practices, and human provisioning strongly influence dog abundance and their distribution (Vanak et al., 2009a; Hughes & Macdonald, 2013). Therefore, effective management strategies should consider human-related factors when designing and informing interventions.

The differences observed between core and buffer zones further suggest that management actions may be adapted to local conditions. Areas with relatively higher dog abundance may require more focused efforts. This is consistent with findings from other studies, which indicates that management interventions in high-density areas are more effective than uniform strategies across larger areas (Morters et al., 2013).

The comparison of population estimates in this study also provide useful information for monitoring dog populations using population estimates. Estimators such as the Schnabel population estimate, and Beck's method, which incorporates repeated sampling, produced more consistent estimates. In contrast, methods such as the SuperDuplicates also incorporates repeated sampling but yielded higher estimates, suggesting that it overestimates the population. Therefore, selecting appropriate estimators is critical for ensuring reliable population assessments and avoiding over and underestimations.

This study can support forest departments and local organizations in planning and implementing management actions. Interventions such as vaccination and sterilization programs are widely recommended for controlling free-roaming dog populations and reducing risks to wildlife and human health (Belsare & Gompper, 2013). In addition, the results of this study provide important foundation data for long-term monitoring of dog populations in tiger reserves. Such data are essential for evaluating the effectiveness of management interventions and for informing management strategies in tiger reserve landscapes.

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Figures

Figure 2.1. Map of the study area showing the locations of surveyed villages in and around Amrabad Tiger Reserve and Kawal Tiger Reserve.

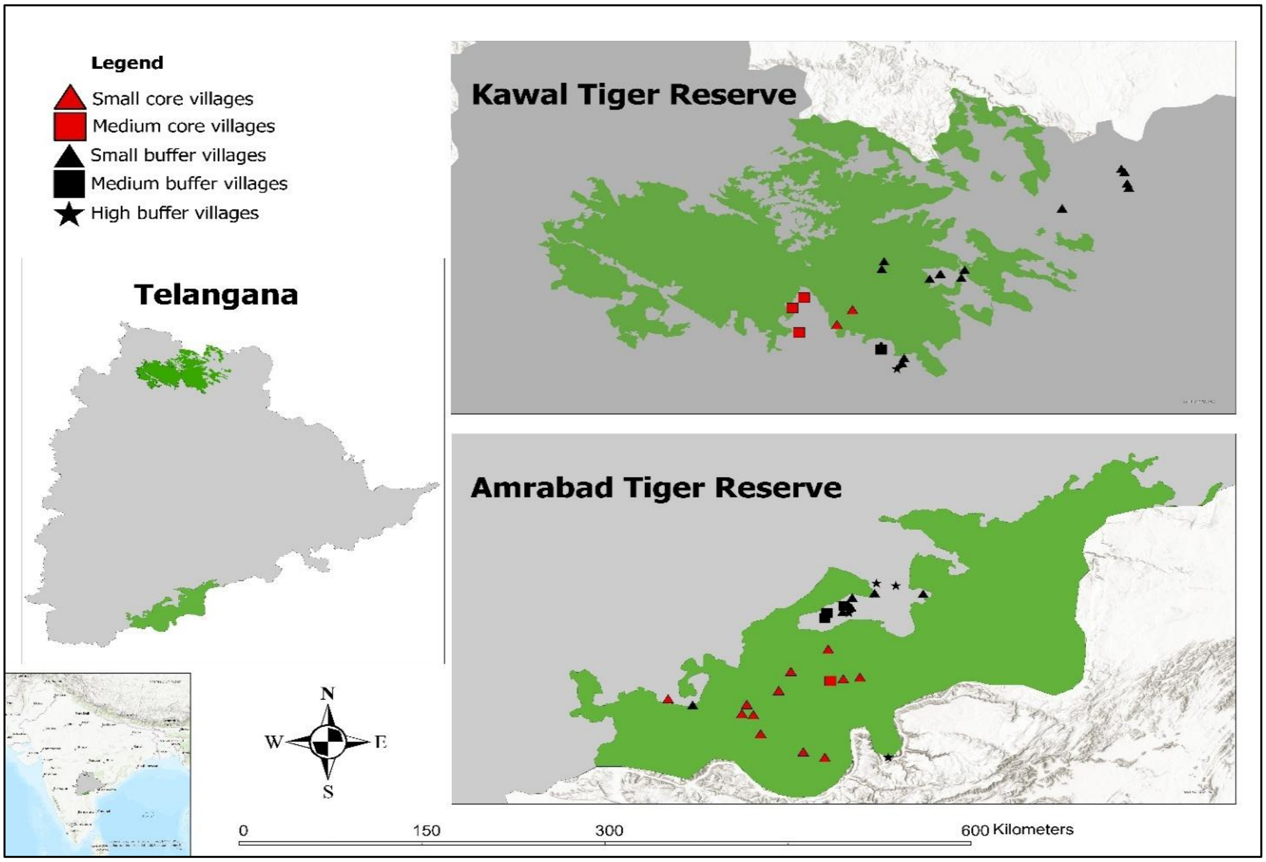


Figure 2.2. Comparison of population estimates of free-roaming dogs across villages in Amrabad Tiger Reserve using Chapman, SuperDuplicates, Schnabel, and Beck estimators.

