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Report of Roaming Dog Survey of Dhaka City Corporation, Bangladesh

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REPORT OF ROAMING DOG SURVEY OF DHAKA CITY CORPORATION, BANGLADESH - January 2016

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SUMMARY

Extrapolating observed dogs/km by total street length and correcting for detectability gives an estimate of 37,009 dogs roaming on the streets of Dhaka City, including both the North and South City Corporation areas. In North City Corporation itself, there is an estimated population of 24,384 roaming dogs, with 26% of which, including both males and females, have already been sterilized. In South City Corporation, there is an estimated population of 12,625 roaming dogs, with only 13% having been sterilized. A total of 3,174 dogs were counted during early morning surveys along 244.35 km of streets in both the North and South City Corporation, from which we can extrapolate an average observed dog density of 12.99 dogs per km. The ratio of humans to dogs is 193:1, at 0.5 dog per 100 people.

3 out of the 10 Zones in Dhaka City (North and South City Corporations) showed no prior sterilization activities, with no sightings of ear-notched dogs. Another 3 zones showed 1-2% of dogs sterilized. The remaining 4 zones had sterilization rates of 24-57%.

A file of survey routes and results is provided as a resource for monitoring future changes in the roaming dog population of Dhaka City by repeat surveys along the same routes.

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INTRODUCTION

Dhaka City is the capital city of Bangladesh, with an estimated population of 7,179,151 people.

In January 2016, Humane Society International (HSI) conducted a dog population survey of Dhaka City to estimate abundance of roaming dogs in the city, including both North and South City Corporation areas. Abundance is the total population size in a given area. A "roaming dog" is defined to mean any dog that may move freely at times on the city streets or other public areas, such as a "stray", "community dog" or unconfined owned dog.

Although an estimate of abundance is a useful prerequisite to planning an Animal Birth Control (ABC) programme targeting roaming dogs, it is a relatively insensitive indicator of the effectiveness of an ABC programme. Abundance is only one attribute of a roaming dog population, and for the purposes of monitoring an ABC program, we also report results for other attributes such as the roaming dog density per km of street length, the percentage of females and males that have been sterilised (as evidenced by the presence of an ear notch) and the percentage of females that are lactating (and thus raising a litter of puppies). Abundance is much slower to respond to ABC efforts than the percentage of pups in the population or the percentage of females that are lactating. Observed dog density per km of street length is also much easier to monitor and more relevant to the city residents because it determines the number of dogs they will encounter as they move around the city. Similarly, breeding activity as evidenced by percentage of lactating females is related to the risk of children being bitten by females responding to a perceived threat to their pups (Reece et al 2013[1]) and to the nuisance of dogs barking and fighting over females in heat.

Furthermore, an estimate of abundance alone may not be sufficient to determine the rate of sterilisations required to achieve a reduction in population size. Estimates of abundance are subject to serious biases and have low precision. Roaming dogs do not exist as a homogeneous population. Abundance will change in response to development and expansion of the city, factors beyond the control of the ABC programme. Changes in future population size will be determined by fecundities and survival rates in sub-populations that may or may not be to the ABC programme; those rates are not known. As an extreme example, it may be that litters produced by the sort of females that can be accessed by the programme have such low survival that almost none of the female pups survive to maturity. In that case, the population is maintained by survival and dispersal onto the streets of pups born in areas that cannot be accessed by the ABC programme, which may include waste ground and gated communities. Then the programme will not reduce the size of the adult population but will reduce the number of pups and the level of breeding activity on the streets. Thus monitoring the impact of existing ABC programmes is a better guide to the planning of future programmes than estimation of current abundance.

