HUMANE SOCIETY INTERNATIONAL
INDIA

MONITORING, EVALUATION AND IMPACT ASSESSMENT

Street Dog, Private Dog Population and KAP Survey

In Ahmedabad Municipal Corporation, Gujarat- June-August 2019

Program Data analysis, Street Dog Survey and Household (KAP) Survey

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BACKGROUND

Humane Society International (HSI), the global arm of The Humane Society of the United States, has been conducting dog population surveys around the world for almost a decade under the MEIA (Monitoring, Evaluation and Impact Assessment) program. Through our thorough surveys we have informed, challenged and mostly improved dog management programs across Asia and Africa and have contributed significantly to the success of dog management programs from local to national level. With expertise in evidence-based program development and implementation, HSI's MEIA program has provided monitoring and evaluation services to external and government run programs throughout Asia and Africa. We have developed the "one-dog-population" approach in which we acknowledge that street and owned dogs are not isolated populations but are interrelated and form one dog population governed by the human population and communities they live with.

The use of animal birth control (ABC) programs in concurrence with rabies vaccination has been promoted since the 1960s (apparently first suggested by Dr Chinny Krishna of the Blue Cross of India) as the method of choice for controlling dog populations and human rabies in urban areas. The World Health Organization (WHO, 2005) has accepted this approach for at least a decade and has criticized culling alone which has been shown to be unsuccessful (Windiyaningsih, Wilde, Meslin, Suroso, &Widarso, 2004; Morters, et al., 2013). In some cases (e.g. in Bali), culling is counterproductive because the sterilized and/or vaccinated dogs are killed while reproduction continues and vaccination thresholds are not maintained (WHO, 2016).

Monitoring surveys serve to assess sterilization and/or vaccination coverage throughout the duration of a program and across a program area. Several methods to estimate dog population densities are available, often consisting of a combination of questionnaire surveys and street counts, depending on the dog populations' demographics and the objectives of the program.

The AMC run Animal Birth Control program has proven to be effective in controlling dog population. It has been implementing an ABC program since 2001 with varied intensity and a year-long break in 2011. Especially the second phase marked the beginning of the model program with high sterilization and has been running uninterrupted since 2011 (8.5 years) reaching high levels of sterilization in street dogs in most of the zones of Ahmedabad. Two street dog surveys have been conducted during the program's live span and both were conducted by HSI; the first in 2010 and the second in June 2019. The results of both surveys, a household survey, sterilization numbers, public health concerns and population estimates as well as other dog population management pillars will be discussed throughout the following chapters.

SURVEY APPROACH AND OBJECTIVES

This document describes survey work that was conducted by HSI in Ahmedabad to evaluate the sterilization program in Ahmedabad and the impact it has had on street dog population dynamics. Additionally, a baseline assessment of the private dog population was conducted using door-to-door surveys of residents using KAP (Knowledge, Attitude and Practices) questionnaires. This report is intended to highlight the main design features of the survey and its most useful results. Household survey results can be found in the appendix by survey area.

The data gathered was used to generate a variety of metrics that were necessary to address the goals of this survey.

Objectives included:

Generate a Street Dog sterilization rate estimate: Using a globally well-established survey protocol to survey the street dog population along transects of defined areas (in Ahmedabad wards and zones) to extrapolate and estimate the achieved sterilization rate in different zones as well as overall in Ahmedabad. Combined with the resulting dog density estimates we can measure the impact of the sterilization program.

Generate a Street Dog Population estimate: The number of sterilizations has been recorded since 2001 and a street dog survey was conducted in 2010. Using a survival estimate model developed in Rajasthan, an estimate of the current street dog population of Ahmedabad can be generated.

Private dog density in Ahmedabad: By dividing the recorded dogs by the households surveyed, a per household dog density figure (dogs/HH) is obtained. Multiplied by the households in the ward (last census data is from 2011) we estimate the dog population of the wards surveyed. The same applies to wards of the same poverty and human density category. A more recent dataset (2019) gives us a total number of households in the Ahmedabad Municipal Corporation area, which we used to generate a total private dog population for Ahmedabad.

Dog ownership practices and attitudes: We recorded different questions pertaining to dog keeping practices and animal welfare as well as attitudes toward rabies vaccinations, sterilizations as well as the acquisition and raising of dogs.

SURVEY METHODOLOGY

STREET DOG SURVEY

Street dog surveys focus on the street dog population. Street dog counts along transects provide relative estimates of the roaming dog population and further provide a quantitative assessment of how many dogs residents encounter in the streets during their daily routines. Monitoring those index routes for density and dog population composition changes

not only enable us to generate sterilization rate estimates but also to follow indicators by which we can assess the impact on the population overall (Hiby & Hiby, 2017).

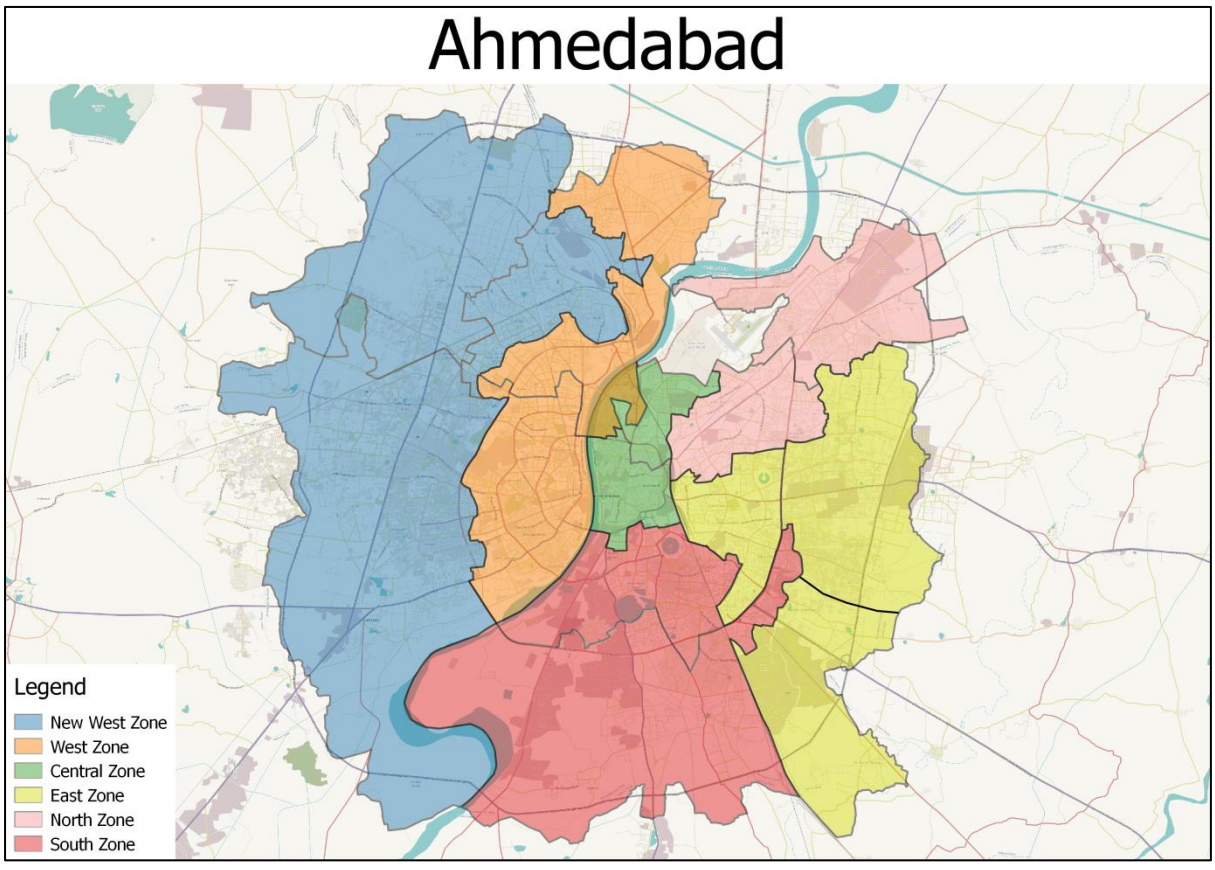
Street dog survey objectives:

- Generate a reliable estimate of the relative dog population per street kilometer
- Generate an estimated total dog population based on the street length in Ahmedabad
- Estimate the proportion of sterilized dogs within the street dog population by zone and overall
- Asses street dog welfare by tracking two indicators, body condition score and skin conditions as a proxy measure

SURVEY DESIGN

The city-wide sterilization program is contracted out to several animal organizations performing catch neuter vaccinate and return (CNVR) for Ahmedabad Municipal Corporation. For this purpose, the city is divided into zones that combine several wards and organizations only work in the zones assigned to them (Image 1). Therefore, we used the zones as our fundamental sampling unit. Zone-wise results can be evaluated to assess the different organizations' impact and recommendations can be tailored towards their goals.

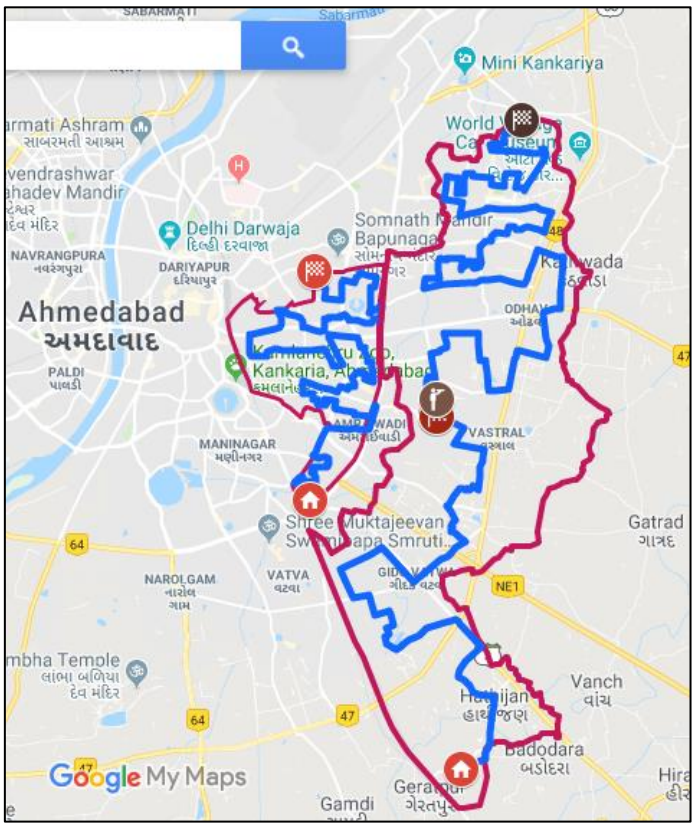
Image 1: AMC area divided into Zones.



SURVEY METHOD AND PROTOCOL

To generate an estimate of dogs per street kilometer we created set routes, also called index or standard routes, in Google Maps along residential roads and highways but avoiding expressways (dogs tend to avoid these roads). Routes are marked with a starting (Flag) and end point (House) (Image 2). For easy access, the routes are saved as KML files and stored in Google My Places, which can be accessed from smartphones (online and offline). A survey team, consisting of a driver and an observer on a motorcycle, conducted the surveys early in the morning starting at dawn. The observer used both the Google Maps app and the OSM Tracker app on a mobile phone. OSM tracker is an application that enables the observer to record a dog sighting and relevant specifics about a dog (female, male or unknown adult, sterile/notched female or sterile/notched male, pup, lactating) as well as record welfare indicators such as skin problems and body condition scores (BCS1 to BCS5), which are saved together with GPS coordinates of the sighted dog. OSM Tracker produces a track record of all sighted dogs and their specifics along the route which was followed during the survey. The data is subsequently downloaded and stored in an Access database for analysis. The survey route was surveyed on two consecutive days, by the same survey team, to measure the accuracy and power to detect change.

Image 2: Transect tracks for East Zone (further divided into Sub-Zone East A and B)



Data gathered during transect surveys were used to generate a variety of metrics that were necessary to address the goals of this project. These included:

Index of dog density: This metric was obtained by dividing the number of dogs counted on each transect by the length of the transect and is expressed as "dogs / km". As described previously, this metric does not account for incomplete detection, but still provides a valid indicator of underlying dog density that can be used to quantify change over time or patterns of dog density over space.