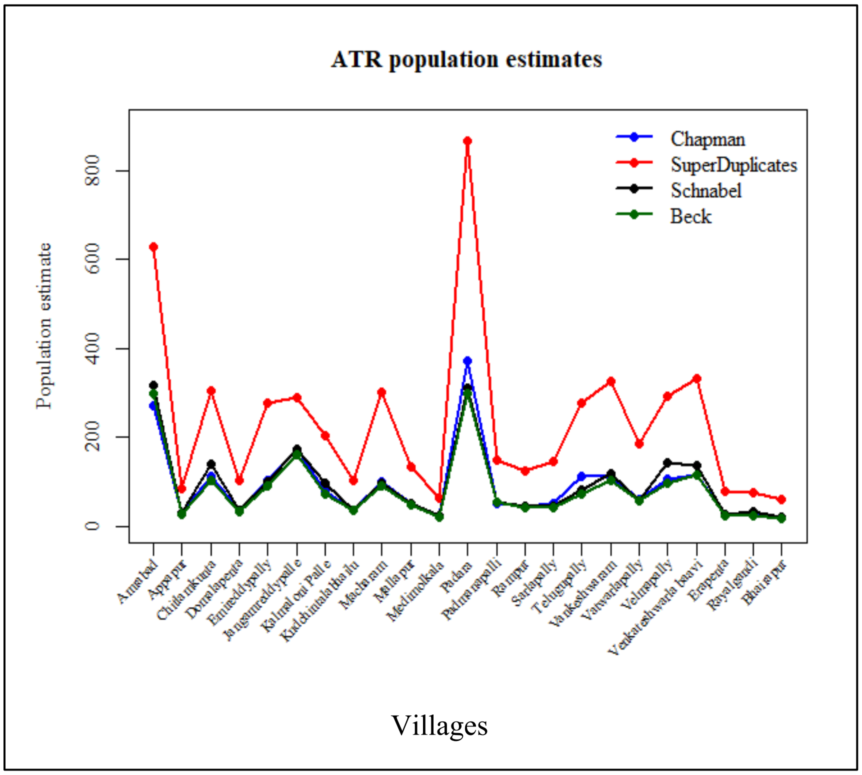
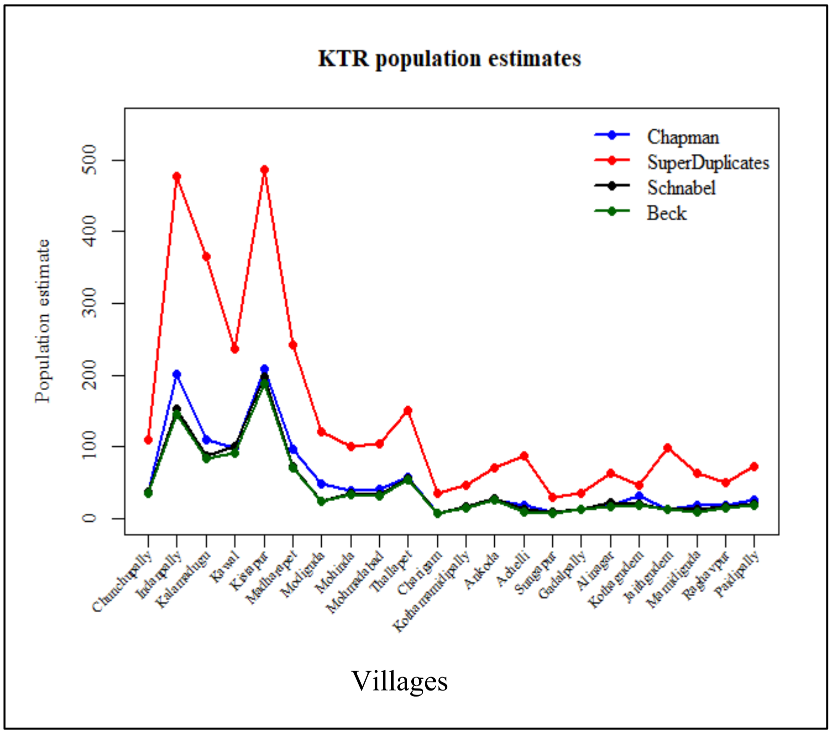


Figure 2.3. Comparison of population estimates of free-roaming dogs across villages in Kawal Tiger Reserve using Chapman, SuperDuplicates, Schnabel, and Beck estimators.



Tables

Table 2.1. Classification of villages into small, medium and large size categories across the core and buffer zones of Amrabad Tiger Reserve and Kawal Tiger Reserve. The core zone is a highly protected area with minimal human disturbance (Post & Pandav, 2013), whereas the buffer zone surrounds the core area and permits limited human activities while maintaining the ecological integrity of the reserve (Kolipaka et al., 2015; Post & Pandav, 2013).

Reserve	Zone	Small villages	Medium villages	Large villages
Amrabad Tiger Reserve	Core	12	1	0
	Buffer	7	3	4
Kawal Tiger Reserve	Core	4	3	0
	Buffer	14	1	0

Table 2.2. Estimates of capture-mark-recapture methods for free-roaming dog population in Amrabad Tiger Reserve

Village name	Households	Human Population	Min "n" Dog Individuals	Chapman Estimate	SuperDuplicate Method	Schnabel's Method	Becks Method
Amrabad	1819	5237	89	270 (95% CI: 114 - 427)	630 (95% 348 – 1250)	317(95% CI: 159-476)	299 (95% CI: 154 - 443)
Appapur	40	200	12	30 (95% CI: 26 - 44)	85 (95% CI: 57 – 157)	30 (95% CI: 13 - 47)	28 (95% CI: 13 - 43)
Chitlamkunta	106	4097	34	114 (95% CI: 57 - 283)	304 (95% CI: 99 - 1259)	139 (95% CI: 21 - 299)	104 (95% CI: 0 - 208)
Domalapenta	1124	3253	15	37 (95% CI: 31 - 54)	102 (95% CI 75 – 164)	35 (95% CI: 21 - 49)	34 (95% CI: 21 - 47)
Emireddypally	160	640	35	104 (95% CI: 52 - 240)	279 (95% CI 100 -1046)	101 (95% CI: 30 - 173)	90 (95% CI: 30 - 150)
Jangamreddypalle	368	1202	59	173 (95% CI: 144 - 663)	141 (95% CI 114 -187)	290 (95% CI: 77 - 268)	160 (95% CI: 75 - 246)

Kalmaloni Palle	187	590	27	80 (95% CI: 40 - 199)	203 (95% CI: 68 - 888)	96 (95% CI: 15 - 207)	72 (95% CI: 0 - 144)
Kudchintalabhailu	64	239	13	36 (95% CI: 33 - 49)	105 (95% CI: 80 - 151)	36 (95% CI: 24 - 49)	35 (95% CI: 23 - 47)
Macharam	401	1072	52	100 (95% CI: 54 - 202)	302 (95% CI: 144 - 751)	98 (95% CI: 42 - 155)	91 (95% CI: 40 - 141)
Mallapur	30	180	37	52 (95% CI: 39 - 85)	135 (95% CI: 83 - 266)	53 (95% CI: 20 - 87)	48 (95% CI: 19 - 78)
Medimolkala	21	72	12	24 (95% CI: 19 - 42)	65 (95% CI: 39 - 154)	24 (95% CI: 7 - 42)	22 (95% CI: 7 - 36)
Padara	150	5464	110	371 (95% CI: 233 - 622)	867 (95% CI: 508 - 1586)	312 (95% CI: 187 - 437)	300 (95% CI: 182 - 418)
Padmanapalli	200	550	25	53 (95% CI: 46 - 72)	150 (95% CI: 108 – 231)	56 (95% CI: 36 - 76)	54 (95% CI: 35 - 74)
Rampur	30	56	17	44 (95% CI: 39 - 58)	124 (95% CI: 35 - 177)	44 (95% CI: 29 - 59)	43 (95% CI: 29 - 57)