[1] Reece, J.F., Chawla, S.K. & Hiby, A R., 2013. Decline in human dog-bite cases during a street dog sterilisation programme in Jaipur, India. *The Veterinary record*, 172(18), p.473. Available at: http://www.ncbi.nlm.nih.gov/pubmed/23492927

ROAMING DOGS ABUNDANCE

Dhaka City is divided into two administrative parts: North City Corporation and South City Corporation. Each administrative region is further divided into 5 zones. The survey was designed to estimate roaming dog abundance in each of the 10 zones, using the following map:

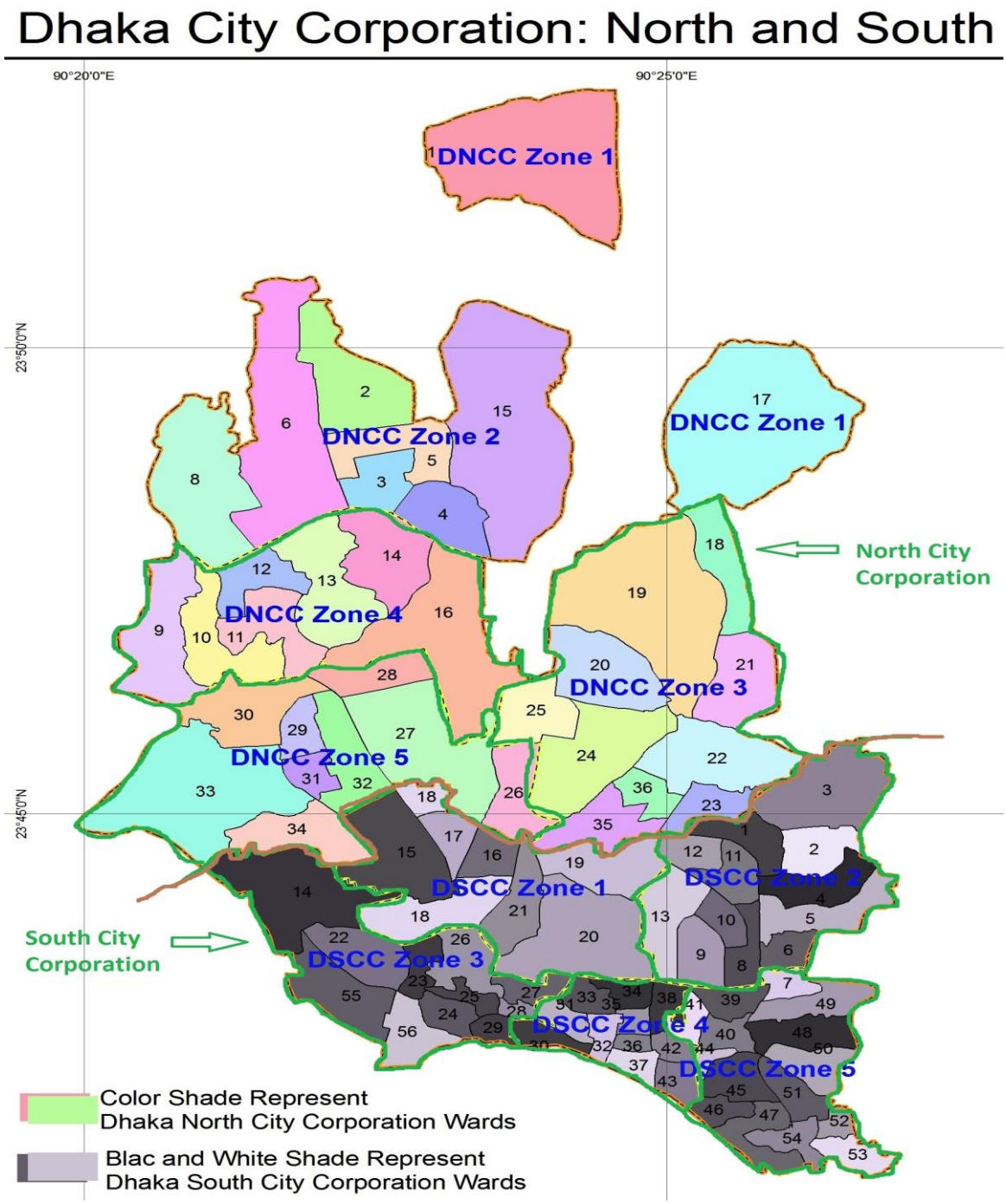

Figure 1 – Map of Dhaka City, including zone boundaries for North and South City Corporation.