Age structure: By recording whether each dog sighted was a puppy (< 6 mo. of age) or adult, a simple estimate of age structure was obtained.

Body condition score and skin conditions: A simple index of dog condition and health status was obtained by rating the body condition of each dog using a simplified veterinary scale (C1 – C5, with C1 corresponding to a malnourished condition and C5 corresponding to an over-nourished condition). In addition, visually obvious skin maladies (i.e. mange) were recorded where observed.

KAP (KNOWLEDGE, ATTITUDE AND PRACTICES) SURVEY

SAMPLING DESIGN

Household surveys were conducted using a systematic random sampling method, which samples a portion of the total available households in the area. Systematic random sampling in comparison to simple random sampling is less susceptible to researcher error. Stratified-random sampling is a variant of random sampling that produces a more efficient return of representative, replicated data in environments that vary systematically over space in one or more critical respects. A short, informal review of stratified-random sampling can be viewed at https://en.wikipedia.org/wiki/ Stratified sampling, with more rigorous treatments available in Sutherland (2006) (pgs. 43 – 51) and Thompson (2002). There are many published studies that have used stratified random sampling for population studies; a few examples can be viewed in Sniff and Skoog (1964), Link and Sauer (1997), and Potvin et al. (2005). In short, this technique requires that the study area be divided into units, and that each unit be assigned to distinct categories, or strata, based on one or more factors that might influence dog density and distribution. Units to be sampled are then randomly selected within each stratum, and data from those samples are used to characterize the remainder of the units in that same stratum. For this survey, the stratification factors selected for Ahmedabad, based on the 2011 census data, were 1. Illiteracy rate (% of the population) 2. Total human population; based on previous data collected by HSI indicating that dog density typically varies as a function of human density and geography.

The 2011 census provided 57 wards, which were stratified by their human population and illiteracy rate (Image 3 and Image 4). This resulted in sixteen distinct sampling strata from within which samples were selected. Out of the 57 wards we surveyed 19 wards (with Motera and Chandkheda combined into one ward, as they have been merged to one ward since the 2011 census) (Image 5), which were randomly selected using MS Excel, however if only one ward was in the category it was automatically selected. In each of the wards we either randomly set eight or four survey points around which the survey team surveyed 50 households. The total number of interviewed households therefore amounted to 400 or 200 households for each ward (confidence interval of 95% with an accepted margin of error of 5% or 90% with an accepted margin of error of 10%, respectively). In strata with large numbers of wards we selected several wards and surveyed 200 households to stay within a reasonable sample size of 5200 households. Sample sizes are based on the assumption that owning a dog and the practices and attitudes towards private and owned dogs are based on human behaviour and cultural norms. Hence, the sample size for a population above 20,000 people (in any given population one would like to extrapolate from) is 400 for 95% confidence interval (e.g. https://www.medecinsdumonde.org/en/actualites/publications/2012/02/20/kap-survey-model-knowledge-attitude-and-practices).

Image 3. Strata – Illiteracy rate of the wards based on 2011 census information

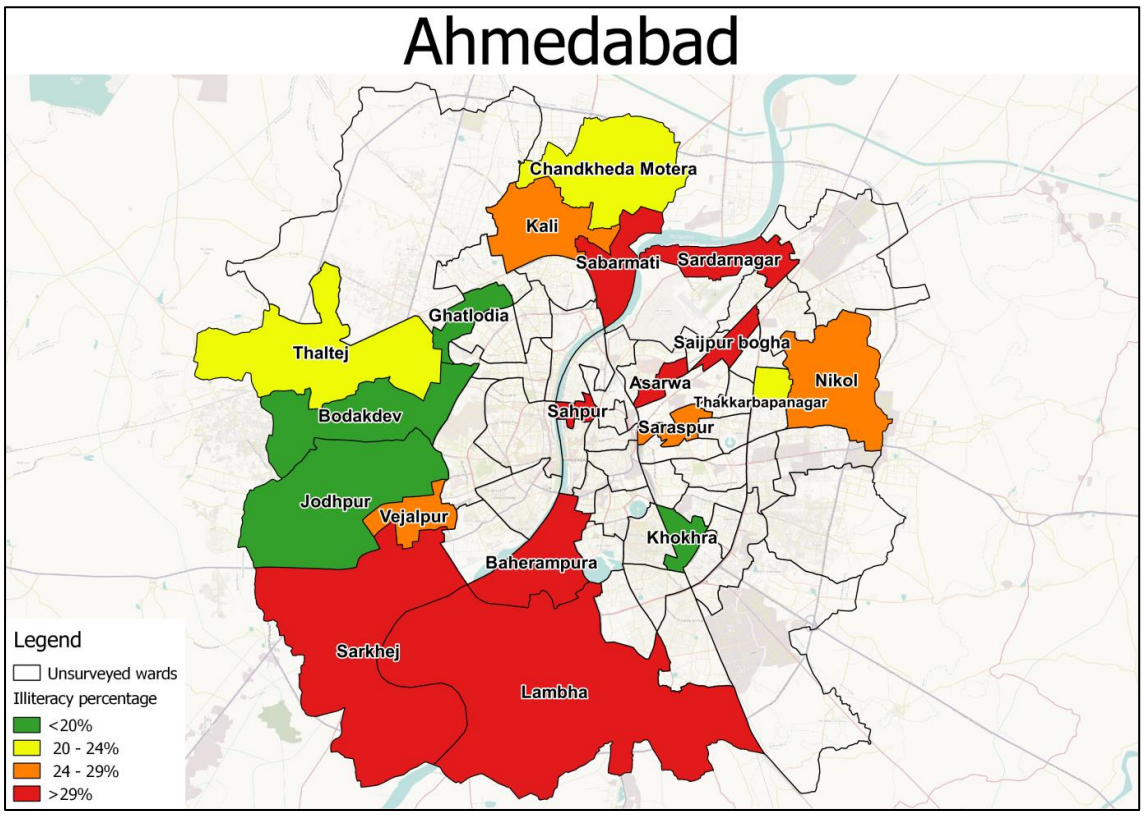


Image 4: Strata – Total human population by ward based on the 2011 census information

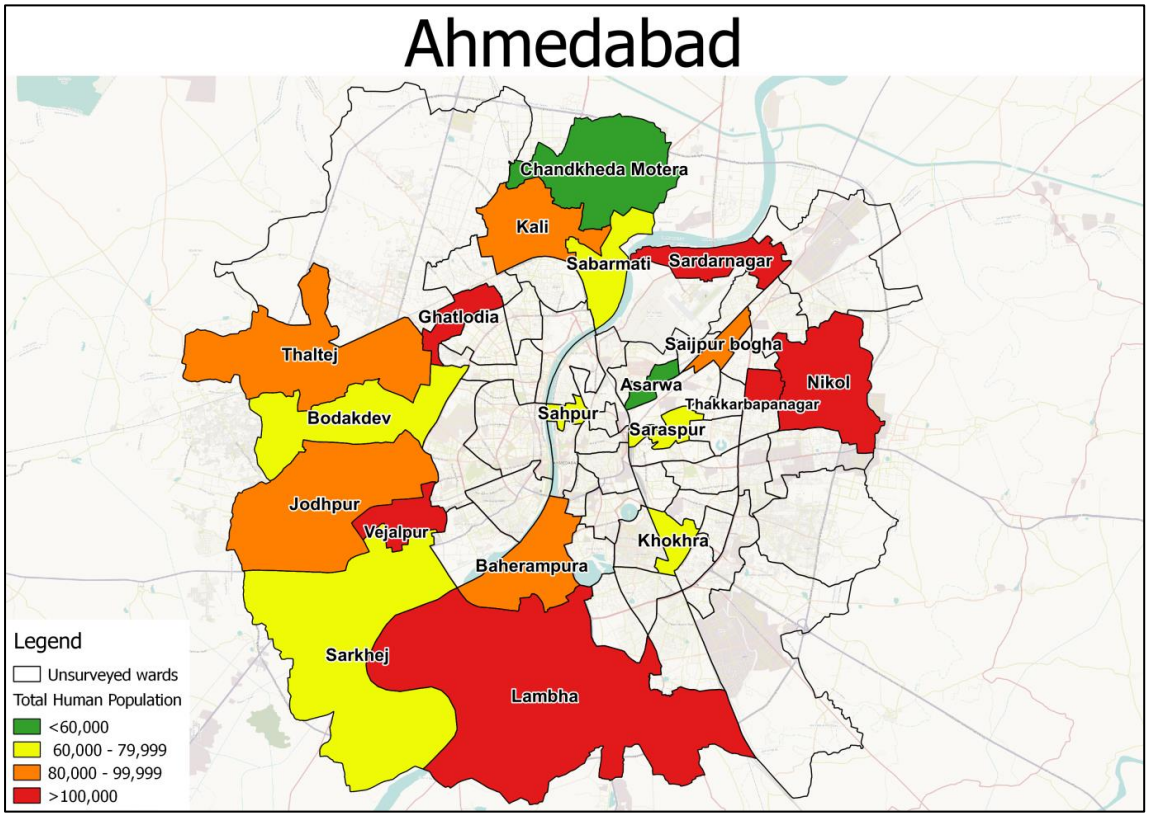
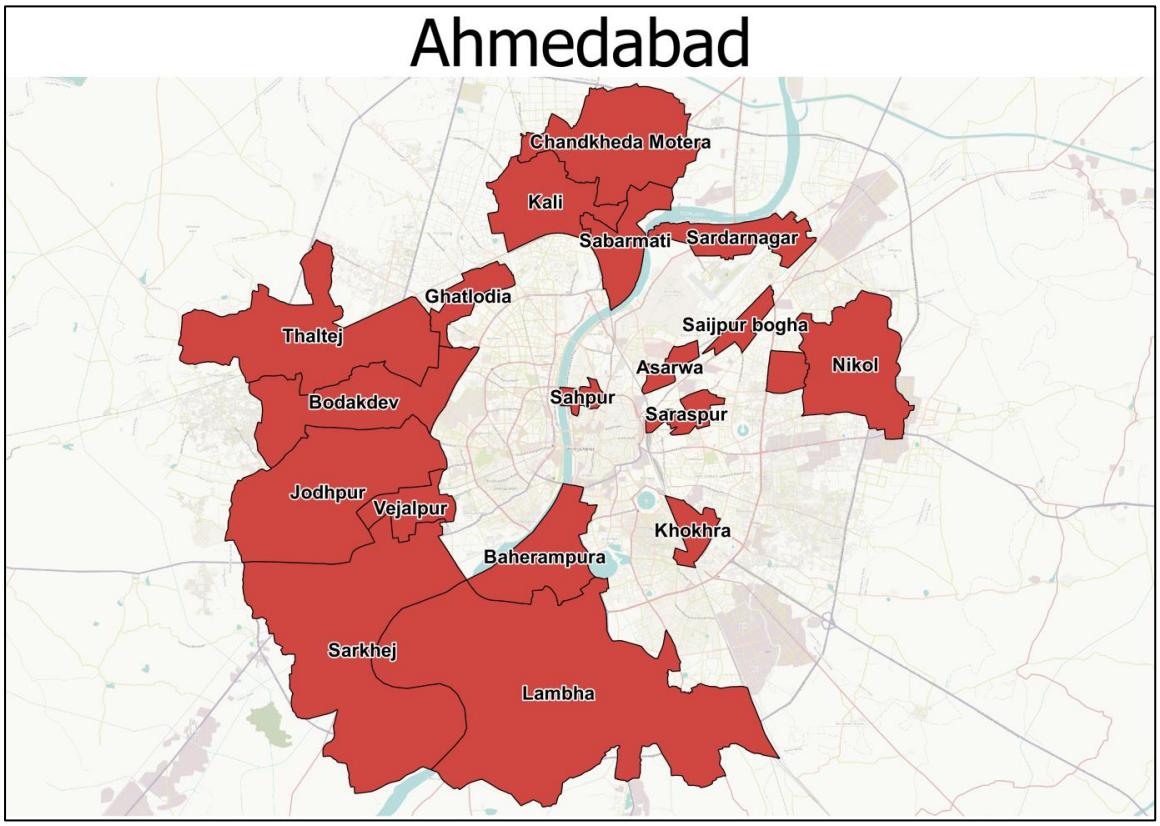


Image 5: Surveyed wards (red) in Ahmedabad



SURVEY PROTOCOL

We used the Ahmedabad census information from 2011. Once new census data is available estimates should be adjusted according to the new household numbers.