Sarlapally	337	600	26	52 (95% CI: 45 - 67)	145 (95% CI: 115 - 198)	44 (95% CI: 32 - 57)	43 (95% CI: 31 - 55)
Telugupally	560	580	35	112 (95% CI: 57 - 257)	279 (95% CI: 94 - 1182)	81 (95% CI: 27 - 134)	72 (95% CI: 27 - 118)
Vankeshwaram	1534	6380	42	114 (95% CI: 56 - 263)	326 (95% CI: 113 - 1260)	120 (95% CI: 29 - 210)	105 (95% CI: 31 - 179)
Vatwarlapally	560	1291	29	61 (95% CI: 51 - 92)	186 (95% CI: 114 - 356)	59 (95% CI: 36 - 81)	57 (95% CI: 35 - 78)
Velmapally	130	370	30	107 (95% CI: 45 - 308)	294 (95% CI: 116 – 850)	144 (95% CI: 60 - 348)	96 (95% CI: -15 - 207)
Venkateshwarla baavi	429	1563	37	115 (95% CI: 52 - 292)	332 (95% CI: 108 - 1348)	138 (95% CI: 15 - 261)	115 (95% CI: 21 - 208)
Erapenta	100	395	8	27 (95% CI: 26 - 35)	80 (95% CI: 62 - 116)	27 (95% CI: 14 - 39)	25 (95% CI: 14 - 37)
Rayalgandi	90	312	12	29 (95% CI: 16 - 72)	76 (95% CI: 33 - 269)	33 (95% CI: 5 - 71)	25 (95% CI: 0 - 50)

Bhairapur	30	95	3	21 (95% CI: 19 - 31)	60 (95% CI: 45 - 102)	21 (95% CI: 9 - 33)	19 (95% CI: 9 - 30)

Table 2.3. Estimates of capture-mark-recapture methods for free-roaming dog population in Kawal tiger reserve.

Village name	Households	Human Population	Min "n" Dog Individuals	Chapman Estimate	SuperDuplicate Method	Schnabel's Method	Becks Method
Chunchupally	95	410	16	38 (95% CI: 32 - 62)	110 (95% CI: 67 - 227)	38 (95% CI: 20 - 56)	36 (95% CI: 20 - 53)
Indanpally	724	2730	68	201 (95% CI: 124 - 350)	477 (95% CI: 262 - 966)	152 (95% CI: 87 - 216)	145 (95% CI: 85 - 206)
Kalamadugu	782	2933	40	109 (95% CI: 76 - 187)	365 (95% CI: 135 - 1392)	88 (95% CI: 52 - 123)	84 (95% CI: 50 - 118)
Kawal	651	2808	39	99 (95% CI: 62 - 180)	236 (95% CI: 106 - 716)	100 (95% CI: 40 - 160)	92 (95% CI: 39 - 145)
Kistapur	191	690	78	208 (95% CI: 144 - 328)	487 (95% CI: 294 - 882)	197 (95% CI: 118 - 276)	189 (95% CI: 115 - 264)
Madharapet	802	2968	36	96 (95% CI: 67 - 161)	242 (95% CI: 120 - 630)	73 (95% CI: 45 - 101)	70 (95% CI: 44 - 97)

Modiguda	40	78	11	48 (95% CI: 33 - 86)	121 (95% CI: 75 - 230)	25 (95% CI: 12 - 39)	24 (95% CI: 12 - 36)
Mohinda	37	221	18	39 (95% CI: 28 - 70)	100 (95% CI: 60 - 213)	36 (95% CI: 17 - 56)	34 (95% CI: 16 - 52)
Mohmadabad	164	652	17	41 (95% CI: 28 - 74)	105 (95% CI: 62 - 223)	34 (95% CI: 17 - 52)	32 (95% CI: 17 - 48)
Thallapet	564	2252	28	57 (95% CI: 45 - 88)	151 (95% CI: 100 - 258)	55 (95% CI: 33 - 77)	53 (95% CI: 32 - 74)
Charigam	235	1121	5	8 (95% CI: 3 - 18)	36 (95% CI: 19 - 80)	8 (95% CI: 0 - 17)	7 (95% CI: 1 - 13)
Kothamamidipally	203	1115	8	17 (95% CI: 13 - 35)	47 (95% CI: 26 - 142)	17 (95% CI: 5 - 29)	15 (95% CI: 5 - 25)
Ankoda	209	905	4	26 (95% CI: 22 - 42)	71 (95% CI: 46 - 140)	28 (95% CI: 11 - 45)	26 (95% CI: 11 - 41)
Achelli	133	563	11	18 (95% CI: 7 - 69)	88 (95% CI: 40 - 226)	13 (95% CI: 0 - 26)	10 (95% CI: 1 - 20)

Sungapur	70	326	4	9 (95% CI: 10 - 18)	29 (95% CI: 16 - 100)	9 (95% CI: 2 - 16)	8 (95% CI: 2 - 13)
Gadalpally	45	198	6	12 (95% CI: 11 - 25)	36 (95% CI: 21 - 98)	13 (95% CI: 3 - 23)	12 (95% CI: 3 - 20)
Alinagar	54	173	10	19 (95% CI: 14 - 52)	63 (95% CI: 28 - 199)	22 (95% CI: 0 - 44)	17 (95% CI: 2 - 33)
Kothagudem	38	164	13	32 (95% CI: 15 - 92)	46 (95% CI: 24 - 147)	21 (95% CI: 5 - 36)	18 (95% CI: 5 - 31)
Jaithgudem	38	147	4	13 (95% CI: 10 - 30)	98 (95% CI: 40 - 319)	13 (95% CI: 4 - 22)	12 (95% CI: 4 - 19)
Mamidiguda	25	120	7	19 (95% CI: 10 - 68)	64 (95% CI: 33 - 144)	12 (95% CI: 0 - 25)	10 (95% CI: 1 - 19)
Raghavpur	21	84	8	19 (95% CI: 13 - 42)	50 (95% CI: 24 - 196)	16 (95% CI: 5 - 27)	15 (95% CI: 5 - 24)
Paidipally	23	76	9	26 (95% CI: 18 - 56)	72 (95% CI: 33 - 224)	21 (95% CI: 8 - 33)	19 (95% CI: 8 - 30)

