STREET DOG POPULATION SURVEY
KATHMANDU 2012

Kashmira Kakati

Supported by:

WSPA
The World Society for the Protection of Animals
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SUMMARY

A population survey of the roaming street dog population of Kathmandu and Lalitpur City was undertaken in December 2012. The population estimate from block counts covering 12% of the area of the city was corrected by the detection probability of dogs (p=0.48) derived from Mark-Resight experiments in a sub-sample of eight blocks. The corrected estimate is 22288±3067 (95% CI) dogs in the area within the Ring Road of Kathmandu (4300 ha), with a mean corrected density of 5.18±0.71 (95% CI) dogs/ha. The figures do not indicate any significant change in population numbers since the previous survey two years before in 2010 (when the population estimate was 22555±2561 dogs, mean corrected density 5.24±0.59 dogs/ha). From visual assessment of body and skin condition of the dogs, 69% of the dogs were found to be in healthy body condition – similar to the proportion (66%) in 2010; and 91% of dogs had no visible skin problems, an improvement from 69% in 2010. Data were also examined at the level of 4 zones, each having had dog welfare activity (spaying, treatment of health and skin conditions) of varying levels with Zone A having had relatively the highest level of intervention and Zone D the least. Dog population density has risen slightly in Zone A and B (and remains highest in Zone B since 2006) and declined in Zones C & D showing no particular effect of intervention on population density per se. Welfare interventions however, show positive correlation with body condition. A higher proportion of dogs were found to be in healthy body condition in the zones where long term welfare has taken place with 81% of dogs in Zone A in healthy body condition, against only 52% in Zone D.

Citation:
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ACKNOWLEDGEMENTS

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INTRODUCTION

A survey of street dogs in the city of Kathmandu was conducted in the month of December 2012 to estimate the roaming street dog population in the city. The dog population now is compared with two previous surveys – a baseline and a follow-up – carried out in 2006 and 2010. The results are to aid WSPA in assessing impact of their funding support to the Kathmandu Animal Treatment Center for Animal Birth Control (ABC) and welfare programmes for street dogs. The methods and analysis follow most of the guidelines suggested by Reece (2006) and WSPA (2008), and are consistent with those used in the previous surveys to enable comparison.

METHODS

1. Sample Block Selection

- A city map of Kathmandu and Lalitpur was used to divide the area within the ring road (43 km² or 4300 ha as measured by GPS mapping of the Ring Road) into 4 broad zones A, B, C and D based roughly on the cardinal directions, and further into 618 blocks of varying sizes, defined by major and/or minor roads. The total area of the blocks surveyed was 12% of the area of the city (details in Table 1). The same map with the numbered blocks was used during the 2010 survey and is available for reference.

- 79 of these blocks (ca. 13% of the blocks) were selected randomly for sampling (Fig.1), in proportion to the total number of blocks in each zone (Table 2). The RANDBETWEEN function on a Microsoft Excel spreadsheet was used for random selection of survey blocks. Exact block boundaries within which the teams surveyed were determined from the Global Positioning System (GPS) locations recorded by each team. From the maps generated, it was found that seven additional blocks had been included along with random blocks. The data from these additional blocks are included with that of the target block. Areas of blocks were calculated using mapping software GPSTM-PRO 4.7 software (Odilon Ferreira Junior, 2010).

<table>
<thead>
<tr>
<th>Table 1. Summary details of block areas, numbers and durations surveyed.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Area (ha) of Blocks</td>
</tr>
<tr>
<td>---------------------</td>
</tr>
<tr>
<td>Average</td>
</tr>
<tr>
<td>Minimum</td>
</tr>
<tr>
<td>Maximum</td>
</tr>
<tr>
<td>Total area of Kathmandu &amp; Lalitpur (within Ring Road)</td>
</tr>
<tr>
<td>Total Sampled (%)</td>
</tr>
</tbody>
</table>
### Table 2. Total area and number of blocks in each zone, area and number (and proportion) of blocks sampled in each zone.