Standard routes were designed using Google Maps to run along highways and residential streets but avoiding expressways (coloured yellow on Google Maps), which are devoid of roaming dogs. One standard route was designed within each zone to keep the ratio of highway to residential street length similar to that ratio for the total length of highways and residential streets in the village. The routes covered an average of 14.3% of the total length of highways and streets in the zones.

Table 1 - Total street length, route length and survey coverage by zone.

Zone	street length (km)	Track length	% street covered during survey
North Zone 1	248	22.52	9.1
North Zone 2	228	22.9	10.0
North Zone 3	238	35.1	14.7
North Zone 4	170	22.2	13.1
North Zone 5	233	30.3	13.0
South Zone 1	138	20.3	14.7
South Zone 2	166	24.2	14.6
South Zone 3	121	26.5	21.9
South Zone 4	53	15.7	29.6
South Zone 5	110	24.6	22.4
Total For Dhaka City	**1705**	**244.32**	**14.3**

Boundaries of each zone were superimposed on Google Maps in order to restrict each route to a single zone. The image in figure 2 illustrates the route for North Zone-3. The flag icon is the start of the route, and the house icon shows the end of the route. Each route is saved as a kml file that can be viewed using a map application such as Maps or Locus Map on a smartphone. Any of the routes can therefore be followed at any time in the future by viewing the kml file on a smartphone and moving the map cursor along each of the route sections in turn.

To complete the current survey, six teams each consisting of a motorcycle driver and an observer followed each route one or two times, recording seven types of dogs seen (Female notched, Female unnotched, Lactating, Male notched, Male unnotched, Unknown adult and Pup) by using the OSM tracker phone app as an event recorder. The phones were GPS-enabled so the exact location of each sighting was recorded. Further details of the recording system are given in the Monitoring section below.