Chapter 3: Assessing Public Perceptions on Free-roaming Dogs *(Canis lupus familiaris)* in Tiger Reserves of Telangana, India

Abstract

India hosts a large population of free-roaming dogs, many of which are sustained through human subsidies in multi-use landscapes where both humans and wildlife coexist. In and around tiger reserves, free-roaming dogs frequently move between villages, agricultural lands, and forest edges, where they interact with humans, livestock, and wildlife, creating both benefits and ecological concerns. While dogs are valued for companionship, household security, and livestock protection, they may also cause wildlife disturbance, predation, competition with native carnivores, and disease transmission. Understanding community perceptions in and around tiger reserves is therefore important for developing effective and socially acceptable management strategies. [add in your main question here. Should be same as stated in first chapter] This study assessed local communities' perceptions of free-roaming dogs in 50 villages surrounding Amrabad Tiger Reserve (ATR) and Kawal Tiger Reserve (KTR) in Telangana, India, using a structured survey. The survey examined perceptions of dog presence, household resource provisioning, observed dog–wildlife interactions, and support for management strategies, with a focus on variation across age categories. Among respondents, 61% reported providing food or water to dogs, 24% veterinary care, 10% other healthcare, and 12% shelter, while 35% reported no support. Reported dog–wildlife interactions were generally low across all age groups, with no statistically significant differences observed. In contrast, support for dog management strategies showed a statistically significant association with age, although most respondents expressed either minimal or strong support for regulatory measures. Overall, communities both support free-roaming dogs through provisioning and are receptive to their management. This information provide baseline data for forest departments and NGOs and incorporates the community perceptions can help reduce impacts on wildlife and humans.

Introduction

Free-roaming dogs *(Canis lupus familiaris)* are increasingly recognized as an important social, ecological, and conservation concern in India, particularly within and around protected areas where people and wildlife are present (Home et al., 2018; Vanak & Gompper, 2009a; Gompper, 2014a). Their ability to move freely across villages, and forest edges increases the frequency of interactions with humans, livestock, and wildlife, creating both benefits and conflicts. Although local communities often value dogs for companionship (Serpell, 1996), security (Gompper, 2014b), and cultural significance (Morters et al., 2014), they can also create serious ecological challenges through predation, competition with native carnivores, and the transmission of infectious diseases (Belsare & Gompper, 2013; Hughes & Macdonald, 2013; Vanak & Gompper, 2009; Gompper, 2014a).

In and around tiger reserves, free-roaming dogs rely heavily on human-derived food resources, including direct feeding by households and opportunistic scavenging from improperly managed waste (Butler & Bingham, 2000). Such anthropogenic activities not only sustain dog populations but may also contribute to their population increase (Gompper, 2014b; Montecino-Latorre & San Martín, 2019). Free-roaming dog populations in India are also strongly associated with predictable human food sources and households, making villages around tiger reserves particularly suitable habitats for their persistence (Vanak et al., 2014; Butler et al., 2018; Vanak & Gompper., 2009a). Consequently, dogs frequently move between households, agricultural fields, and adjoining forests, increasing the likelihood of encounters with wildlife (Vanak & Gompper, 2010). In addition, dogs often accompany people into deeper forest areas during livestock grazing, fuelwood collection, and non-timber forest product gathering, especially among tribal and forest-dependent communities (Kolipaka et al., 2015a; Tripathi, 2016). This regular movement into forest habitats further intensifies ecological interactions with wildlife and elevates the risk of disturbance, predation, and disease spillover beyond village boundaries (Mahajan et al., 2024; Vanak et al., 2014; Belsare et al., 2014; Vanak & Gompper, 2009b).

Despite the growing relevance of this issue, limited studies have examined local community perceptions of free-roaming dogs in the context of tiger conservation. In particular, there is a lack of information on how communities perceive the presence of free-roaming dogs, the extent to which households provide resources that sustain these populations, and how frequently dog–wildlife interactions are observed. There is also limited understanding of how demographic factors, particularly age, influence these perceptions and support management strategies. Addressing these gaps is important because community behavior directly affects both the persistence of free-roaming dog populations and the success of management interventions.

The aim of this study is to assess public perceptions and experiences related to free-roaming dogs in villages surrounding Amrabad Tiger Reserve (ATR) and Kawal Tiger Reserve (KTR), and to examine how these perceptions vary across age categories. Specifically, the study asks: (1) to what extent households provide resources to dogs, (2) how frequently respondents report dog–wildlife interactions, and (3) how levels of support for dog management strategies differ across age groups.

Materials and Methods

Study Area

I conducted this study in two tiger reserves located in Telangana state, India: Amrabad Tiger Reserve (ATR) and Kawal Tiger Reserve (KTR) (Fig 3.1). Amrabad Tiger Reserve (ATR; 2611.4 km^2) is located in southern region of Telangana, spans the Nagar Kurnool and Nalgonda districts. It was initially designated as a Wildlife Sanctuary in 1983, later included under Project Tiger in 1993 and officially declared as a Tiger Reserve in 2014. Amrabad Tiger Reserve was earlier a part of the larger Nagarjunasagar-Srisailam Tiger Reserve (NSTR) that covers the states of Andhra Pradesh and Telangana. With the bifurcation of Andhra Pradesh in 2014, the Telangana part of the reserve was named as Amrabad Tiger Reserve. ATR ranges in elevation from about 150 m to 1000 m above sea level and is predominantly covered by tropical dry deciduous forest. This reserve has a diverse range of wildlife species, including tigers (*Panthera tigris*), leopards (*Panthera pardus*), sloth bears (*Melursus ursinus*), dholes (*Cuon alpinus*), gaur (*Bos gaurus*) and various herbivores like spotted deer (*Axis axis*) and sambar deer (*Rusa unicolor*). This reserve is home to Chenchu tribes, an indigenous community recognized as a Particularly Vulnerable Tribal Group (PVTG).

Kawal Tiger Reserve (KTR; 1015.35 km^2) is located in northeastern region of Telangana and lies within Jannaram mandal of Mancherial District (Old Adilabad district). The area was first established as a wildlife sanctuary in 1965 and later recognized as a Tiger Reserve in 2012. The KTR is connected by a wildlife corridor to the Tadoba-Andhari Tiger Reserve in Maharashtra and the Indravati Tiger Reserve in Chhattisgarh, allowing for tiger movement between these areas. The elevation within the reserve ranges from about 200 m to 900 m above sea level and is primarily covered by tropical dry deciduous forest. KTR supports diverse array of wildlife species such as tigers, leopards, sloth bears, gaur, Indian fox (*Vulpes bengalensis*), golden jackal (*Canis aureus*) and various herbivores like spotted deer, and sambar deer.