<table>
<thead>
<tr>
<th>Zone</th>
<th>Locality</th>
<th>Total Area (ha) of Zone</th>
<th>Total Number of Blocks</th>
<th>Total Area (ha) of Sample Blocks (% area sampled within each zone)</th>
<th>No. of Blocks Sampled (% no. of blocks sampled within each zone)</th>
</tr>
</thead>
<tbody>
<tr>
<td>A North</td>
<td>Maharajgunj, Baluwarat, Lazimpat DurbarMarg, Dillibazar</td>
<td>1365</td>
<td>230</td>
<td>140 (10%)</td>
<td>27 (4.3%)</td>
</tr>
<tr>
<td>B West</td>
<td>Balaju, Swayambhu Baphal, Thamel, Teku Kalimati, Kalanki</td>
<td>1177</td>
<td>166</td>
<td>140 (12%)</td>
<td>22 (3.5%)</td>
</tr>
<tr>
<td>C East</td>
<td>Ratna Park, Putalisadak Baneshwor, Thapathali Sinamangal, Sahyoginagar</td>
<td>887</td>
<td>158</td>
<td>112 (13%)</td>
<td>22 (3.5%)</td>
</tr>
<tr>
<td>D South</td>
<td>Patan/Lalitpur: Kupondole, Jhamsikhel Pulchowk, Jwalakhel Sundhara, Lagankhel</td>
<td>870</td>
<td>64</td>
<td>129 (15%)</td>
<td>8 (1.2%)</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td></td>
<td><strong>4300</strong></td>
<td><strong>618</strong></td>
<td><strong>520</strong></td>
<td><strong>79</strong></td>
</tr>
</tbody>
</table>

*Discrepancy due to rounding off of decimals.
Fig.1. GPS generated map showing survey area circumscribed by the ring road with outlines of the 79 sample blocks where street dogs were counted. The sub-sample of 8 blocks where Mark-Resight sampling was carried out are shown in solid green colour. On right, a Google Map of Kathmandu City showing the Ring Road.

2. Survey Period

The block counts (8 days), Mark-Resight exercise (3 days) and dog catching (5 days) to read ear tattoos were carried out concurrently by the volunteer teams between Dec 1st and 11th, 2012.

This is the beginning of the dry winter season in Kathmandu and also the peak breeding months (starting November) for roaming dogs.

3. Block Counts

a. Survey teams, Survey hours and Block area

- Total counts of the selected blocks were carried out by 4 teams of 2 to 3 people each comprising the team leader who recorded the data on pre-designed data sheet and a colleague.
• Volunteers had a briefing on survey methods, use of GPS units and data recording protocols before the survey.
• Teams conducted the block searches between 5:45 – 10:32 AM.
• In each block, the inner half of the block boundary road, as well all minor roads and alleys within the block were actively searched for street dogs.
• Only roaming dogs were counted. Those confined within property (e.g. behind closed doors or gates) were not counted. Owned dogs i.e. those with their owners were noted as such, dogs wearing collars but roaming free were recorded as collared dogs while all others were categorized as street dogs.
• The teams recorded the following information to identify blocks and quantify survey effort:

<table>
<thead>
<tr>
<th>Date</th>
<th>Zone</th>
<th>Block No.</th>
<th>Time Start</th>
<th>Time End</th>
<th>GPS Start</th>
<th>GPS End</th>
</tr>
</thead>
</table>

b. Dog numbers, Animal Birth Control (ABC) and Health Status assessment
• For each dog seen, the parameters recorded on standardized data sheets were:

<table>
<thead>
<tr>
<th>Sex (Adult Dogs)</th>
<th>Pup</th>
<th>Ear Notch</th>
<th>Collar (+ type)</th>
<th>Body Condition Score (1-5)</th>
<th>Skin Condition Score (1-3)</th>
<th>Remarks</th>
</tr>
</thead>
<tbody>
<tr>
<td>Male</td>
<td></td>
<td></td>
<td></td>
<td>1=Very Thin</td>
<td>0=Normal</td>
<td></td>
</tr>
<tr>
<td>Female (whether lactating)</td>
<td>Unknown</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Male</td>
<td></td>
<td></td>
<td></td>
<td>2=Thin</td>
<td>1=Mild</td>
<td></td>
</tr>
<tr>
<td>Female (whether lactating)</td>
<td>Unknown</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Male</td>
<td></td>
<td></td>
<td></td>
<td>3=Normal</td>
<td>2=Moderate</td>
<td></td>
</tr>
<tr>
<td>Female (whether lactating)</td>
<td>Unknown</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Male</td>
<td></td>
<td></td>
<td></td>
<td>4=Stout</td>
<td>3=Severe</td>
<td></td>
</tr>
<tr>
<td>Female (whether lactating)</td>
<td>Unknown</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Male</td>
<td></td>
<td></td>
<td></td>
<td>5=Overweight</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Female (whether lactating)</td>
<td>Unknown</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

• For females, left ear notches that are a mark of identification for dogs spayed by KAT Centre (Photo 1) and lactation (Photo 2a, b) were recorded.

Photo 1. Female dog with ear notch indicating she has been spayed (sterilised).

• The total number of puppies recorded was <5 % of all dogs seen. The puppy category was not included in the population estimate.

• For estimating health status of the dogs, each dog was assigned a score for body condition (Photo 3) and skin condition (Photo 4) through visual assessment.

![Photo 3. Dogs in the 5 categories of Body Condition assessed during the survey.](image)

![Photo 4. Dogs in the 4 categories of Skin Condition assessed during the survey.](image)

4. Mark-Resight

a. Detection probability

In any survey of animal populations, a proportion of the total is likely to be missed. A method called Capture-Recapture or Mark-Resight/Recapture (MR) can be used to estimate this missing proportion. This involves calculating the detection or sighting probability of the target species in its particular habitat, which can then be used to correct the population estimate arrived at through other counting methods such as line transects or block counts. Individual identification of the target animal(s) is essential for MR experiments. For example, in a street dog survey in Cairo, Hiby (2005) estimated that about one third of the dogs were missed during the one-time survey of sample blocks. He, therefore, corrected this count by a factor of 0.33 to approach the true population statistic.

b. Correction factor

Mark Resight of individually identified dogs was conducted in a randomly selected sub-sample (n=8) of total surveyed blocks (n=79) in order to estimate the average detection probability of dogs in Kathmandu. The correction factor thus derived was used to correct the block count estimate.

In the previous two surveys in Kathmandu, the program CAPTURE calculated the detection probabilities of street dogs from the Mark-Resight data as 0.45 (in 2006) and 0.55 (in 2010). This means that around half the dogs were missed both times. The block count population estimates were therefore corrected up a factor of 0.55 (i.e. 1 - 0.45) and 0.45 (i.e. 1 - 0.55) respectively in 2006 and 2010.

c. Number of occasions

The number of capture occasions was set at 3 consecutive days, following the exploratory analysis and protocol used in the 2010 survey when 3, 5 and 7 capture
occasion data were tested for number of days to asymptote and population closure. *For example*, during the 2010 test, the population closure assumption was violated in 11% of blocks when there were 3 capture occasions, and in more than 22% of sample blocks when 5 capture occasions were used. Similarly, the asymptote (i.e. the number of days after which no new dogs were added) was reached on Day 2 itself in one test block (however, new dogs appeared from Day 6) and only on Day 5 for the second test block. Thus, considering these factors and the limited time and resources available, the 3-occasion sampling was considered to be the best fit for roaming dogs.

![Graph showing cumulative number of dogs in 8 Mark-Resight blocks over a period of 3 consecutive days. Assumption of population closure was met in all the blocks (Program CAPTURE).](image)

**Fig. 2.** *Figure shows cumulative number of dogs in the 8 Mark-Resight blocks over a period of 3 consecutive days. Assumption of population closure was met in all the blocks (Program CAPTURE).*

d. **Sample size**

MR was conducted in a total of 8 blocks randomly chosen from among the blocks where block counts were carried out (5, 1, 1 and 1 respectively in Zones A, B, C and D). Each MR block was visited for 3 consecutive days by the survey team. Capture history matrices were built for a total of 220 individual dogs. The blocks had 27.5 dogs on average (range 11 to 39, n=8).