To explore knowledge, attitude, and practices regarding owned and street dogs we designed a household questionnaire. The cross-sectional survey was conducted using the smartphone app Epicollect5, which contained a prepared survey form. Households were surveyed by a team of two trained surveyors using questionnaires about 15-25 mins in length. Questionnaires included or excluded questions depending on whether the household owned a dog or not. Inclusion criteria for households were:

1. The person being interviewed had to be over 18 years old and a resident at the address
2. In the case of dog ownership, the interviewee had to be the main caretaker or at least well informed about the dog or dogs in the household

Participants were asked to confirm their consent to be part of the study and had the option to opt-out before the interview started and at any time during the interview. Once questionnaires were completed, the completed forms were saved and uploaded to a cloud-based database by the surveyor.

To remain consistent throughout the survey either the left or the right side of the street was surveyed and households were selected following an interval of either every third or fifth household. In case nobody was available at the selected household, either the household before or after was surveyed instead.

RESULTS

DOG POPULATION ESTIMATES – STREET AND PRIVATE

For the purpose of monitoring and evaluation we have generated relative and total estimates of the street dog population as well as the private dog population based on the surveys and the available information on sterilization numbers.

Monitoring surveys should be conducted on a regular, e.g. bi-annual or annual, basis to track the change in density of street dogs over time. However, at this point, we only have two surveys and no baseline survey for Ahmedabad. Therefore, we employed several different methods to generate total street dog population estimates to compare and validate the estimates.

STREET DOG SURVEY AND STREET LENGTH CALCULATIONS TO ESTIMATE THE RELATIVE DOG DENSITY PER KILOMETER STREET LENGTH

Dog densities on the street varied throughout the city and between different regions within one zone. The highest density was recorded in East Zone A (Table 1).

Ahmedabad has a total street length of 3997.73 km of which we surveyed 459.8 km on 15 tracks. On average (we surveyed each track twice) we saw 5995.5 dogs which translates to a density of 13 dogs per km.

Table 1: Total street dog population estimate corrected for detectability

Sub-Zone/ Wards	Survey Track Length	Street Length	Average Count	Dogs/km
Central Zone A	15.3	89.62	225.5	14.7
Central Zone B	19.1	81.27	315	16.5
East Zone A	24.3	200	577.5	23.8
East Zone B	31.1	516	365.5	11.8
Ramol Hathijan	20.2	160	137.5	6.8
North Zone A	33.3	248.27	376	11.3
North Zone B	26.1	224.35	384	14.7
South Zone A	29.4	270.46	353.5	12.0
South Zone B	35.6	474.23	301.5	8.5
West Zone A	38.8	345.4	430	11.1
West Zone B	39.3	283.73	701.5	17.8
New west Zone A	38.7	470	697.5	18.0
Vejalpur Sarkhej	39.8	208.7	396	9.9
New West Zone B	30.8	240.3	361	11.7
Gota	38	185.4	373.5	9.8
Total for AMC	**459.8**	**3997.73**	**5995.5**	**13.0**

SURVIVIAL ESTIMATES TO GENERATE TOTAL DOG POPULATION

Estimates of total street dog populations are more sensitive to errors compared to generating relative dog numbers per km street length surveyed. However, with on-going sterilization efforts in Ahmedabad and two street dog surveys in 2010 and 2019 we can generate better estimates by using a formula to estimate survival rates.

In order to estimate the total number of dogs, we used a formula developed during a study in Rajasthan (Reece et al., 2008). If we calculate this on an annual basis, 296,730 dogs were caught, neutered, vaccinated and returned to the place where they were caught between 2001 and June 2019. For the first decade we only have annual sterilization numbers and since 2012 we have monthly sterilization rates. To calculate how many dogs survived till this year from the year they have been sterilized for the first decade, we multiply the number of released dogs with 0.764 to the power of the years that have passed (Table 2).

Table 2: Survival and total abundance estimate for AMC

Year of sterilization	Interval (Years)	Released	Lex survivors estimate formula
2001	18.5	1897	13.04
2002	17.5	3061	27.54
2003	16.5	2586	30.46
2004	15.5	3636	56.05
2005	14.5	7632	153.99
2006	13.5	45011	1188.72
2007	12.5	1218	42.10
2008	11.5	1855	83.93
2009	10.5	14704	870.79
2010	9.5	6856	531.44
2011	8.5	0	0.00
2012	7.5	19354	2570.22
2013	6.5	26634	4629.60
2014	5.5	27181	6184.13
2015	4.5	38375	11427.95
2016	3.5	35646	13894.33
2017	2.5	31860	16254.71
2018	1.5	21560	14397.56
2019	0.5	7664	6698.88
Estimated total survival			**90202**
Estimated Total Dog Population for AMC			**149341**

For the time period April 2012 till June 2019 we have monthly sterilization rates and used the above formula adjusted for it as follows.

Number released dogs*0.764^ ((Months since passed+1)/12)

Based on those calculations, we have a total of 296,730 sterilized and released dogs since 2011 of which there are an estimated 89,468 dogs on the streets today. In combination with our street survey results and sterilization rates, **we estimate a total dog population of 149,341 dogs in Ahmedabad as of June 2019. This translates to 20 street dogs per 1000 people (or 2.0 dogs per 100 people).**

PRIVATE DOG POPULATION ESTIMATE

We estimate the private dog population from the household survey results. By dividing the recorded dog by the households surveyed in a ward, a per household dog density figure (dogs/HH) is obtained. Multiplied by the total households in the ward (last census data is from 2011) we estimate the dog population of the wards surveyed (Table 3). This number is then applied to all wards within the same strata to generate an estimate for entire Ahmedabad. Using this method and the 2011 census household and population data we estimate 31646 private dogs in Ahmedabad. However, a more recent dataset (2019) provided by AMC does not provide ward-wise household data but a total number of households in the Ahmedabad Municipal Corporation area, **which we used to generate a total private dog population for Ahmedabad using the average of dogs per households, 0.027 dogs per household, from our KAP survey and estimate that there are 43,041 private dogs in Ahmedabad.**

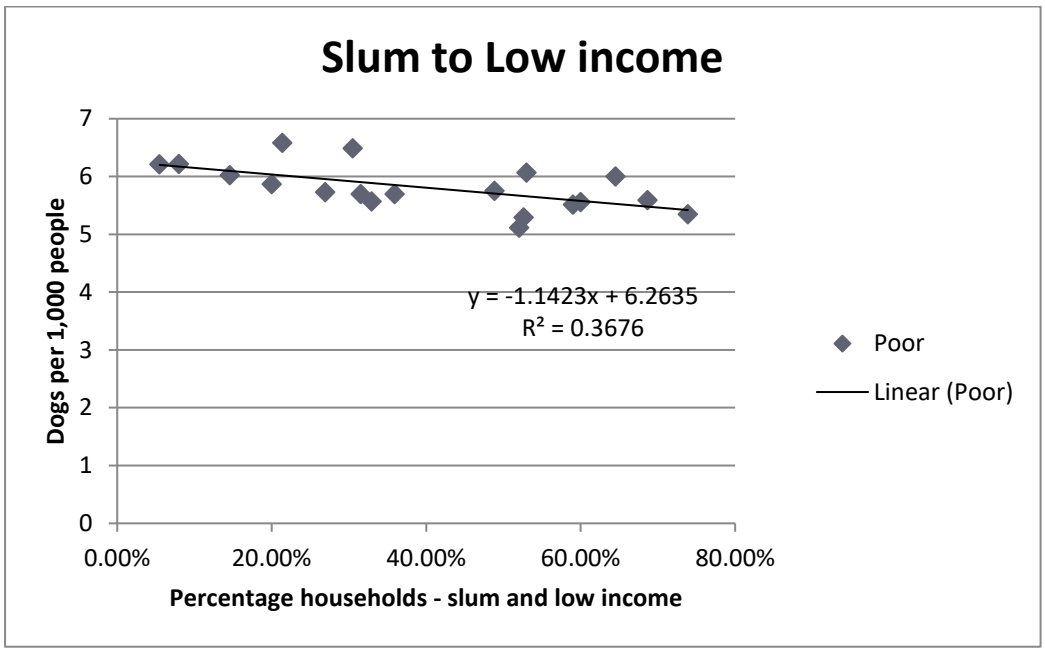
Table 3: KAP survey results and estimated total private dog population

Ward name	Number of Households (HH)	Total Human Population	Households (HH) surveyed	Total Estimated Dogs	Humans Per Sq. Km	Dogs per 1000 people
Sabarmati	14362	68566	206	390.8	12840.1	5.7
Thakkarbapanagar	29056	137446	217	790.6	83300.6	5.8
Thaltej	21749	98240	206	591.8	4523.0	6.0
Sardarnagar	25483	124548	401	693.4	23280.0	5.6
Vejalpur	63639	295075	204	1731.5	57296.1	5.9
Saijpur Lodha	18372	89953	400	499.9	53226.6	5.6
Asarwa	10523	55983	417	286.3	41468.9	5.1
Sarkhej	14740	72727	404	401.1	1924.0	5.5
Bodakdev	18529	76574	206	504.2	5317.6	6.6
Lambha	23200	104001	404	631.2	1815.0	6.1
Nikol road	28852	137840	200	785.0	10032.0	5.7
Ghatlodiya	47229	206893	201	1285.0	47021.1	6.2
Shahpur	14006	68150	201	381.1	66165.1	5.6
Motera + Chandkheda	27775	130090	390	755.7	8130.6	5.8
Khokhra	15896	69545	200	432.5	31901.4	6.2
Jodhpur	22766	95444	200	619.4	4089.3	6.5
Saraspur	13491	68670	402	367.1	35035.7	5.4
Kaali	20757	94077	403	564.8	9407.7	6.0
Baherampura	15886	81636	401	432.2	9415.9	5.3
Survey Total			5660	12143.4		
31646.0						
	1179823					
Extrapolated to entire Ahmedabad (2019)				**43041.0**		
	1594105					

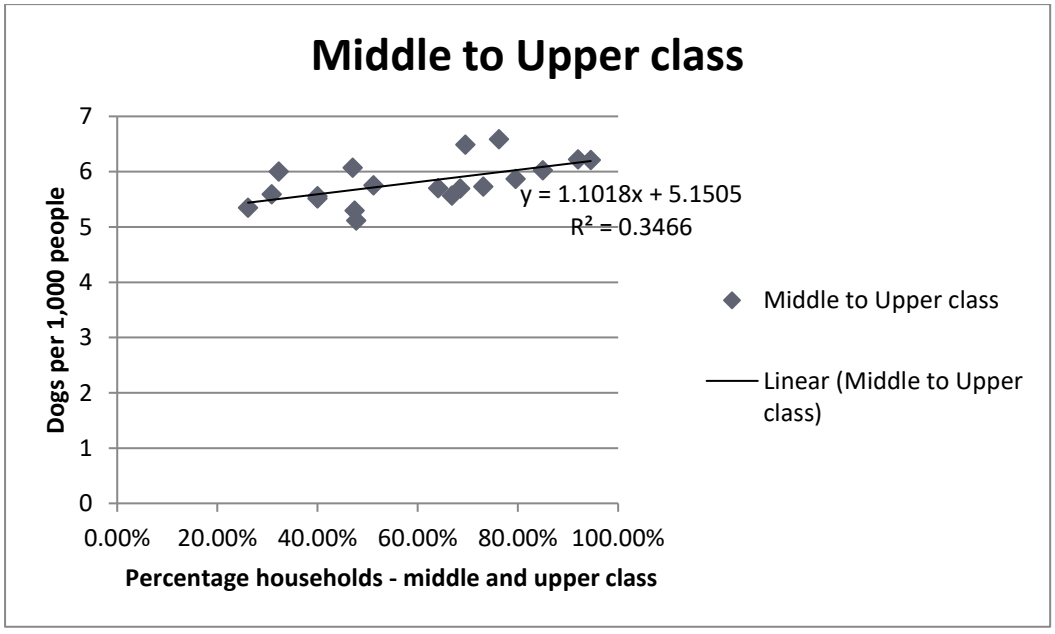
It appears, although not statistically significant, that there is a correlation between the proportion of economically wealthy people and a higher number of pet dogs per 1000 people (Graph 2) as well as the reverse relationship, when the ward had a higher proportion of economically poor households the number of dogs per 1000 people was lower. More broadly analysed we would expect a looser relationship as we find it here because we are measuring

human behaviour or choice, which in itself is influenced by a multitude of factors including economic status. However, we believe that socio economics influence the choice of owning a dog and hence the dog density in a ward.