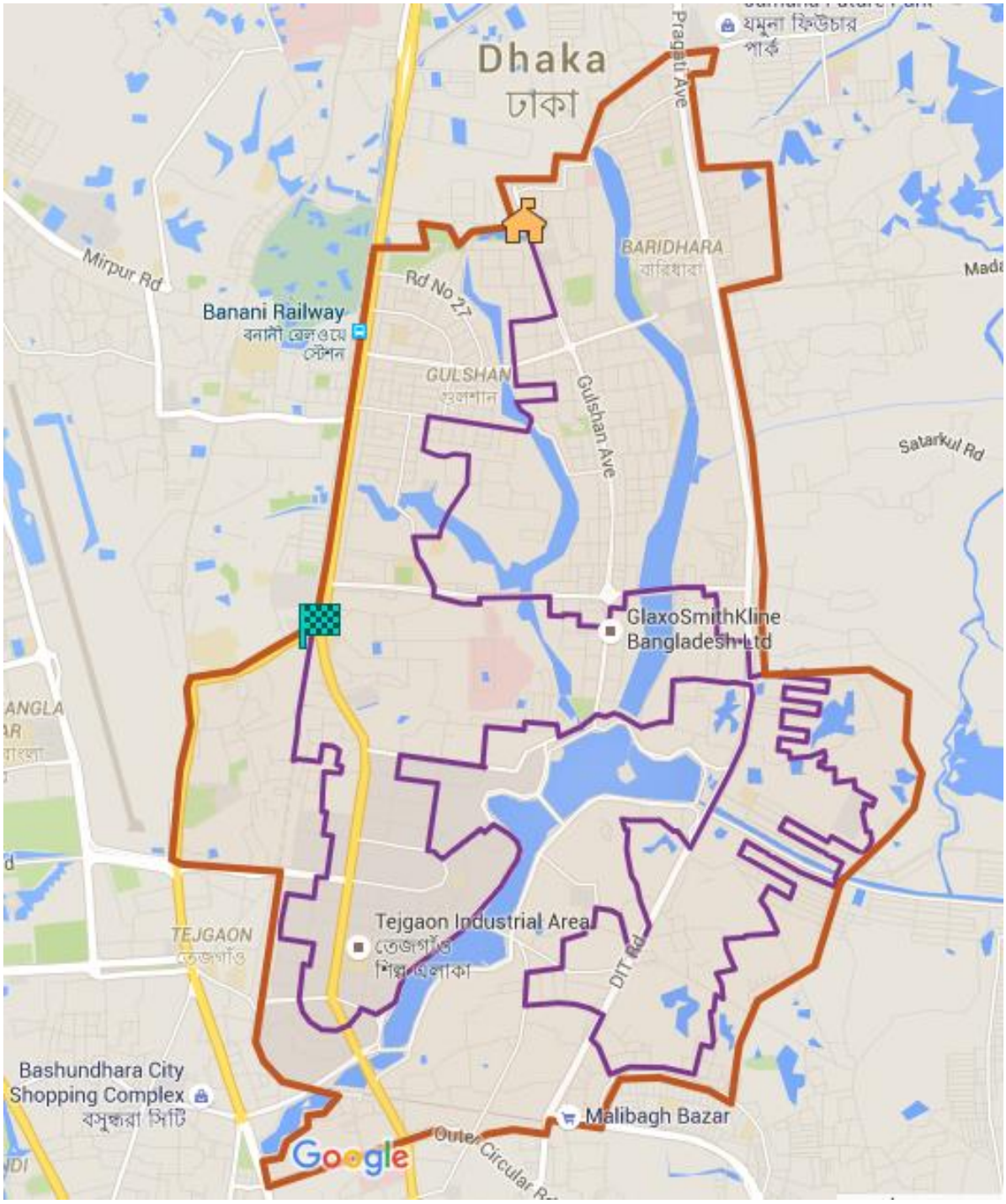

Figure 2 - Survey route for North Zone-3. Flag icon shows the start of the route, and the house icon shows end of the survey route.

Table 2 shows the count results, extrapolation to dogs per km roaming the streets in the early morning and to total population by correcting for detectability. The average number of dogs counted over the one or two surveys conducted along each standard route is expressed as the number of dogs counted per km of street length. The dogs per km are multiplied by the total street length to give the estimated number of dogs on all the streets in the zone at the time of the morning surveys. This figure is then divided by the estimated probability that a dog that may roam at any time will be on the streets and seen at the time of the surveys (the "detectability" factor of 0.4) to give the total number of dogs that may roam at any time in each zone (the roaming dog abundance) in the final column.

Table 2 - Count results and population estimates for all the zones: total street length per zone, track length, average number of dogs counted per track, dogs per km and therefore estimate of total dogs on the streets per zone. The second to last column uses the probability of 0.4 that a dog will be seen on a street in the morning to extrapolate to the total roaming dog population per zone, i.e. corrected for detectability.

Zone	street length (km)	Track length	Dogs counted (average)	Dog/km	Detectability	Dog Population
North Zone 1	248	22.52	95	4.2	0.4	2604
North Zone 2	228	22.9	198	8.6	0.4	4902
North Zone 3	238	35.1	319	9.1	0.4	5415
North Zone 4	170	22.2	323	14.5	0.4	6163
North Zone 5	233	30.3	276	9.1	0.4	5301
Total For North City Corporation						24384
South Zone 1	138	20.3	75	3.7	0.4	1277
South Zone 2	166	24.2	241.5	9.9	0.4	4109
South Zone 3	121	26.5	398	15	0.4	4538
South Zone 4	53	15.7	63.5	4	0.4	530
South Zone 5	110	24.6	193.5	7.9	0.4	2173
Total For South City Corporation						12625
Total For Dhaka City						**37009**

Thus, the count results show an abundance of 24,384 roaming dogs in North City Corporation area and 12,625 roaming dogs in the South City Corporation area. In total, there are 37,009 roaming dogs in Dhaka City. Dogs per km vary from around 4, in North Zone 1 and South Zone 1, to around 15 in North Zone 4 and South Zone 3.