e. **Mark-Resight Survey period and field method**

MR surveys took place over 3 days. On the first day at each block, all dogs encountered were individually identified by physical markings and features such as sex, colour,
injury, disease symptoms, collars etc. which were also noted on the data sheet. The team then took 2 or 3 photos of the dog from different angles with a digital camera. On the following 2 days, photo sheets of the marked sample were carried by the team members to help identify repeat sightings. All dogs encountered on the subsequent days (both marked dogs as well as new dogs seen) were also photographed, and photos were cross-checked by me to verify that individual identifications of dogs were correct.

f. Program software used
The software program CAPTURE (White et al 1978) was used to estimate the street dog population in 8 sample blocks. CAPTURE computes estimates of detectability for closed populations i.e. the model assumes there are no additions or losses (e.g. demographically through birth or death; or geographically through immigration or emigration) from the population over the period of study. Closed population models are preferred for population estimation over open population models because heterogeneity in detection probabilities e.g. due to time or behavioural variation, can be accounted for and this improves estimates (Stanley and Richards, 2005). We used values from Model (h), where h = heterogeneity among animals, in the CAPTURE program which assumes that capture probabilities vary by individual animal.

g. Closure
The closure test (test statistic Z, significance level p<0.05), automatically computed by the program, attempts to determine statistically if the population closure assumption is met. If the test statistic is not significant (i.e. p >0.05), then this tends to support the validity of the closure assumption (Otis et al 1978). The population closure assumption was met in all the 8 sample blocks.
RESULTS

1. Block Count Summary, Sex Ratio and ABC assessment

- A total of 1596 dogs, including puppies, were counted during the block count survey within Kathmandu and Lalitpur City, enclosed by the Ring Road (ca. 4300 ha).
- The sex ratio of male to female dogs was 1.39 to 1, compared to 1.31 to 1 in 2006 and 2010. This translates to 1000 males per 718 females, and a population of 12973±1785 males to 9315±1282 females.
- Puppies constituted 4.6 % of the total sightings, as against <2.5% in 2010.
- 13% of the females encountered were lactating as opposed to only 2.9% in 2010.
- 47% of the females encountered were spayed (ear-notched), up from 40% in 2010 (Table 3).
- The proportion of spayed females, lactating females and pups in the 4 different zones is shown in the Fig.3. Relatively more spayed females were encountered in Zones A and B where KAT has done most of its interventions. Oddly, however, despite greater ABC intervention in Zone B since 2010, the proportion of pups was high.

Table 3. Age and sex break-up of dogs seen in the sample blocks.

<table>
<thead>
<tr>
<th>No. of blocks sampled (Area in ha)</th>
<th>No. of Males (% of total males and females)</th>
<th>No. of Females (% of total males and females)</th>
<th>No. of Females lactating (% of females)</th>
<th>No. of Females spayed (% of females)</th>
<th>No. of dogs sex unidentified (% of total)</th>
<th>Puppies (% of total)</th>
<th>Total dogs seen</th>
</tr>
</thead>
<tbody>
<tr>
<td>79 (520)</td>
<td>789 (58%)</td>
<td>567 (42%)</td>
<td>74 (13%)</td>
<td>268 (47%)</td>
<td>165 (10%)</td>
<td>75 (4.6%)</td>
<td>1596</td>
</tr>
</tbody>
</table>
2. **Mark Resight Experiment to determine Dog Detection Probability:**

   - The capture or detection probability of street dogs from the mark-resight experiment in 16 sample blocks was 0.48 *i.e.* the survey teams saw 0.48 of the dogs in a block during their one-time block count (Table 4). This correction factor (1-0.48) = 0.52 *i.e.* the proportion of dogs that were missed during a block count, was added to the block count estimate to derive the **Corrected Estimate** of the street dog population.

*Fig.3. Proportion of spayed females, lactating females and puppies seen during the block counts in the 4 survey zones.*
Table 4. Detection probability of dogs (p-hat) calculated from Mark-Resight survey in 2012, using Program CAPTURE. The population closure assumption (test statistic Z) is violated when $p<0.05$. Here, closure assumption is met in all sample blocks.