Survey Design, Implementation, and Questions

Data on community perceptions and experiences related to free-roaming dogs were collected through a structured survey. The survey was conducted in villages located in the core zone , which is protected area with minimal human disturbance (Post & Pandav, 2013), whereas the buffer zones includes villages located within the peripheral area surrounding the critical tiger habitat, with a lesser degree of habitat protection allows human activities while maintaining ecological integrity of the reserve (Kolipaka et al., 2015b; Post & Pandav, 2013)

The questionnaire included both closed-ended and open-ended questions (See Appendix A) and was designed to address the main research questions of this study. Closed-ended questions were used to collect consistent responses on household support for free-roaming dogs, observations of dog–wildlife interactions, and views on management strategies such as vaccination, sterilization, and movement restrictions. These questions directly relate to the study objectives of understanding human support for dog populations, perceived interactions with wildlife, and attitudes toward management. Open-ended questions allowed respondents to share additional experiences and local concerns that may not have been fully captured through fixed response options, providing useful context to the structured responses. Demographic variables recorded during the interview included gender (male or female), approximate age (categorized into age groups), tribal or non-tribal status, location of the village within core or buffer zones, and reserves (ATR or KTR).

I conducted all interviews in person, primarily in Telugu. The survey was prepared in both Telugu and English, and questions were administered in the language preferred by each respondent to ensure clarity and comfort. Responses were audio recorded using a voice recorder to accurately capture both structured responses and detailed explanations provided during closed- and open-ended discussions. Interview duration was a minimum of approximately 15 minutes, although total time varied depending on the respondent's willingness to elaborate on their experiences and perspectives. This study was reviewed by the Auburn University Institutional

Review Board (IRB ID: STUDY00000443) and IRB approved information letter are provided in Appendix B.

Field data collection in ATR was conducted from June 3 to July 15, 2025, beginning in Macharam village, which served as the initial site for community engagement and interviews. Data collection in KTR was subsequently carried out from August 1 to September 14, 2025, following the same protocol. Villages from both the core and buffer zones of each reserve were included in the survey design.

Villages located within the zones of both reserves were initially identified using online maps and secondary information. Preliminary village lists and location information were compiled prior to fieldwork. Upon entering the field, the final selection was refined with guidance from the forest department, and some villages were added or removed based on ground accessibility, logistical feasibility, and field relevance to the study objectives. Fieldwork in ATR began in Macharam village, the nearest accessible location, while in KTR it began in Modiguda village, based on suggestions from the forest department.

Before beginning surveys, village-level meetings and repeated interactions with community members were conducted to build trust and encourage participation. Discussions with village leaders and residents helped explain the purpose of the study, the nature of voluntary participation associated with survey sampling and the relevance of the research to local communities. Follow-up visits to households and common gathering places further strengthened trust which was especially important for collecting reliable responses on perceptions of free-roaming dogs and their interactions with wildlife.

Data Processing and Statistical Analysis

I prepared and organized the dataset prior to analysis by entering survey responses into a database and coding all variables numerically. I coded responses as −1, 0, 1, 2, and 888, with 0 = unsure and 888 treated as missing, or invalid. For each analysis, I excluded observations with missing values in the relevant variables so that results were based only on valid responses. The remaining numeric codes (-1, 1, and 2) were retained to represent response categories, such as no observation, occasional observation, and frequent observation, or no support, minimal support, and strong support.

Data analysis was conducted to examine community perceptions of free-roaming dogs and to understand the factors associated with these perceptions in villages surrounding ATR and KTR. For the question on household support provided to dogs, respondents were allowed to select multiple response options. Therefore, each support category, including food or water, veterinary care, other healthcare, and shelter, was treated as a separate variable and analyzed independently.

A total of 621 respondents participated in the study, including 376 respondents from 27 villages in ATR and 245 respondents from 23 villages in KTR (Table 3.1 and 3.2). Village leaders have assisted in gathering community members, after which the purpose of the study, including problems related to free-roaming dogs, was explained. Their participation was voluntary, and 621 individuals chose to take part in survey across both tiger reserves.

Chi-square tests were used to examine how responses varied across age categories (18–29, 30–49, 50–69, and 70+). Reported observations of dog–wildlife interactions were compared among these groups to assess whether some respondents were more likely than others to report such interactions. Attitudes toward dog management measures were examined in a similar way to understand variation in support for management strategies.

To evaluate differences in response distributions among demographic groups, I used Pearson's chi-square tests of independence. These analyses were conducted to examine associations between age categories and responses to key survey questions, including household provisioning of dogs, observed dog–wildlife interactions, and support for dog management regulations. For household provisioning of dogs which allowed multiple responses, each option (e.g., food/water, veterinary care, other healthcare, shelter, none) was treated as a separate binary variable (1 = selected, 0 = not selected), and chi-square tests were applied to each variable independently. For observed dog–wildlife interactions, responses were coded as (-1 = no, never; 1 = yes, occasionally; 2 = yes, frequently), and "unsure" responses were retained as 0. For support for dog management regulations, responses were coded as (−1 = no support, 0 = unsure, 1 = minimal support, 2 = strong support). Statistical significance was assessed at $p < 0.05$, and all analyses were conducted in R version 4.4.2 (2024-10-31).

Results

Household Provisioning of Resources to Dogs

A majority of respondents reported providing some form of support to free-roaming dogs at the household level. The most frequently reported type of support was the provision of food and water, with approximately 61% of respondents indicating that their households provided these resources. In contrast, more direct forms of care were less commonly reported, with veterinary care (including vaccinations and treatments) reported by 24% of respondents and other healthcare practices, such as grooming or deworming, reported by approximately 10%. Provision of shelter was relatively uncommon and was reported by around 12% of respondents, while approximately 35% of respondents indicated that their households did not provide any form of support (Fig 3.2).

Provision of different types of support to dogs varied across age groups with differences between age and the provision of food and water ($\chi^2 = 15.81$, df = 3, p = 0.001) and veterinary care ($\chi^2 = 8.36$, df = 3, p = 0.039). A significant association was also found between age and other forms of healthcare support ($\chi^2 = 10.07$, df = 3, p = 0.018), and shelter provision with age ($\chi^2 = 7.94$, df = 3, p = 0.047; Fig 3.1).