Graph 1: Scattered Plot dogs per 100 people against percentage income group



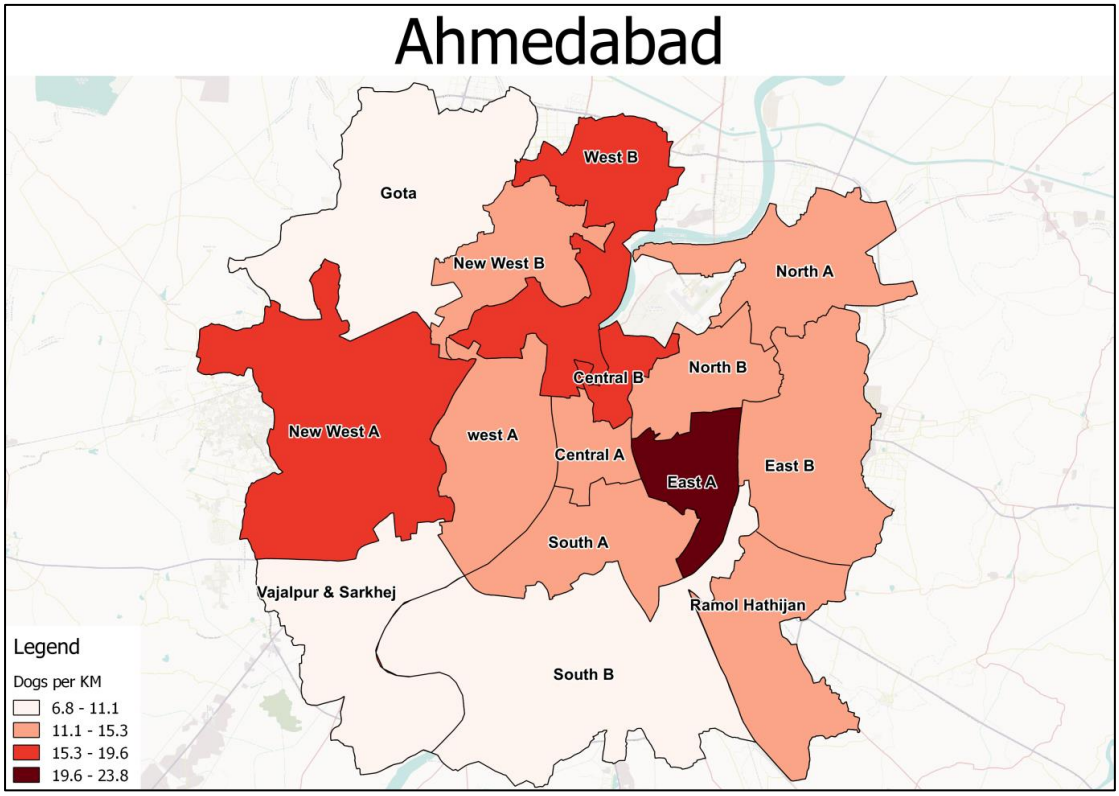
Graph 2: Scattered Plot dogs per 100 people against percentage income group



STREET DOG DENSITY PER KM STREET LENGTH

Street dog densities by zone varied from 23.8 dogs per km in Zone East A to 6.8 dogs per km in Gota, Vajalpur & Sarkej and Zone South B (Image 6), reflecting a very different carrying capacity for the different zones. Unfortunately, ward names and numbering have changed since 2010 and a direct comparison between wards is impossible at this point, however future monitoring surveys can use the results of this survey to compare the surveyed wards as well as the upcoming census data on human density.

Image 6: Zone, sub-Zones and Wards surveyed in this study across AMC



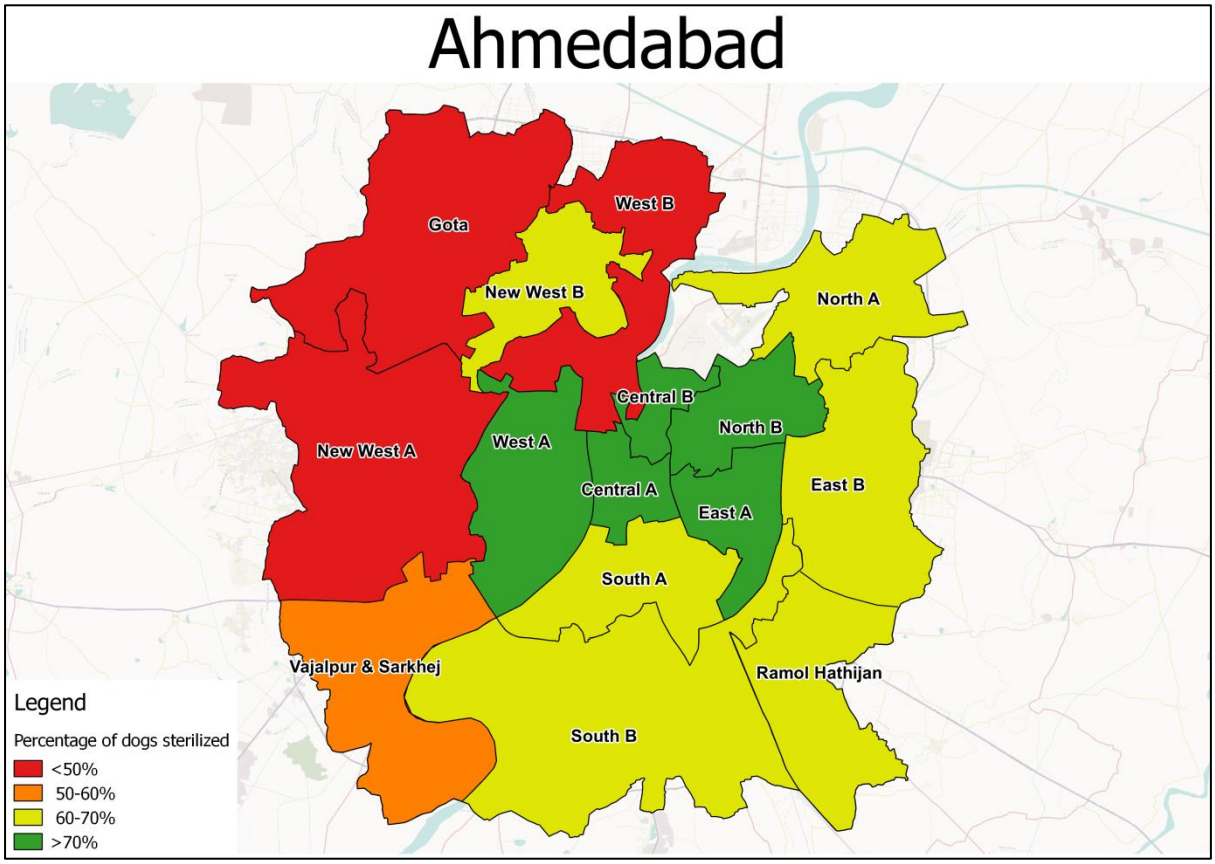
STREET DOG STERILIZATION RATES

As much as the street dog densities vary between the zones, so does the achieved sterilization levels. However, there is no relation between the densities and the achieved level of sterilization. East A is the zone with the highest number of dogs per km but is also one of the zones with the highest sterilization rate (Table 4 and Image 7).

Table 4: Street survey results – Proportion sterilized

Zone / Sub-Zone/Ward Name	Percentage of Dog sterilized	Percentage of Female dog Sterilized	Percentage of dogs remained to sterilize
North Zone			
North Zone A	64.0 %	61.9 %	36.0 %
North Zone B	74.5 %	74.8 %	25.5 %
East Zone			
East Zone A	83.7 %	83.6 %	16.3 %
East Zone B	67.2 %	60.7 %	32.8 %
Ward- Ramol Hathijan	54.3 %	54.3 %	45.7 %
South Zone			
South Zone A	62.7 %	66.3 %	37.3 %
South Zone B	67.8 %	60.1 %	32.2 %
Central Zone			
Central Zone A	87.0 %	84.8 %	13.0 %
Central Zone B	70.5 %	71.0 %	29.5 %
West Zone			
West Zone A	75.2 %	73.1 %	24.8 %
West Zone B	39.0 %	35.9 %	61.0 %
New West Zone			
New West Zone A	47.4 %	40.1 %	52.6 %
New West Zone B	67.5 %	64.4 %	32.5 %
Ward - Gota	34.3 %	27.5 %	65.7 %
Wards – Vejalpur + Sarkhej	53.2 %	42.9 %	46.8 %

Image 7: Overview of sterilization levels reached in the different Zones, Sub-Zones and Wards in AMC



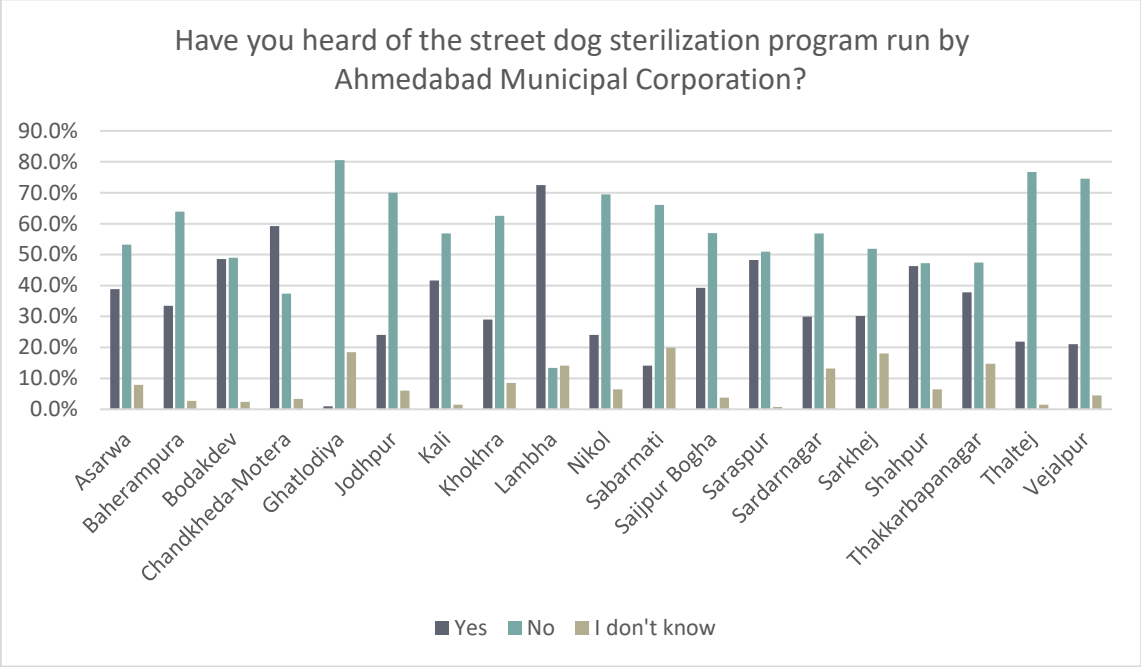
KNOWLEDGE, ATTITUDE AND PRACTICES MAIN FINDINGS

We interviewed 6099 households across 19 wards in Ahmedabad with a responds rate of 96.4%, of which 5660 households were included in the analysis. Interviews were discarded when survey protocols were not followed or the questionnaires were incomplete.