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Table 3 – Human and dog populations and dogs per 100 humans for Dhaka City by zones.

Zone	Dog Population	Human Population	Area Size	Human Population/ sq.km	Dogs per 100 humans
North Zone 1	2604	394436	11.57	34091	0.66
North Zone 2	4902	981197	21.318	46027	0.50
North Zone 3	5415	962542	18.987	50695	0.56
North Zone 4	6163	868407	11.962	72597	0.71
North Zone 5	5301	842433	18.54	45439	0.63
Total For North City Corporation	**24384**	**4049015**		**49770**	**0.58**
South Zone 1	1277	790970	11.504	68756	0.16
South Zone 2	4109	403448	11.336	35590	1.02
South Zone 3	4538	717895	8.098	88651	0.63
South Zone 4	530	423578	3.492	121300	0.13
South Zone 5	2173	794245	9.522	83412	0.27
Total For South City Corporation	**12625**	**3130136**		**79542**	**0.42**
Total For Dhaka City	**37009**	**7179151**		**64656**	**0.5**

Table 3 shows the human and dog population for each zone and also the number of dogs per 100 humans. The human to dog ratio for Dhaka City is 193:1, at 0.5 dog per 100 people.

COMPOSITION OF THE ROAMING DOG POPULATION

Table 4 - Composition of dog population observed on the streets.

Zone Name / Track ID	% Sterilized Female	% Sterilized Male	% Sterilized dogs	% Lactating Female	% pups
North Zone 1	0	4	2	2	10
North Zone 2	57	58	57	7	6
North Zone 3	0	0	0	22	11
North Zone 4	15	29	24	7	10
North Zone 5	33	43	39	10	9
South Zone 1	0	0	0	9	9
South Zone 2	0	2	1	14	13
South Zone 3	30	48	40	18	8
South Zone 4	0	3	1	2	5
South Zone 5	0	0	0	15	9

Tables 4 shows the composition of the dog population as well as the evidence of sterilization activities previously carried out in Dhaka City. In North City Corporation, 3 zones out of 5 have carried out ABC activities while only 1 zone in South Dhaka City had conducted ABC activities.

SPATIAL DISTRIBUTION OF THE ROAMING DOG POPULATION

The zones were found to vary in both dog density and percentage composition. In general, North City Corporation has a higher dog density than South City Corporation. However, Zone 2 of South City Corporation has the highest density, at 1 dog per 100 people. The highest percentage of lactating females was found in Zone 3 of North City Corporation, where no ear-notched dogs were seen. Zone 3 of South City Corporation had the second highest percentage of lactating females, and while the survey reports a 40% sterilization rate in that zone, out of the sighted ear-notched dogs, less than 30% were females.

Figure 3 illustrates variation of roaming dog density over the North and South Dhaka City Corporation. The colour of the icons indicates the dog type seen at that location: Green = Female notched; Yellow = Female un-notched; Red = Lactating; Black = Male notched; Blue = Male un-notched; Light purple = Pup.