Dog wildlife interactions

There was no relationship between age category and reported dog–wildlife interactions ($\chi^2 = 6.59$, df = 9, p = 0.68; Fig 3.3). The majority of respondents across all age groups reported no observed dog–wildlife interactions, while smaller proportions reported occasional or frequent interactions. These response patterns were similar across the four age groups (18–29, 30–49, 50–69, and 70+; [show stat result here before the p value] $p > 0.05$).

Support for dog management strategies

There was a significant association between age group and response category in terms of supporting dog management regulations ($\chi^2 = 17.37$, df = 9, p = 0.04). Across age groups, minimal support and strong support were the most common responses, whereas no support was less frequent. This other response category showed a significant association between age and unsure responses ($\chi^2 = 10.87$, df = 3, p = 0.01), while no associations were found for no support

($\chi^2 = 2.15$, df = 3, p = 0.54) or minimal support ($\chi^2 = 1.58$, df = 3, p = 0.66). Strong support showed a marginal association with age ($\chi^2 = 7.41$, df = 3, p = 0.06).

Discussion

In both reserves, a majority of respondents reported providing some form of support to free-roaming dogs, particularly food and water. This pattern is similar with previous research indicating that free-roaming dog populations in human-dominated area are largely sustained by anthropogenic food sources and human tolerance (Butler & Bingham, 2000; Vanak & Gompper, 2009a). The relatively lower levels of veterinary care and shelter provision suggest that communities may tolerate or support dogs, but investment in their health and welfare remains limited. This imbalance may cause to the persistence of unmanaged dog populations, which can increase risks to both human and wildlife health (Belsare & Gompper, 2013).

The lack of a significant association between age and reported dog–wildlife interactions informs that perceptions of such interactions are almost similar across demographic groups. The majority of respondents reported no observed interactions, which may indicate either low encounter rates or limited awareness of such events. Previous studies have shown that free-roaming dogs can engage in predation, harassment, and disease transmission affecting wildlife, even when such interactions are not frequently observed by local communities (Vanak & Gompper, 2009b; Doherty et al., 2017). Therefore, the absence of perceived interactions does not necessarily imply low ecological impact but rather highlights potential gaps in local awareness.

In contrast, support for dog management strategies showed a significant association with age, indicating that attitudes toward regulation may vary across demographic groups. While minimal and strong support for regulations were the most common responses overall, the significant variation in “unsure” responses suggests that some age groups may have less clarity or confidence regarding management approaches. This finding aligns with human and wildlife conservation, where socio-demographic factors can influence attitudes toward wildlife management and policy interventions (Dickman, 2010). The weak association observed for strong support further suggests that differences in opinion may exist but are not strongly pronounced across all groups.

Conclusion

These findings help to inform important insights of community perceptions and their interactions with free-roaming dogs in and around Amrabad Tiger Reserve and Kawal Tiger Reserve. Most households reported providing basic resources such as food and water to free-roaming dogs, while direct care, including veterinary support and shelter, was relatively limited. Reported observations of dog–wildlife interactions were generally low and did not vary significantly across age groups. In contrast, support for dog management strategies was high across the study area, with most respondents expressing either minimal or strong support for regulatory measures. These results indicate that communities both support free-roaming dogs and are open to their management and provides an opportunity to implement community-based strategies, such as vaccination, sterilization, and awareness programs, to reduce potential risks to wildlife and public health (Vanak & Gompper, 2009a; Doherty et al., 2017). Overall, integrating local perspectives into management planning will be essential for developing effective and socially acceptable approaches to managing free-roaming dog populations.

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Figure 3.1. Map of the study area showing villages surveyed in Amrabad and Kawal Tiger Reserves, Telangana, India.

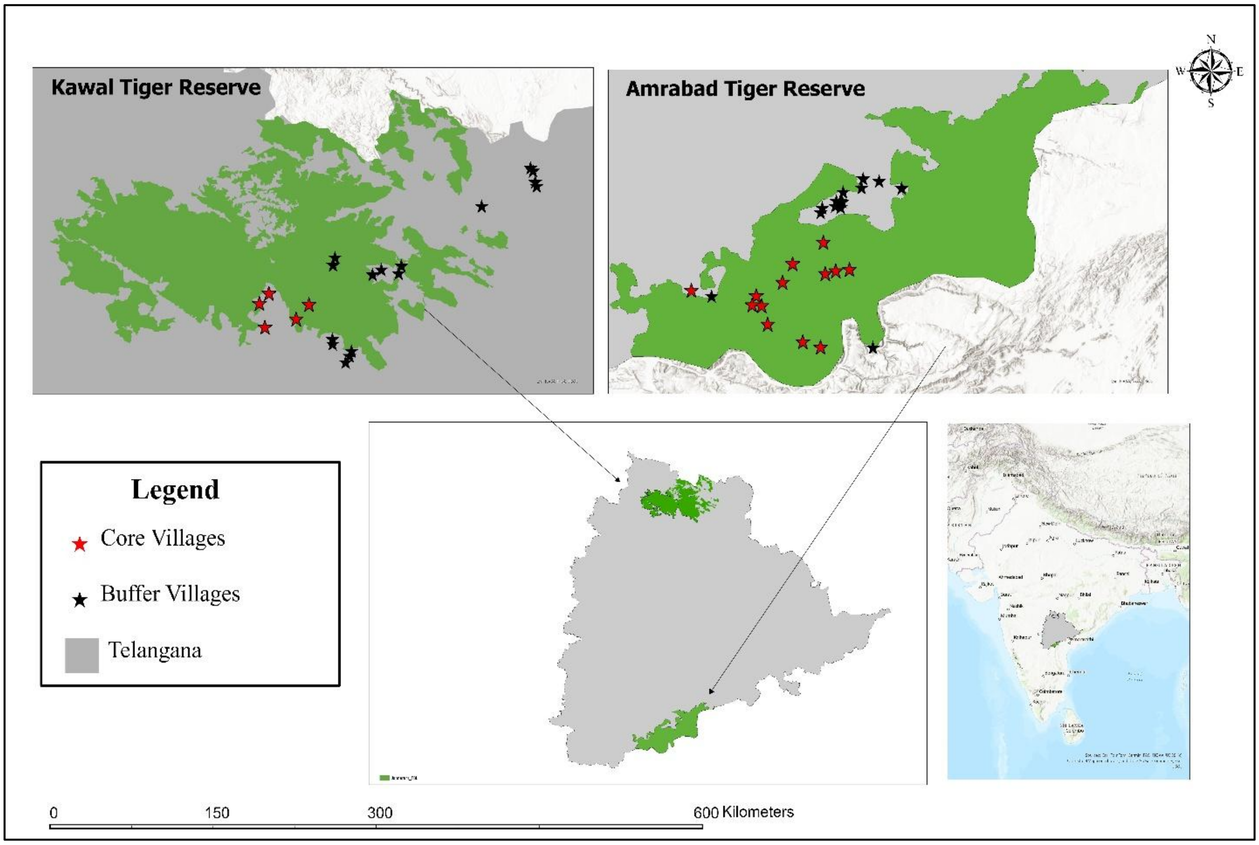

Figure 3.2. Support provided by households to free-roaming dogs, including food and water, veterinary care, shelter, and other forms of support.