<table>
<thead>
<tr>
<th>Sl. No.</th>
<th>Block No.</th>
<th>Closure Z (Probability of a smaller value)</th>
<th>Probability of Detection (p-hat)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>30</td>
<td>0.16</td>
<td>0.50</td>
</tr>
<tr>
<td>2</td>
<td>63</td>
<td>0.36</td>
<td>0.35</td>
</tr>
<tr>
<td>3</td>
<td>121</td>
<td>0.98</td>
<td>0.44</td>
</tr>
<tr>
<td>4</td>
<td>137</td>
<td>0.33</td>
<td>0.48</td>
</tr>
<tr>
<td>5</td>
<td>165</td>
<td>0.31</td>
<td>0.45</td>
</tr>
<tr>
<td>6</td>
<td>295</td>
<td>0.33</td>
<td>0.55</td>
</tr>
<tr>
<td>7</td>
<td>545</td>
<td>0.14</td>
<td>0.47</td>
</tr>
<tr>
<td>8</td>
<td>600</td>
<td>0.50</td>
<td>0.58</td>
</tr>
</tbody>
</table>

Average Probability of Detection (p-hat) = 0.48

3. Corrected Density Estimate

- The density of adult street dogs in Kathmandu is estimated to be $5.18 \pm 0.71$ dogs/ha. (Table 5). The density figures in each of the 4 survey zones are in Fig.4. Comparison with 2006 data shows that the dog densities have declined considerably in Zones B and D while increasing slightly in Zones A and C.

Table 5. Population density of street dogs in Kathmandu and Lalitpur, within the Ring Road.

<table>
<thead>
<tr>
<th>Year</th>
<th>Mean no. of dogs/ha</th>
<th>95% Confidence Interval</th>
<th>Range/ha</th>
<th>Minimum no. of dogs/ha</th>
<th>Maximum no. of dogs/ha</th>
</tr>
</thead>
<tbody>
<tr>
<td>2006</td>
<td>7.20</td>
<td>±1.48</td>
<td>5.71 – 8.69</td>
<td>0</td>
<td>59.8</td>
</tr>
<tr>
<td>2010</td>
<td>5.24</td>
<td>±0.59</td>
<td>4.64 – 5.84</td>
<td>0.34</td>
<td>18.6</td>
</tr>
<tr>
<td>2012</td>
<td>5.18</td>
<td>±0.71</td>
<td>4.46 – 5.89</td>
<td>0.82</td>
<td>15.6</td>
</tr>
</tbody>
</table>
Fig. 4. Population density of street dogs in the 4 survey zones in Kathmandu and Lalitpur, within the Ring Road. Error bars represent 95% Confidence Intervals.
4. Corrected Population Estimate

- The total population estimate of street dogs in Kathmandu and Lalitpur City within the Ring Road limits is **22,288 ± 3067**. The comparisons with the 2006 and 2010 estimates are in Table 6 and represented graphically in Fig.5. The zone-wise break-up is shown in Table 7 and Fig.6.

**Table 6. Total population estimate of street dogs in Kathmandu and Lalitpur, within the Ring Road (ca. 4300 ha)**

<table>
<thead>
<tr>
<th>Year</th>
<th>Mean</th>
<th>95% Confidence Interval</th>
<th>Min.</th>
<th>Max.</th>
<th>Sighting probability (p)</th>
<th>CORRECTED ESTIMATE (Adult Dogs)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Mean</td>
</tr>
<tr>
<td>2006</td>
<td>19995</td>
<td>±4128</td>
<td>15867</td>
<td>24123</td>
<td>0.45</td>
<td>30992</td>
</tr>
<tr>
<td>2010</td>
<td>15555</td>
<td>±1766</td>
<td>13789</td>
<td>17321</td>
<td>0.55</td>
<td>22255</td>
</tr>
<tr>
<td>2012</td>
<td>14663</td>
<td>±2018</td>
<td>12645</td>
<td>16681</td>
<td>0.48</td>
<td>22288</td>
</tr>
</tbody>
</table>