About two third of the interviewees were female and about one third male. The majority was between 26 and 55 years old and their households almost in equal parts evaluated as either poor or wealthy (see Appendix for more details).

The street dog sterilization program was overall not very well known among the participants (Graph 3), however there were significant differences between wards. Active community engagement to mobilize and include citizen efforts would be good at this point. For example, in zones with low sterilization coverage communities can help to localize unsterilized dogs.

Graph 3: KAP results – Knowledge of the AMC wide sterilization program



Only 132 (2.33%) households owned 154 dogs, with an average of 1.16 dogs per dog owning household and 0.026 dogs per household across the wards.

A recent household dataset (2019) provided by AMC does not provide ward-wise household data, however a total number of households in the Ahmedabad Municipal Corporation area of 1594105 households. **We used this number to generate a total private dog population for Ahmedabad using the average of dogs per households, 0.027 dogs per household, from our KAP survey and estimate that there are 43,041 private dogs in Ahmedabad.** There was a slight preference to own male dogs (88 or 57.1%) over female dogs (66 or 42.9%).

In the following chapters the results of the survey are discussed overall, because of the low numbers of dogs recorded in each ward (See appendix). In order to extrapolate to dog owners across the entire ward, the sample size of dog owners per ward would have to be increased. We suggest that if target areas are defined in the next phase of planning, more in-depth studies can be planned if needed.

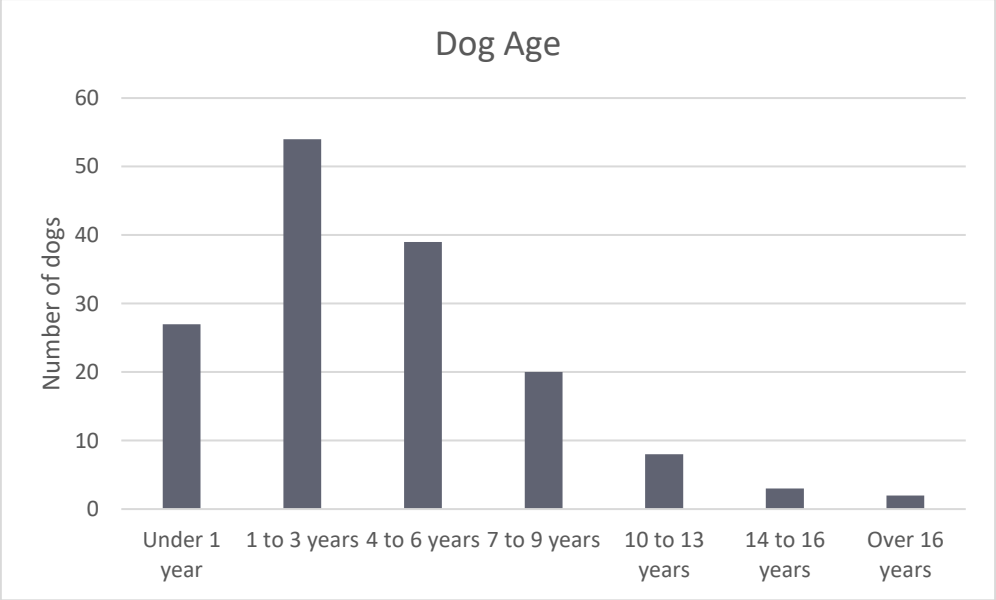
DOG DEMOGRAPHICS AND DOG OWNER ATTITUDES, KNOWLEDGE AND PRACTICES

Due to the small number of dogs per ward in this study we are unable to compare dog owner behaviour by ward, however, discuss the results in general.

Pet dogs are becoming popular in Ahmedabad and we asked interviewees how long they have been a pet owner to explore whether it has been a recent trend. Across all surveyed wards 75% of dog owners reported that this was their first dog they owned and over half of the respondents were dog owners for 4 or less years (see appendix), 29.5% between 5 and 10 years and only 9.8% over 10 years. The majority (88.6%) said they owned a dog for companionship/pet, 10.7% said the dog was owned to protect the property and 0.7% owned a dog for breeding. In comparison, most dogs in rural areas of India, e.g. mountain areas, are kept for protection purposes.

There was a slight preference for male dogs with 57.1% male and 42.9% female private dogs. The age distribution was normal with most dogs under 7 years old (Graph 4).

Graph 4: Age distribution among private dogs recorded in this study



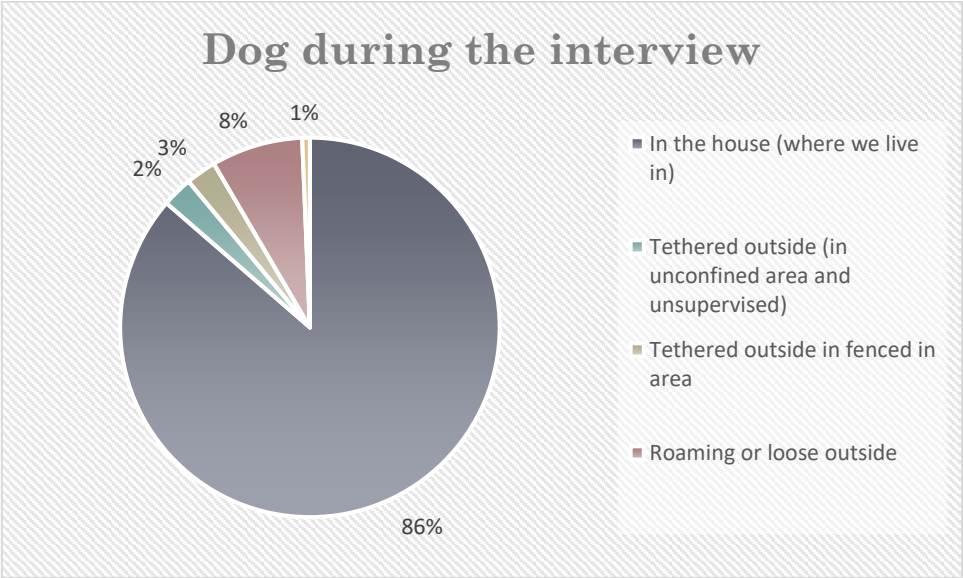
Acquisition of private dogs appears to be overall a conscious choice rather than accidental or gifted. With only 11% (17) stating that they were gifted the dog they own from within Ahmedabad and 5.8% (9) were gifted the dog from outside Ahmedabad. The remaining households either purchased or adopted the dogs they owned. Reasons for relinquishments of pets to shelters in the US have been of interest for a long time (e.g. DiGiacomo, Arluke & Patronek, 1998). Findings included that the human-dog relationship and the attachment quality/depth, even in multi-dog households, played a role in relinquishment of pets. Therefore, acquisition can be an indication of the depth of the human-dog relationship, which can influence the level of attachment between the dog owner and the dog and hence the level of care provided to the dog.

Reported pet ownership practices varied between wards, however, indicate an overall positive and responsible relationship. 33.8% of pet owners owned sterilized dogs and only

13% of the remaining dog owners were unwilling to have their dogs sterilized for various reasons, mainly because they felt it was unnecessary (62.75% or 64), 12.75% (13) thought it was too dangerous and 10.8% (11) wanted to have puppies. Hence the majority of dog owners with unsterilized dogs were unaware of the benefits of sterilization, however, 58% of the intact-dog owners would be happy to have their dogs sterilized free of charge at an AMC run clinic or at their dog's private vet clinic and another 9.7% would be happy to attend any government vet hospital to have their dog sterilized. A high level of sterilized pet dogs, therefore, can be achieved if services are offered to them in a convenient and safe way for their pet dogs.

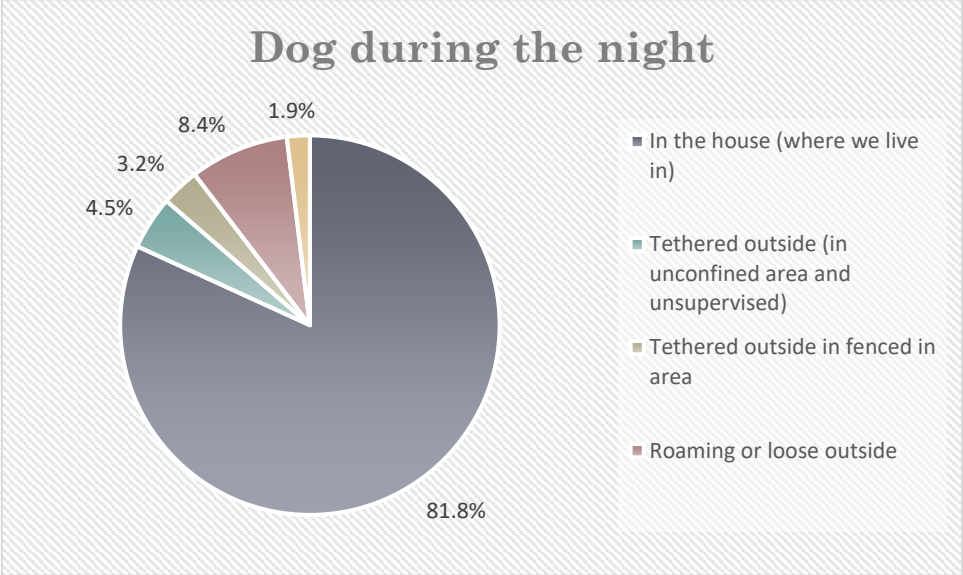
Similarly, dog owners mostly confined and controlled their owned dogs (Graph 5). The vast majority (133 or 86.4%) had their dogs in the house at the time of the interview and only 7.8% (12) had their dogs roam the streets at that time.

Graph 5: Location of the dog at the time of the survey



Proportions were similar for during the night (Graph 6) with 8.4% (13) leaving their dogs on the street to roam and 81.8% (126) having them in their house. The number of tethered dogs increases slightly during the night-time, which is likely a practice to keep the dogs around the house for protection.

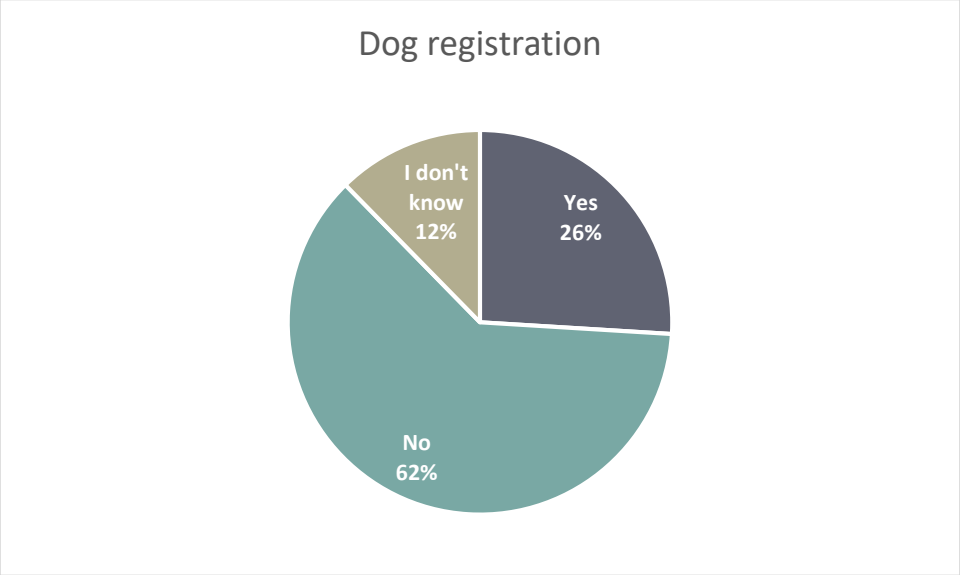
Graph 6: Location of the dog during the night



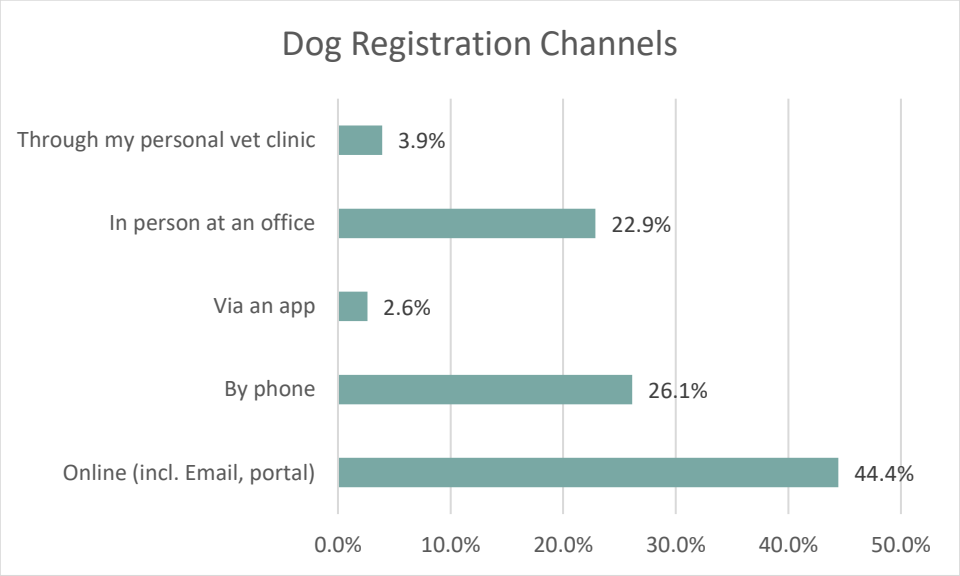
However, if asked if their dog is ever allowed to roam freely on the street in a 24-hour period only 31.8% (49) said no, increasing the number of owned dogs allowed to roam on the street to 68.2% (154). Hence, these dogs could potentially contribute to the rising dog bite numbers in Ahmedabad.