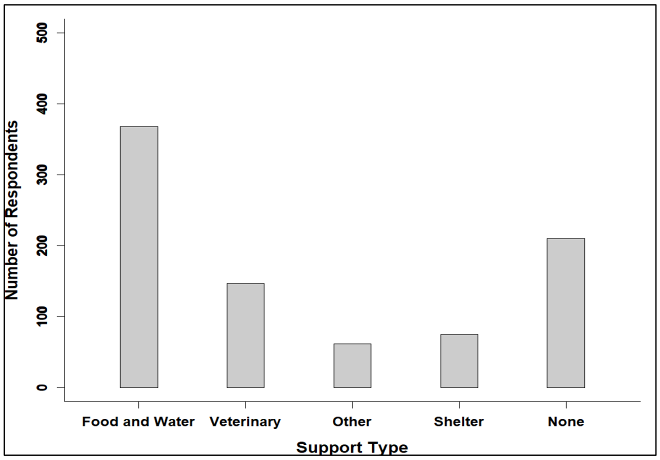

Figure 3.3. Reported dog–wildlife interactions across age categories.

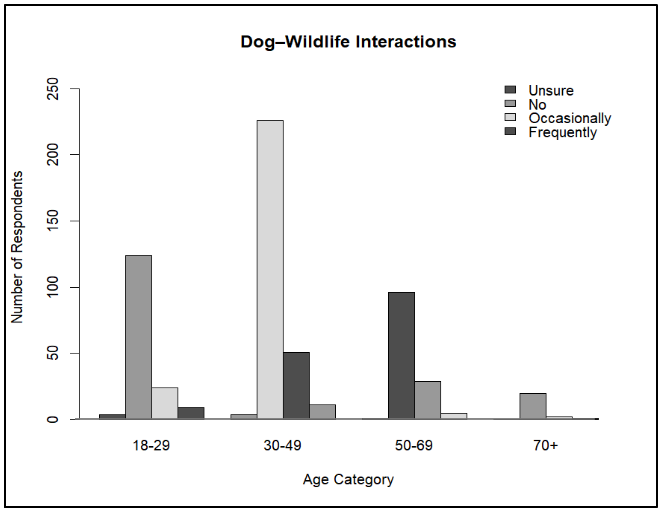

Figure 3.4. Support for dog management regulations across age categories.

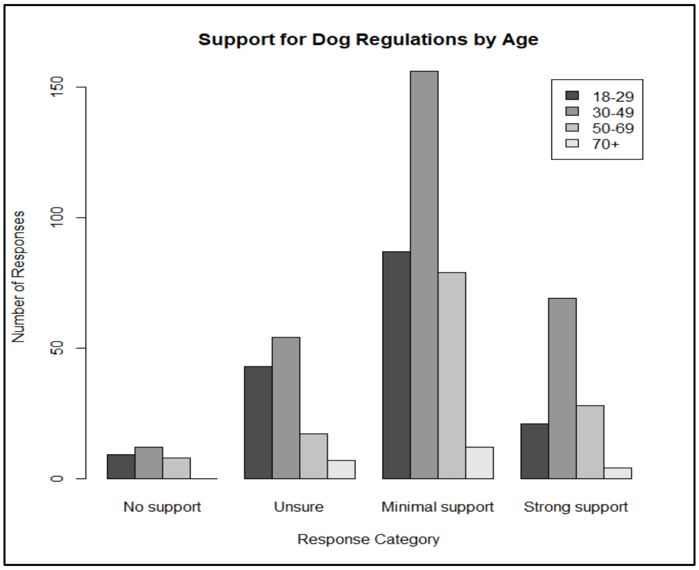

Table 3.1. Distribution of surveys across villages in ATR.

Village name	Households	Human Population	Number of Surveys
Amrabad	1819	5237	15
Appapur	40	200	17
Chitlamkunta	106	4097	15
Domalapenta	1124	3253	14
Emireddypally	160	640	13
Jangamreddypalle	368	1202	16
Kalmaloni Palle	187	590	16
Kudchintalabhailu	64	239	20
Macharam	401	1072	25
Mallapur	30	180	11
Medimolkala	21	72	9
Padara	150	5464	18
Padmanapalli	200	550	10
Rampur	30	56	10
Sarlapally	337	600	31
Telugupally	560	580	10
Vankeshwaram	1534	6380	20
Vatwarlapally	560	1291	30
Velmapally	130	370	18
Venkateshwarla baavi	429	1563	8

Erapenta	100	395	10
Rayalgandi	90	312	11
Bhairapur	30	95	8

Table 3.2. Distribution of surveys across villages in KTR.

Village name	Households	Human Population	Number of surveys
Chunchupally	95	410	11
Indanpally	724	2730	17
Kalamadugu	782	2963	18
Kawal	651	2808	7
Kistapur	191	690	13
Madharapet	802	2968	7
Modiguda	40	78	7
Mohinda	37	221	8
Mohmadabad	164	652	18
Thallapet	564	2252	17
Charigam	235	1121	12
Kothamamidipally	203	1115	10
Ankoda	209	905	11
Achelli	133	563	12
Sungapur	70	326	12
Gadalpally	45	198	8
Alinagar	54	173	7
Kothagudem	38	164	6
Jaithgudem	38	147	9
Mamidiguda	25	120	10
Raghavpur	21	84	3

Paidipally	23	76	9

Appendix A: Questionnaire on Community Perceptions of Free-Roaming Dogs (English and Telugu)

1. In what ways do dogs contribute positively to your household or community (e.g., guarding property, protecting livestock)? ***Please describe any specific examples.***

కుక్కలు మీ ఇంటికి లేదా సమాజానికి ఏ విధాలుగా సానుకూలంగా దోహదపడతాయి (ఉదాహరణకు, ఆస్తిని కాపాడటం, పశువులను రక్షించడం)? *దయచేసి ఏవైనా నిర్దిష్ట ఉదాహరణలను వివరించండి.*

2. How many dogs does your household own, how many do you personally take care of, and how often do you see them around?

మీ ఇంట్లో ఎన్ని కుక్కలు ఉన్నాయి, మీరు వ్యక్తిగతంగా ఎన్ని కుక్కలను చూసుకుంటారు మరియు మీరు వాటిని ఎంత తరచుగా చూస్తారు?'