**Fig.5. Population estimate of Kathmandu street dogs in 2006, 2010 and 2012.**
Table 7. Total population estimate of street dogs in the 4 zones of Kathmandu and Lalitpur, within the Ring Road (ca. 4300 ha)

### 2006

<table>
<thead>
<tr>
<th>Zone</th>
<th>Total Area of Zone (ha)</th>
<th>Total Dogs</th>
<th>95% Confidence Interval</th>
<th>Min.</th>
<th>Max.</th>
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<td>3322</td>
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<tr>
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<td>±4818</td>
<td>9454</td>
<td>19090</td>
</tr>
<tr>
<td>C</td>
<td>887</td>
<td>3809</td>
<td>±770</td>
<td>3039</td>
<td>4579</td>
</tr>
<tr>
<td>D</td>
<td>870</td>
<td>7527</td>
<td>±3049</td>
<td>4478</td>
<td>10576</td>
</tr>
<tr>
<td>Total</td>
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<td>30347*</td>
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<td></td>
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</table>

### 2010

<table>
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<tr>
<th>Zone</th>
<th>Total Area of Zone (ha)</th>
<th>Total Dogs</th>
<th>95% Confidence Interval</th>
<th>Min.</th>
<th>Max.</th>
</tr>
</thead>
<tbody>
<tr>
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<td>5056</td>
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<tr>
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<td>9051</td>
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<td>4594</td>
<td>±988</td>
<td>3606</td>
<td>5583</td>
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<tr>
<td>D</td>
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<td>4650</td>
<td>±2026</td>
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### 2012

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<th>Min.</th>
<th>Max.</th>
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<td>2738</td>
<td>±770</td>
<td>1968</td>
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</table>

*Discrepancies due to decimal rounding off.
Fig. 6. Population estimate of street dogs in 2006, 2010 and 2012 in the 4 survey zones of Kathmandu. Since 2010, populations show increasing trends in Zone A and B and decreasing in Zone C and D, but with overlapping confidence intervals.

5. Health Status of Dogs

a. Body Condition Index

- Majority (69%) of dogs were in healthy body condition being of normal or stout size. 30% of the dogs were thin or very thin, and 1% were overweight. (Fig. 7a).
- The zone-wise data indicates that the majority of dogs in Zones A, B and C were healthy (81, 68, 60% dogs respectively) whereas only about half (52% dogs) in Zone D could be classified as healthy. (Fig. 7b). Zone A has had the longest and most intensive welfare intervention of all zones, and these findings demonstrate that KAT interventions have greatly helped in improving the health status of street dogs.
Fig. 7a. Body condition of dogs in Kathmandu, 2012.

Fig. 7b. Proportion of dogs in 5 body condition score categories in the 4 survey zones of Kathmandu, 2012.
**b. Skin Condition Index**

- 9% of dogs were found to have skin problems ranging from mild (6%) to severe conditions (1%). (Fig. 8a).
- There was no significant difference among zones in Skin Condition with 6 – 12% afflicted and 88-94% free of skin problems in all zones; unlike in 2010, when Zone C and D had higher proportions (34 and 82% respectively) of dogs with skin problems (Fig. 8b).

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**Fig 8a. Skin condition of dogs in Kathmandu, 2012.**
6. Ownership Status of Dogs

The majority (90%) of dogs seen were free roaming street dogs, while 8% were dogs on the street but with their owners and 2% dogs wore collars but were roaming free.

Zone C had the highest proportion (11%) of dogs that were owned but were free to roam on the streets while Zone D had the least proportion of roaming but owned dogs.
Fig 9a. Ownership status of dogs in Kathmandu, 2012.

Fig 9b. Proportion of dogs in different ownership categories in the 4 survey zones of Kathmandu, 2012.
7. DISCUSSION

1. Population and density estimates

The total population estimate of street dogs in Kathmandu and Lalitpur is 22,288 ± 3067, with a mean density of 5.18 ± 0.71 dogs/ha. The numbers show no particular difference since the last census in 2010 using the same methods (Kakati 2010).