Dog owning practices can improve in two areas, registration and veterinary care. Although most dog owners (77.3% or 119) stated they had seen a veterinarian in the last 12 months, this question usually produces a lot of confirmation bias, which means that more people confirm that they visited a vet because they know it is the responsible answer. The same applies to the question about registration of pet dogs, (Graph 7). However, since AMC is planning to introduce mandatory registration of dogs, we also asked non-registered dog-owners how it would be convenient for them to get their dogs registered with AMC and their answers are relatively unbiased. Most dog owners prefer an online way of registering their dog (44.4%), followed by phone (26.1%) and a physical office where they can register the dog in person (22.9%). Only 2.6% would like an app and 3.9% said they would find their veterinarian most convenient (Graph 8). The fact that not many people would consider their veterinarian a good choice to register their dog indicates that they likely do not provide the annual check-up and vaccination visit that would be recommended. Therefore, both areas would need to be enhanced and registration of dogs would be best provided through multiple channels, likely a combination of the first three channels and what is most practical for AMC.

Graph 7: Proportion of recorded dogs registered with AMC



Graph 8: Ways considered most convenient to register dogs with AMC



KNOWLEDGE, ATTITUDES AND PRACTICES – STREET DOGS

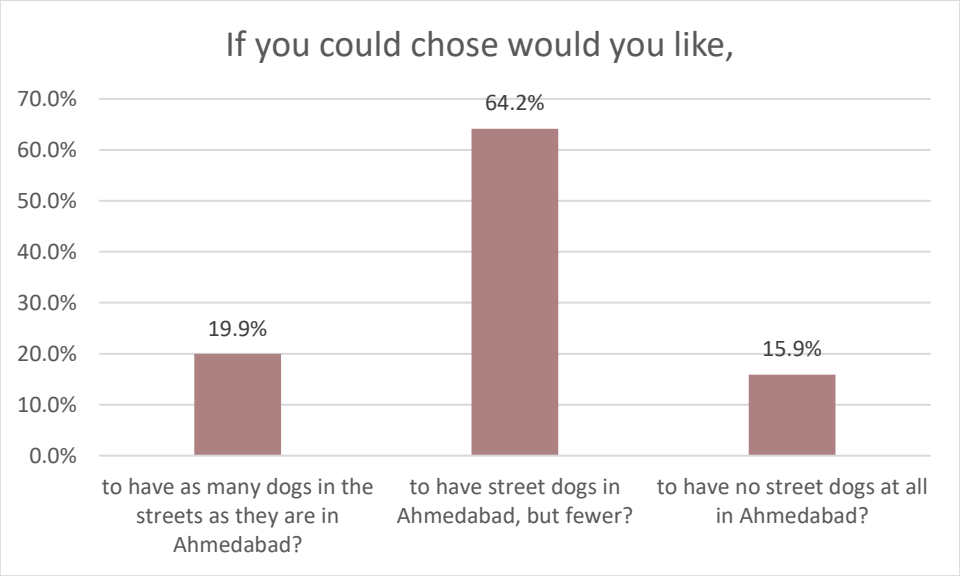
Knowledge is commonly perceived as the driving force behind our attitudes, perceptions and practices, however culture and peers have at least an equal influence on shaping our attitudes and practices. Understanding the dynamics of humans and dogs is helpful in identifying barriers as well as dog management approaches appropriate for street and private dogs. We directly asked and indirectly explored the relationship interviewees have with street dogs.

We asked how people in general felt about the street dog population, and the vast majority reported either to be happy to have as many street dogs as there are currently or wanted

street dogs but fewer on the streets (Graph 9). Only 15.9% reported to want no dogs on the streets. Similarly, positive but contrary to media reporting, feeding of dogs is not only common but also mostly accepted as a good practice. Most people knew about dog feeders in their neighborhood (47.5%) and of all interviewees 56% felt that “It is okay and I do not mind the feeding” and almost a third (26.9%) felt that more people should feed dogs and take care of them. Only 3.3 % felt that feeding dogs is the cause of problems and dog bites. Others were neutral or did not support dog feeding but also did not see a relationship between supporting dogs and problems.

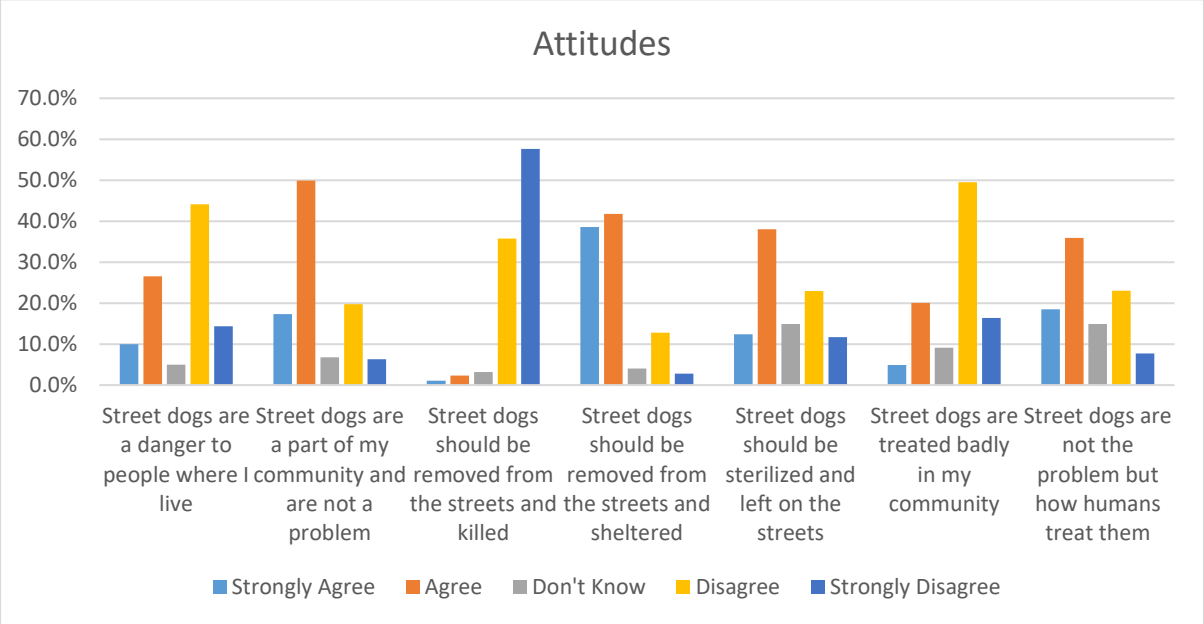
Street dog feeding as a practice varied for various reasons between wards, however only 32% of all interviewees reported to never feed street dogs compared to 19.8% who daily feed street dogs and 35.4% who reported to sometimes feed street dogs (see appendix). And 18.5% of the interviewees who feed street dogs reported that they sometimes touch the dogs and only 36.3% reported that they would not want to touch the dogs they feed.

Graph 9.: Attitude towards street dogs



The attitudes we explored in the above paragraph were confirmed when interviewees agreed or disagreed with statements about street dogs (Graph 10). Interviewees opposed strongly the inhumane removal of dogs and mostly agreed to humane ways of reducing the population including sterilization and return to the streets. And while the majority believed that street dogs are not treated badly in their community, they also believed that dogs were not the problem but how people behave around them. Most interviewees also disagreed that dogs pose a threat in the areas where they live, which is interesting considering the high reported rate of dog bites.

Graph 10: Likert scale attitude questions

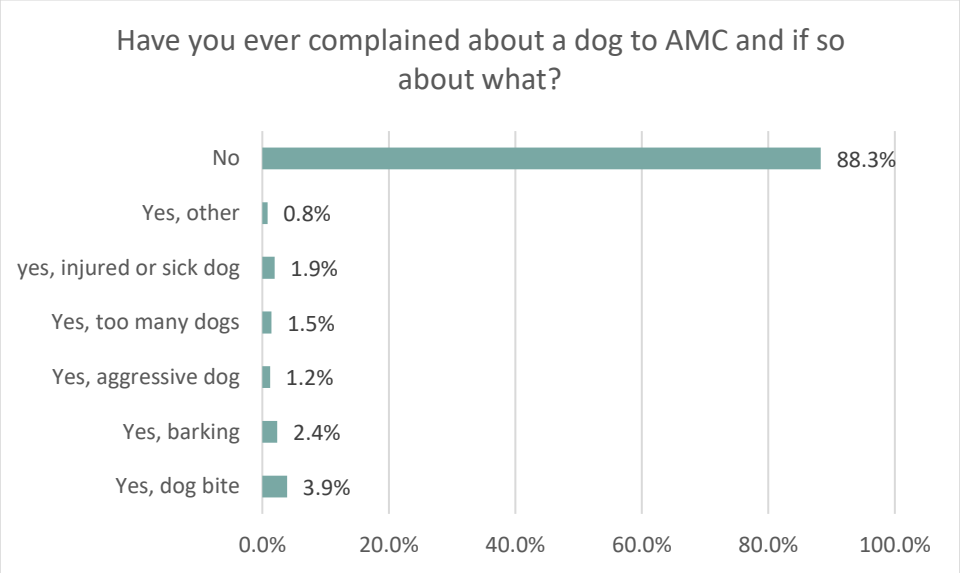


Changes in street dog density on the street interviewees lived on (over past 10 years) was very differently perceived among residents of the same ward as well as between wards (see appendix). Across the surveyed wards 17.6% felt that the number of dogs had decreased, 40.3% said that the number remained about the same, 33.3% felt the number had increased and 8.9% of interviewees either did not pay attention or did not know. This result is surprising if one considers the overall decreasing number of street dogs in Ahmedabad, however perceptions are, as mentioned above, not necessarily shaped by knowledge but influenced by other factors, e.g. media reports and common assumptions. Furthermore, developing wards with increasingly fewer space for street dogs will create a density increase of street dogs because dogs will be more visible on the street with fewer opportunities to escape from the streets. Thaltej and Saraspur are very different geographically and have a low and high human density respectively, however in both wards a significant proportion of interviewees felt that the street dog population had increased. In Thaltej 59.7% and in Saraspur 49.8% of interviewees felt that the street dog population on their street had increased. While this might be because of the randomly selected survey points, we suspect that there might also be factors contributing to this perception. Thaltej has been highly developed in the past 10 years (and continuing) and is in a zone of low sterilization coverage, while Saraspur is in a zone with a high sterilization coverage but is geographically in the old part of the city, which has an already high human density but is ever increasing.