3. Which of the following do you or your household provide to dogs? ***(Select all that apply OR "none")***
మీరు లేదా మీ ఇంటివారు కుక్కలకు ఈ క్రింది వాటిలో ఏది అందిస్తారు? (వర్తించేవన్నీ ఎంచుకోండి లేదా "ఏదీ లేదు")

- ☐ Food or water/ ఆహారం లేదా నీరు
- ☐ Veterinary care (e.g., vaccinations, treatments) / పశువైద్య సంరక్షణ (ఉదా., టీకాలు, చికిత్సలు)
- ☐ Other healthcare (e.g., grooming, deworming) / ఇతర ఆరోగ్య సంరక్షణ (ఉదా., వస్త్రధారణ, నులిపురుగుల నిర్మూలన)
- ☐ Shelter / ఆశ్రయం
- ☐ Other – please describe: / ఇతర - దయచేసి వివరించండి:
- ☐ None of the above / పైన పేర్కొన్నవేవీ కాదు

4. What challenges or issues do you think free-roaming dogs cause in your village (e.g., attacks, spreading diseases)? ***Please provide details or examples.***

మీ గ్రామంలో స్వేచ్ఛగా తిరిగే కుక్కలు ఎలాంటి సవాళ్లు లేదా సమస్యలను కలిగిస్తాయని మీరు అనుకుంటున్నారు (ఉదాహరణకు, దాడులు, వ్యాధులు వ్యాప్తి చేయడం)? *దయచేసి వివరాలు లేదా ఉదాహరణలు అందించండి.*

5. Have you observed dogs in your village interacting with wildlife (e.g., chasing or attacking wildlife, bringing wildlife into the village)? *(Select one)*

మీ గ్రామంలో కుక్కలు వన్యప్రాణులతో సంభాషించడం గమనించారా? (ఉదా., వన్యప్రాణులను వెంబడించడం లేదా దాడి చేయడం, వన్యప్రాణులను గ్రామంలోకి తీసుకురావడం)? *(ఒకటి ఎంచుకోండి)*

- ☐ Yes, frequently – please describe: / అవును, తరచుగా - దయచేసి వివరించండి:
- ☐ Yes, occasionally – please describe: / అవును, అప్పుడప్పుడు - దయచేసి వివరించండి:
- ☐ No, never / లేదు, ఎప్పుడూ లేదు
- ☐ Unsure / ఖచ్చితంగా తెలియదు

6. Do you believe there should be any government regulations regarding dogs (e.g., mandatory vaccination, neutering, or restrictions on movement)? *(Select one)*
కుక్కలకు సంబంధించి ఏవైనా ప్రభుత్వ నిబంధనలు (ఉదా., తప్పనిసరి టీకాలు వేయడం, సంతానోత్పత్తి చేయడం లేదా కదలికలపై పరిమితులు) ఉండాలని మీరు నమ్ముతున్నారా? *(ఒకటి ఎంచుకోండి)*

- ☐ Yes, I strongly support more regulations / అవును, నేను మరిన్ని నిబంధనలను గట్టిగా సమర్థిస్తాను.
- ☐ Yes, but only minimal regulations. / అవును, కానీ కనీస నిబంధనలు మాత్రమే.
- ☐ No, I do not support more regulations. / లేదు, నేను మరిన్ని నిబంధనలకు మద్దతు ఇవ్వను.
- ☐ Unsure / ఖచ్చితంగా తెలియదు

7. Is there anything else you would like to share today?

RA to record:	Gender	Age (approx.)	Non/Tribal?	Core/buffer?	Amrabad/ Kawal?
Research assistant to record other notes/reflections:					

ఈ రోజు మీరు పంచుకోవాలనుకుంటున్నది ఇంకేమైనా ఉందా?

రికార్డ్ చేయడానికి RA:	లింగం	వయస్సు (సుమారుగా)	గిరిజనేతర మా?	కోర్/బఫర్?	అమ్రాబాద్ / కావాల్?
ఇతర గమనికలు/ఆలోచనలను రికార్డ్ చేయడానికి పరిశోధన సహాయకుడు:					

Appendix B: IRB-Approved Participant Information Letter

AUBURN UNIVERSITY
Institutional Review Board

EXEMPT DETERMINATION

March 3, 2025

Allie McCreary
Forestry, Wildlife and Enviroment Bldg 3301
Auburn Univ, AL 36849
334-844-1007
aem0200@auburn.edu

Dear Allie McCreary:

On 3/3/2025, the IRB reviewed the following submission:

Protocol Information	**Submission Details**
Type of Review:	Initial Study
Title:	Understanding Community Members' Perspectives on Environmental Issues Near Tiger Reserve Protected Areas
Investigator:	Allie McCreary
IRB ID:	STUDY00000443
Funding:	Name: Forestry Wildlife and Environment
Grant Title:	N/A
Grant ID:	None
IND, IDE or HDE:	None
Documents Reviewed:	• Community Perceptions at Tiger Reserves, Category: IRB Protocol; • HRP-581 - Information Letter with translation-updated 2.18.25.pdf, Category: Consent Form; • Survey questionnaire, Category: Data Collection Form

The IRB determined that this protocol meets the criteria for exemption from IRB review.

In conducting this protocol you are required to follow the requirements listed in HRP-103 - INVESTIGATOR MANUAL.

Ongoing IRB review and approval by this organization is not required. This determination applies only to the activities described in the IRB submission and does not apply should any changes be made. If changes are made and there are questions about whether these activities impact the exempt determination, please submit a new request to the IRB for a determination.

Sincerely,
IRB Administration
540 Devall Drive
Auburn, AL 36849
irbadmin@auburn.edu
(334) 844-5966

Page 1 of 1 Version Date: July 31, 2023