The first scientific dog population estimate from Kathmandu was done by Kato et al (2003) who reported a density of 29.30 dogs/ha, using a different Mark-Recapture model. The first systematic, city-wide population count using standardized methods was done in 2006 (Kakati 2006) with a follow-up survey in 2010. The mean densities decreased from 2006 (7.21 ± 1.49 dogs/ha) to 2010 (5.25 ± 0.59 dogs/ha). However, there has not been any significant change in the 2 years between 2010 and this survey in 2012.

It is possible that at this rate of intervention the population is currently stable. The effort may not be sufficient to sustain a continued decrease in the population. Alternatively, 2 years may be too short an interval to detect a clear pattern.

2. Detection probability

The Mark-Resight survey indicated that the average detection probability of dogs in any one block count this year was 0.48 i.e. 48% of the roaming dog population are seen, which means 1-0.48 = 0.52 or 52% are missed during the one-off block count. This is within the range of detection probabilities estimated at 0.45 and 0.55 in years 2006 and 2010; but less that the 63% detection probability estimated in Colombo (Anon., 2010) or 67% in Cairo (Hiby 2005).

3. Population trend in 4 survey zones

- Overall, in the zones (A since 2004, B since 2008 and C since 2004) where KAT interventions have been the most sustained, dog densities have increased marginally in Zone A and B and declined in Zone C. Density has also declined in Zone D where there has been minimal ABC. One possible explanation could be fresh immigration of dogs from surrounding areas into Zone A & B as numbers stabilized and territories became available, but does not explain why the same should not have occurred in Zone C.

- The mystery of declining dog numbers in Zone D remains because there has been no significant ABC conducted here. No tangible data exists on off take rates through poisoning and puppy trade cited as possible factors in 2010 (Kakati 2010).

4. ABC status assessment

Assuming that the number of spayed females encountered reflect actual proportion of dogs spayed, the year on year percentage growth in number of dogs spayed was 25%
between 2006 and 2010 (calculated using growth rate formula below). If this pace had continued, WSPA would have been on track to achieve its target of “75% of female dogs spayed by 2015” (WSPA, 2010). However, the year on year growth rate in spayings slowed to 8% between 2010 and 2012. If this rate continues, then it will take another 6 years i.e. until 2018 to achieve WSPA’s target of “75% females spayed”.

Growth Rate = \[\frac{\ln \left(\frac{N_t}{N_0}\right)}{t}\], where

- \(N_t\) = proportion at current time
- \(N_0\) = proportion at base year
- \(t\) = time period between \(N_t\) and \(N_0\) (in years).

The year on year growth rate in number of spayings have to more than double from the current 8% per year to ca. 17% per year to achieve the target of “75% female dogs spayed by 2015”.

*For example*, for every 100 female dogs spayed in 2012, the spaying effort has to increase to
- 2013 – 117 dogs
- 2014 – 137 dogs

More spayed females were encountered in zones A and B where more females had been spayed and released by KAT Centre, and fewest in Zone D where there is little ABC practiced, but there was an inexplicable dip in encounters of spayed females in Zone C.

5. **Health status assessment**

WSPA’s target of 80% dogs with no skin problems by 2011 for Kathmandu (WSPA, 2010) appears to have been reached with overall 91% of dogs free of skin disease, as well as in each of the zones separately (88 to 94%). Proportion of dogs in healthy body condition also increased from 66% to 69% between 2010 and 2012, but nearly 30% of dogs remain severely (very thin) or moderately (thin) undernourished.

6. **Ownership status**

Ownership allows dog welfare costs and effort to be shared between welfare organisations and the general public. During this survey, 90% of dogs encountered were free roaming street dogs, and 10% had owners or signs of ownership (collars). Ownership often signifies better welfare measures, vaccinations and sterilisations, as also high adult and pup survival compared to street dogs. In Colombo, almost 46% roaming dogs were estimated to be owned (Anon. 2010) (through questionnaire surveys), and it is possible that the estimate in Kathmandu may be revised up as well.
REFERENCES