We explored how severe street dogs are perceived as nuisance by asking about whether households had complaint to AMC about street dogs and if so about what. 88.3% (4992) of households reported to have never complaint to AMC about dogs (Graph 11). The most frequent complaint was aggressive behavior of dogs with 3.9% reporting to have called AMC

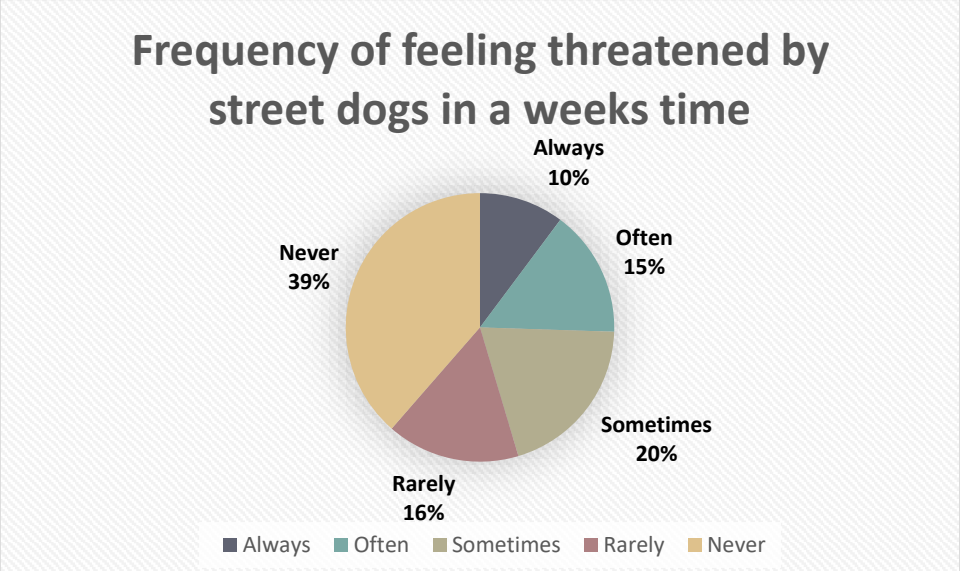
about a dog bite, 2.4% about barking dogs and 1.2% about an aggressive dog. Interestingly 1.9% also called to report a sick or injured dog.

Graph 11: Proportion of respondents who complaint to AMC about dogs.



People who have experienced a dog bite usually remember such incidences vividly over a long period of time and are able to recall details. However, besides actual bites a good indication of the human-street dog relationship are intimidating situations on the streets in the daily routine. To explore how frequently they occur in daily life, we asked how often (in a week's time) interviewees felt threatened by dogs they meet on the streets. Comparable to the complaint numbers more people reported that they felt safe around street dogs more often than they did not (Graph 12). Reflecting an overall good relationship with street dogs.

Graph 12: Level of negative perception of street dogs in daily life.



Interviewees were, across wards, most concerned about dog bites, followed by barking/growling or other intimidating behaviour towards them from street dogs. Public health seemed to be less of a concern and in some wards more than a third of interviewees had no concerns at all (see appendix), which does not mean that others in the same ward felt less threatened in general. In Nikol for example, 32% of interviewees had no concerns but 44% reported to be most concerned about dog bites. Fear of dogs and dog bites is usually a reflection of the kind of relationship humans have with street dogs and can but does not necessarily reflect dog behaviour interviewee experience.

DOG BITES

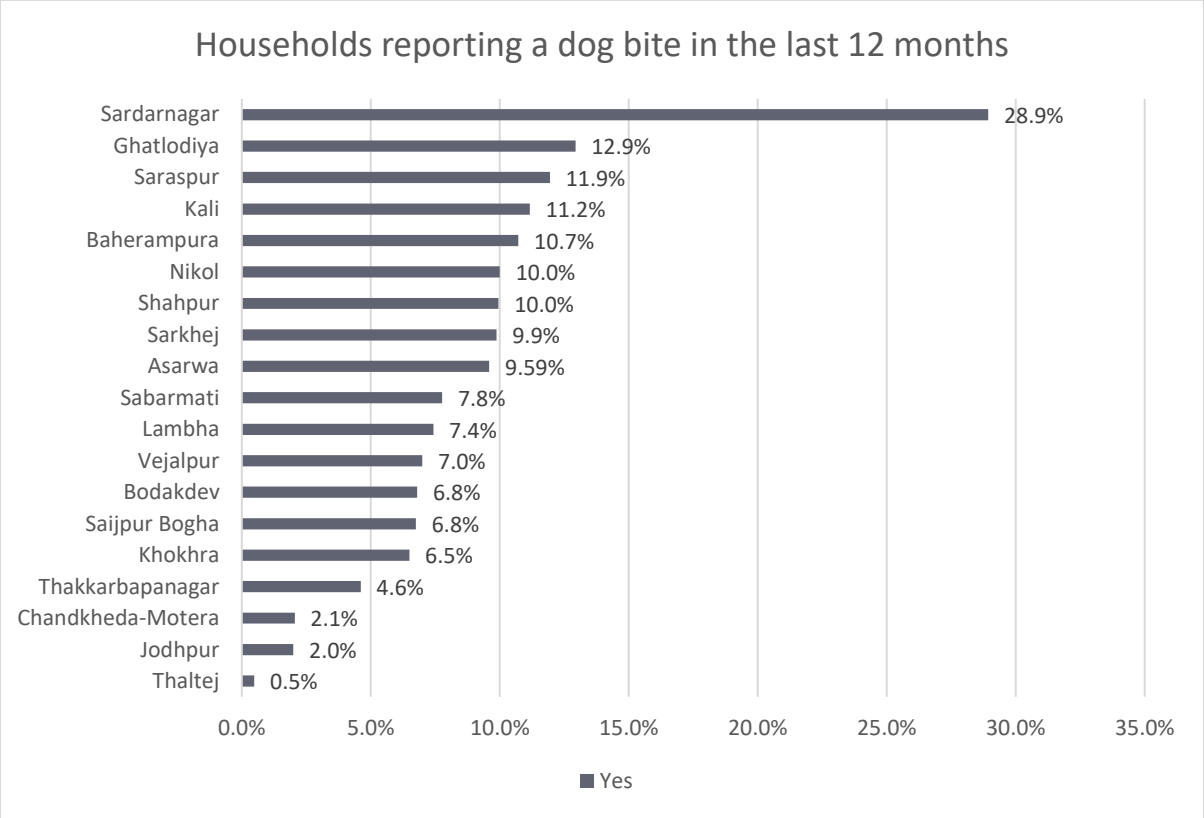
Dog bites have been developed as an indicator to measure impact in dog management programs of different types, however dog bite numbers are often not interpreted in the context of the human population they occur in. Further, dog bite dynamics are very complex and are often misinterpreted based on assumptions. Especially the media continues to use dog bite numbers in terms of public health risks related to street dogs and the only indicator to measure a success of a street dog management program.

Dog bite numbers should always be interpreted and compared as dog bites per humans and not as total numbers. It is often ignored that dog and human densities are both important measures when it comes to dog bite numbers. Therefore, for example despite a stable or declining dog population there might be a growing human population, which could increase the total number of dog bites but not necessarily the ratio per humans. It is important to look at trends of dog bites per humans and compare them over time. Additionally, not accounted for factors such as city development, which creates a lack of living space for existing dogs, increasing private dog numbers, roaming and leashed, can and will contribute to new situations, which potentially increase dog bite numbers. Those, however, are factors we currently have no way of measuring or tracking on a city-wide scale.

For Ahmedabad we are using both KAP survey results as well as dog bite records, obtained from the AMC and collected in hospitals, to evaluate the situation in the AMC area. The results of the KAP survey show a very different situation for different wards of different human density with very high to very low dog bite rates compared to other cities in Gujarat and India overall, where we on average find a dog bite rate of about 5%. As shown in Graph 13, we recorded by far the highest number of households (28.9%) reporting dog bites within the last 12 months in Sadarnagar, followed by Ghatlodiya (12.9%) and Saraspur (11.9%). According to the census data from 2011 they fall under medium human density per km^2 and have moderate to low illiteracy rates. Overall and our surveyors evaluation of the economic status indicate that socio economic factors (based on the 2011 census) do not let us believe that they play a role in the distribution of dog bites in the surveyed wards, however this possibly has changed since 2011 and would need to be revisited when the new census data is released. Most dog

bites occurred by unknown dogs and fewer by owned dogs, however with variations between wards.

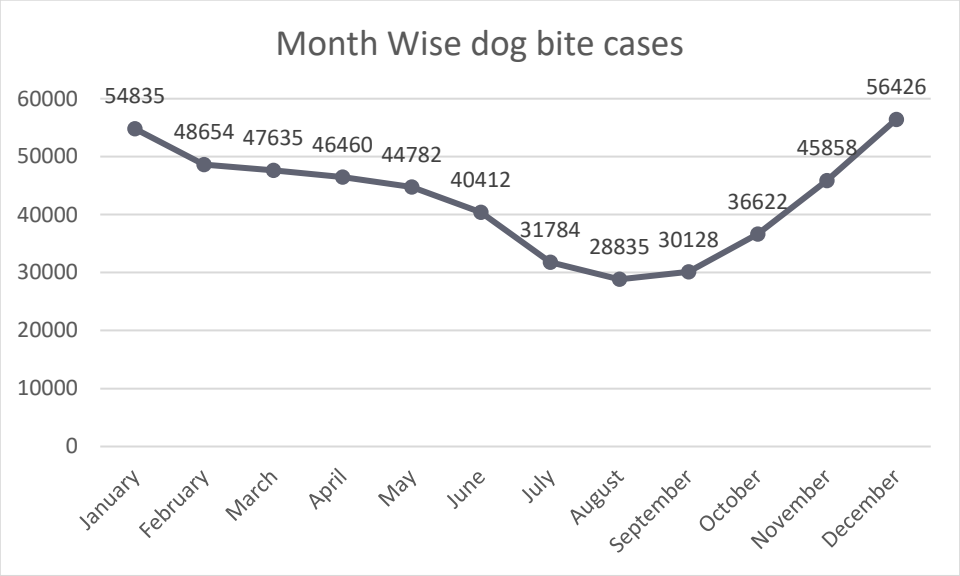
Graph 13: Percentage of households reporting a dog bite in the last 12 months by ward



It occurs that the wards with low or average dog bite numbers are either in already developed, or recently newly developed areas. The street survey data by zone is not sufficient to conclude whether the breeding behaviour in some high human density and rapidly developing wards is responsible for the conflict between humans and dogs, although some of the wards fall into the yellow and red zones. However, for some areas it is very likely that the situation of decreasing living space and increasing human population due to development of new gated communities and complexes combined with a not yet decreasing dog population produces conflict. Female dogs have very limited space to rear their litters and will hardly be able to avoid humans and dog density might artificially increase on the streets in those areas where constructions take place, and space is newly restricted to dogs. Those areas should be targeted, and female sterilizations should take priority. While we cannot conclude one single reason for the high dog bite numbers in some areas versus others we suspect it is a multitude of things that would need exploring on the ward level in more in-depth with qualitative and quantitative data collection and could be combined with mapping exercises for selected wards to address highly developing areas that show an increased dog bite rate to further develop humane dog management plans specific for those areas to mitigate problems causing dog bites.