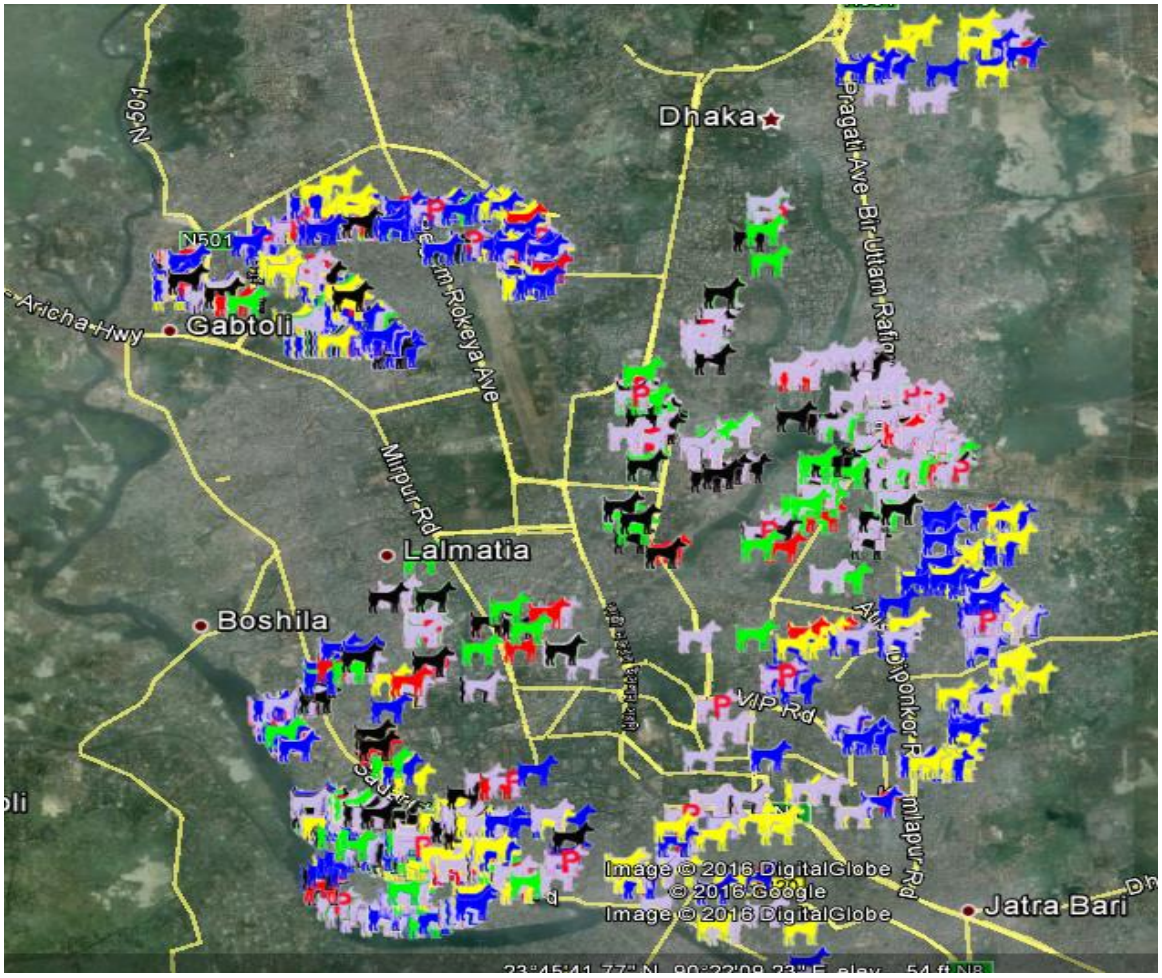

Figure 3 – Google Earth display of dogs of known types seen on surveys of 10 routes in the North and South Dhaka City Corporation area.

Clustering of lactating females is evident as regions with more red coloured icons.

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MONITORING

SURVEY CONSISTENCY

The route files provided with this report are a resource that can be used to monitor changes in the population into the future. However, for the results to be comparable, it is vital that the same search protocol and, if possible, the same observers are used on each route. On upload of the street counts to the database, the driver and observer names and the timing and duration of each survey are recorded. The protocol used during the surveys was kept deliberately simple: all dogs seen from the motorcycle were recorded and those that could not be sexed without getting off the motorcycle to make the dog stand up were recorded as "Unknown adult".

THE POWER TO DETECT CHANGE IN DOG DENSITY

Table 5 illustrates the amount of variation in the roaming dog counts made during the one or two surveys of each zone:

Table 5 - Replicate counts for routes in each zone.