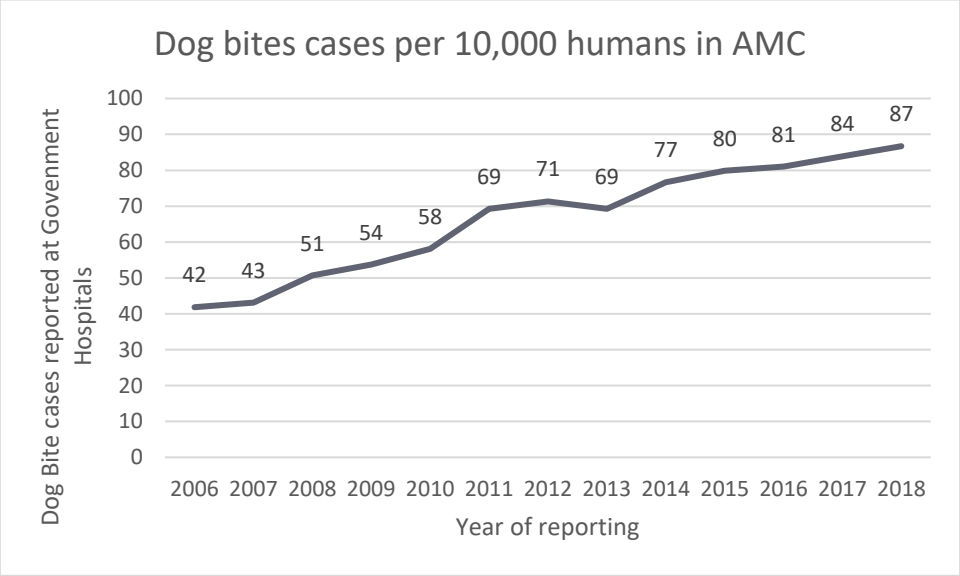
Dog bite data reported is from the AMC area overall and does not allow for more detailed analysis. Although some areas have shown to have high levels of street dog sterilization, the dog bite numbers very much follow the breeding cycle of street dogs in India (Graph 14). Hence, we speculate that puppy season might still play a role in areas where there is still a lot of breeding behavior, puppies on the streets and female dogs defending their puppies.

Graph 14: Dog bites reported to hospitals by month (2006-2018)



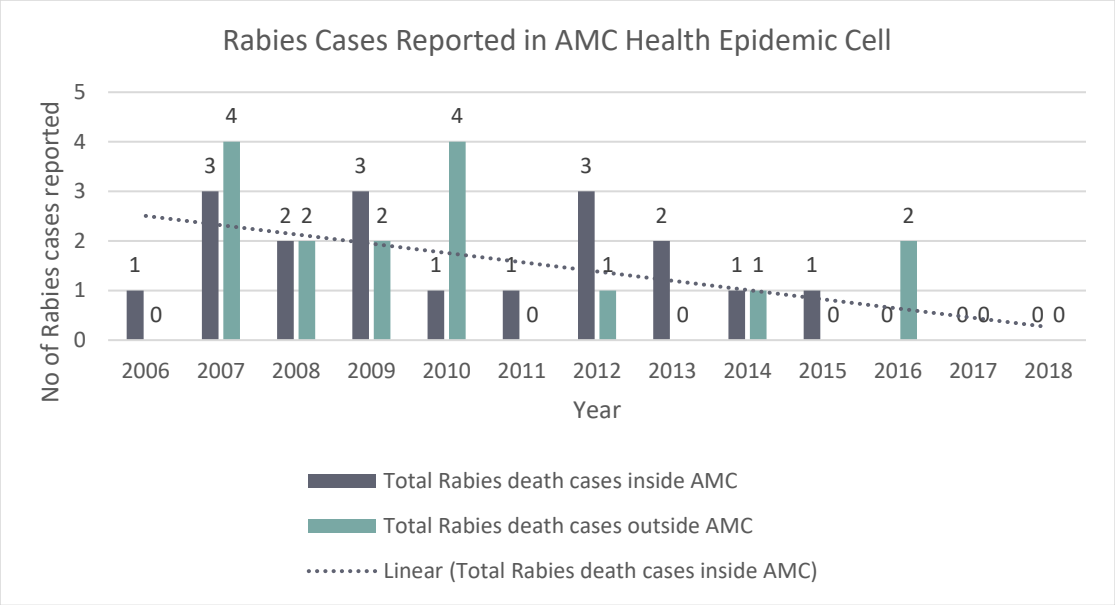
Dog bite numbers in the AMC area, however, are in fact steadily rising (Graph 15 and appendix) even as a ratio of the human population. Reasons and factors for this increase are unclear at this point but further in-depth analysis of more detailed records from the hospitals could provide some insights.

Graph 15: Dog bites per 10,000 humans since 2006



Despite the rising number of dog bites and therefore greater potential for rabies infections in humans, the dog management program has brought down the reported cases of human rabies case in the AMC area to zero (Graph 16). Rabies is a fatal disease and eradicating rabies from the AMC area is a major achievement of the dog management program.

Graph 16: Reported human rabies cases in hospitals since 2006



DISCUSSION AND RECOMMENDATIONS

Based on the results of this study, the Ahmedabad Municipal Corporation dog management program can only be described as an effective program and should be considered for other cities in Gujarat and India in general. With high sterilization efforts, the city halved the size of the street dog population within 10 years.

It is recommended that future efforts in Ahmedabad aim to achieve high proportions of sterilized dogs in the zones that were found to have under 70% in this study. Campaigns to encourage private dog owners to sterilize, register and provide veterinary care to their dogs should help to keep abandonment continuously at a minimum. Community engagement and bylaws can make use of the overall positive relationship citizen have with street dogs overall and can create a safer environment for humans and dogs in the AMC area. Focus groups such as dog feeders could be mobilized on a community level to increase dog welfare and therefore public health.

Dog bite numbers appear to be on the rise. We recommend an analysis of the situation and possible contributing factors because a growing street dog population is not the cause of the increase. Potential reasons could be, increase in private dog population, private dog bites misreported as street dog bites, rapid development of wards and higher human-dog conflict potential in those areas.

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APPENDIX

DOG BITE CASES

Month	2006	2007	2008	2009	2010	2011
January	2330	2209	2563	2704	3228	4255
February	2184	1865	2413	2431	2942	3684
March	1910	1843	2190	2713	2982	3517
April	1382	1773	2057	2340	2980	3546
May	1420	1551	2008	2366	2453	3254
June	1441	1460	1923	2142	2326	3136
July	999	1147	1481	1662	1910	2280
August	1021	1105	1266	1490	1594	2045
September	1020	1236	1514	1642	1591	2263
October	1038	1457	1696	1889	2219	2655
November	1576	1928	2343	2727	2857	3580
December	2093	2298	2991	3030	3641	4407
Total	**18414**	**19872**	**24445**	**27136**	**30723**	**38622**

Month	2012	2013	2014	2015	2016	2017	2018
January	4680	4755	5197	5482	5239	5945	6248
February	3932	4017	4307	4720	4832	5766	5561
March	3955	3687	4177	4596	4969	5387	5709
April	3763	3646	4218	4692	4969	5686	5408
May	3594	3475	4039	4437	4870	5553	5762
June	3131	3062	3895	3942	4279	4604	5071
July	2567	2585	3083	3207	3275	3528	4060
August	2176	2343	2660	2853	3058	3566	3658
September	2241	2328	2971	2990	3317	3251	3764
October	3120	2963	3213	4009	3684	3862	4817
November	3411	3728	4302	4784	4608	4732	5282
December	4571	4756	5292	5343	6474	5502	6028
Total	**41141**	**41345**	**47354**	**51055**	**53574**	**57382**	**61368**

KAP DATA – ALL SURVEYED WARDS*

MAIN FORM	Total	Total %
Gender of interviewee		
Male	1935	34.2
Female	3725	65.8
Transgender	0	0
Interviewee age group		
18-25	763	13.5
26-35	1576	27.9
36-45	1814	32.1
46-55	884	15.6
56-65	462	8.2
Over 65	155	2.7
Evaluate: Economic situation of the household		
Slum/temporary housing	498	8.8
Low income class	2000	35.3
Middle class	2747	48.5
Upper class	388	6.9
I don't know	27	0.5
Evaluate: What religion is practiced in this household		
Hinduism	4198	74.3
Christianity	61	1.2
Islam	712	12.6
Jainism	206	3.6
Sikhism	55	0.9
Other	82	1.5
I don’t know	338	5.9
Do you own a Dog?		
Yes	132	2.3
No	5528	97.7

Has anyone in the household been bitten by a dog in the last 12 months in Ahmedabad?		
Yes	535	9.45
No	5125	90.53
By which type of dog?		
Own household dog	8	1.5
Neighbour's dog	19	3.55
Unowned dogs in Ahmedabad	154	28.79
Unowned dog in the street I live in	304	56.82
Unidentified strange dogs	50	9.34
In the morning hours, how many dogs do you see on the street where you live?		
0-3	1690	29.86
4-6	2658	46.96
7-10	892	15.76
More than 10	1312	23.18
Do you think that the number of dogs in the street you live in has changed over the past 10 years?		
Decreased	996	17.60
About the same	2279	40.26
Increased	1884	33.29
I haven't paid attention/don't know (e.g. there are no dogs on the street)	501	8.85
If you could chose would you like, (please read the below options)		
to have as many dogs in the streets as they are in Ahmedabad?	1129	19.95
to have street dogs in Ahmedabad, but fewer?	3631	64.15
to have no street dogs at all in Ahmedabad?	900	15.90
Have you ever complained about a dog to AMC and if so about what?		
Yes, dog bite	221	3.91

Yes, barking	134	2.37
Yes, aggressive dog	69	1.22
Yes, too many dogs	82	1.45
Yes, injured or sick dog	110	1.95
Yes, other	47	0.83
No	4992	88.28
Have you heard of the street dog sterilization program run by Ahmedabad Municipal Corporation?		
Yes	2128	37.60
No	3086	54.53
I don’t know	446	7.88
Do you feed street dogs?		
Every Day	1118	19.75
Sometimes	2001	35.35
Once a week	396	7.00
Several times a month	333	5.88
No, never	1812	32.01
Would you be able to touch the dog?		
Yes, I think so	806	20.96
Yes, I touch it sometimes	711	18.49
No, I never tried	765	19.90
No, it would not let me touch it	169	4.40
No, I would not want to	1394	36.25
Do you know of anyone in your neighbourhood/community who regularly feeds street dogs?		
Yes	2685	47.46
No	2261	39.97
I don’t know	711	12.57
How do you feel about that?		
It is okay, I don't mind	1902	55.99
I think it is great and more people should feed street dogs	914	26.90

I don't think it is good but it does not bother me	103	3.03
I think it is not good and I would prefer s/he would not feed street dogs	88	2.59
It is wrong, because of them the dogs are staying and biting other people	111	3.27
I don't know	279	8.21
How frequently (in a week's time) would you say you feel threatened by street dogs you meet on the streets?		
Always	347	10.21
Often	520	15.30
Sometimes	675	19.86
Rarely	545	16.04
Never	1311	38.58
If at all, what would you consider threatening or concerning about street dogs?		
Dog poop and pee	750	13.25
Barking/growling	773	13.66
Dog/s being aggressive	289	5.11
Dog bite	1780	31.45
Risk to my own dog	12	0.21
Having a car accident with a dog	58	1.02
Rabies	101	1.78
Messing with the garbage	149	2.63
Chasing vehicles	384	6.78
Dogs with skin conditions or smelly dogs	38	0.67
Dogs fighting with each other	55	0.97
Injured dogs	48	0.84
Sick looking dogs	40	0.71
I have no concerns	1183	20.90
Do you know of anyone in our neighbourhood/community who has		

abandoned a dog and/or puppies in the last 12 months?		
Yes	125	2.21
No	5144	91.03
I don't know	382	6.76
ATTITUDE QUESTIONS		
Street dogs are a danger to people where I live		
Strongly agree	563	9.95
Agree	1504	26.58
I don't know	281	4.97
Disagree	2499	44.16
Strongly disagree	812	14.34
Street dogs should be removed from the streets and killed		
Strongly agree	60	1.06
Agree	133	2.35
I don't know	180	3.18
Disagree	2023	35.77
Strongly disagree	3259	57.63
Street dogs should be removed from the streets and sheltered		
Strongly agree	2183	38.60
Agree	2365	41.82
I don't know	227	4.01
Disagree	724	12.80
Strongly disagree	156	2.75
Street dogs should be sterilized and left on the streets		
Strongly agree	700	12.38
Agree	2149	38.00
I don't know	844	14.92
Disagree	1299	22.98
Strongly disagree	663	11.72

Street dogs are treated badly in my community		
Strongly agree	277	4.90
Agree	1137	20.09
I don't know	515	9.10
Disagree	2802	49.53
Strongly disagree	926	16.37
Street dogs are not the problem but how humans treat them		
Strongly agree	1044	18.46
Agree	2030	35.91
I don't know	841	14.88
Disagree	1300	23
Strongly disagree	438	7.75

*Results by ward are available upon request.