Route	Length	Count	number/km
Route North Zone 1	22.52	88	3.9
Route North Zone 1	22.52	102	4.5
Route North Zone 2	22.9	198	8.6
Route North Zone 3	35.1	319	9.1
Route North Zone 4	22.2	373	16.8
Route North Zone 4	22.2	273	12.3
Route North Zone 5	30.3	276	9.1
Route South Zone 1	20.3	74	3.6
Route South Zone 1	20.3	76	3.7
Route South Zone 2	24.23	208	8.6
Route South Zone 2	24.6	275	11.2
Route South Zone 3	26.5	398	15.0
Route South Zone 4	15.7	66	4.2
Route South Zone 4	15.7	61	3.9
Route South Zone 5	24.6	189	7.7
Route South Zone 5	24.6	198	8.0

The total number of dogs counted over the replicate surveys was 3174 over 374.27 km, an average of 8.48 dogs seen per km. Taking the square root of the sum of the variances over the 5 replicated routes to estimate the standard deviation of a total count over those routes and dividing by that total count gives a coefficient of variation (CV) of 0.0955 for the estimate of average dogs counted per km. Doubling both the variance and the total to estimate the CV for a total count over all 10 routes reduces the CV to 0.0675.

To estimate the resulting power to detect a change in dog density let $D1$ and $D2$ represent the average dogs counted per km over the same 10 routes at the same time in two different years. Under the null hypothesis of no change in the population dog density, the absolute difference in the estimates divided by the standard deviation of the difference has the Student's t distribution based on 7 degrees of freedom:

$$\frac{|D1 - D2|}{0.0675 \times (D1 + D2)/2 \times \sqrt{2}} \sim t_{0.05,7}$$

Thus an observed proportional change in mean density can be considered to be significant (at the 95% level) if it exceeds $0.0675 \times \sqrt{2} \times t_{0.05,7}$ or about 22% (e.g. if 1500 were counted in one year then counting 330 fewer over the same routes at the same time in another year would be sufficient to indicate a significant decline in average density). These calculations assume the observed difference is based on a single count in each year; to increase the power replicate the counts in each year and divide the CV by the square root of the number of replicates.

DISCUSSION

This survey of Dhaka City roaming dog population took a total of 6 days to complete, with 10 survey routes and 6 teams of driver plus observer, surveying only in the early morning hours of each day. Fifteen surveys of the 10 prepared routes were conducted, taking an average of 2 hours each to complete, a total of 30 hours for driver and observer. The method is thus efficient as a way to monitor and study the status of the roaming dog population over a large area.

There was generally little day to day variation in counts along the standard routes, suggesting that such counts have enough power to detect small changes in roaming dog density and other indicators. For monitoring change over the city as a whole, a single count along each of the standard routes is enough to detect quite small changes but to check on a single zone or to monitor change in distribution requires replicate counts (thus a minimum of two per route). In addition to averaging out day to day variation in counts, it is essential use a consistent search protocol, particularly in regard to timing and duration of the surveys. We suspect there is then little difference between observers. However a conservative approach would be to use the same observers to survey the

routes they surveyed previously or at least to check for consistency between observers in the number of dogs seen along the same route. Ideally, therefore, monitoring would be by one or more local NGOs, as in Jaipur where Help in Suffering have monitored dog density along a standard route in the Pink City region since 1998, using largely the same team of observers. Furthermore, as surveying is only possible early in the morning, a local NGO might be able to incorporate surveys into their normal work schedule.

In relation to timing, the possibility of seasonality in breeding (as in northern India) should be checked using previous ABC records of pregnancy in females collected for sterilisation. Surveys conducted just prior to the breeding season are more consistent because they include a minimum number of pups; surveys following the peak in breeding season are more sensitive to the degree of breeding activity.

Extrapolating by street length from the street counts and correcting for detectability gives an estimate of 37,009 dogs roaming on the streets in the Dhaka City Corporations area. The estimated dog to human ratio is low at 1 dog to 193 people (based on a human population of 7,179,151 for Dhaka City). Although roaming dog density is low, the percentage of females lactating is high, suggesting that sterilisation is urgently required to maintain that low density.