

“DOGS SEEN PER KM” MONITORING OF A DOG POPULATION MANAGEMENT INTERVENTION

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AN OUTLINE OF THE METHOD

The effectiveness of a dog population management intervention can be monitored by conducting repeated counts of dogs seen along the same city streets. The programs included in the DogDensity folder below use an Android “smartphone” to make it as easy as possible to record roaming dog counts and welfare indicators consistently along one or more standard routes across a city (also referred to below as “tracks”). The number of dogs seen per km relates well to the perceived dog “problem” because it gives the expected number that will be encountered, for example, while a citizen is travelling to work or school. The total roaming dog population is much more difficult to estimate and of no immediate relevance to most residents. It depends on how the limits of the “city” are defined and on its growth and development since the start of the intervention. Thus an intervention could be judged to have failed on the basis of total population size even if it has succeeded in controlling the average density of roaming dogs along the streets.

Counting dogs along a randomly selected route is similar in principle to the “strip transect” method of wildlife survey in that moving the observers relatively quickly along an extended line avoids double counting and integrates effectively across spatial variation in dog population density. However in this case extrapolating the counts to an estimate of total population size is not intended, instead comparisons of the average number of dogs seen per km are made over time (see later section ‘Routes as samples for estimating total abundance’ if estimates of abundance are required). The method thus depends on consistency: using one or more standard routes at a consistent time of day and year and following a standard counting protocol, for example whether or not to include dogs seen down side streets.

Counting should be from a motorcycle or car. The driver and observer are both responsible for searching for roaming dogs, ideally at least one person should be experienced at quick identification of the gender of dogs and assessing their basic health status. The observer can see the route and current position displayed on the phone by the Maps “app” and can therefore tell the driver where to turn in order to follow the route. On seeing a dog the observer switches to an event-counter app (OSMtracker) via the “home” button and taps an icon to record the dog as one of the following types:

- Males
- Females
- Lactating females
- Unknown adults
- Pups

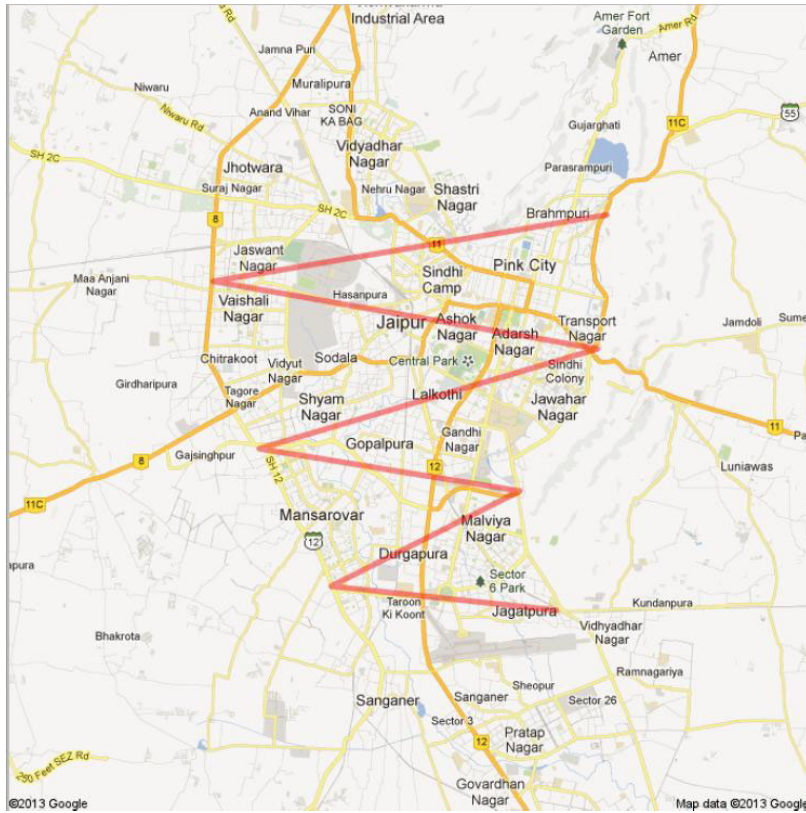
For interventions that include marking dogs, such as Animal Birth Control projects in India who traditionally ear-notch dogs whilst they are anaesthetised for sterilisation, there will be two additional types:

- Ear-notched males
- Ear-notched females

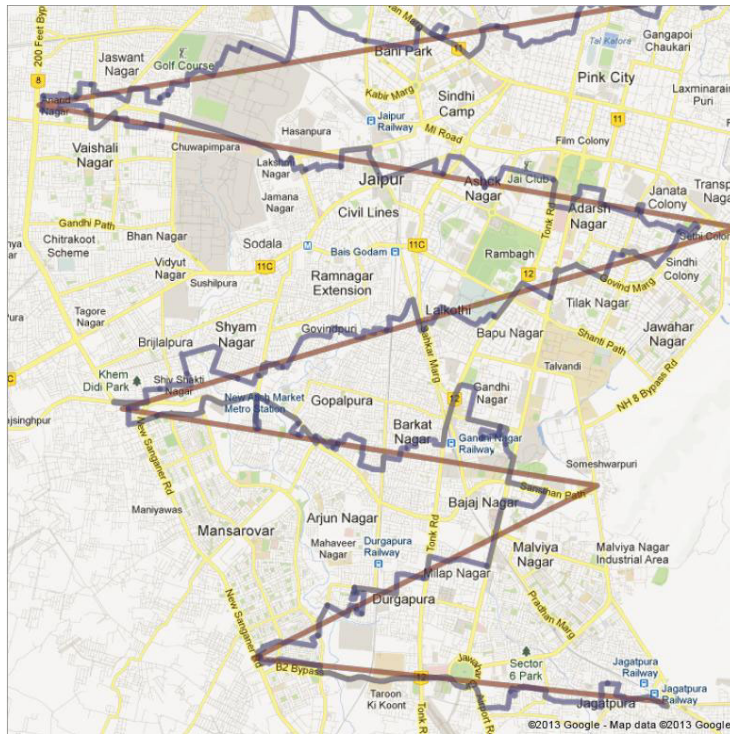
A second page displays icons for body (5-point scale) and skin condition (presence/absence). On completion of a route data are downloaded from the phone to a small offline “DogDensity.mdb” Access database, which is also in the DogDensity folder. The database stores the detail of successive surveys conducted along the standard route/s and displays the counts and welfare indicator frequency distributions. The dog sightings are also mapped, using coloured icons for dog types that match those used on the phone.

USING GOOGLE MAPS ON THE PC TO CREATE STANDARD ROUTES

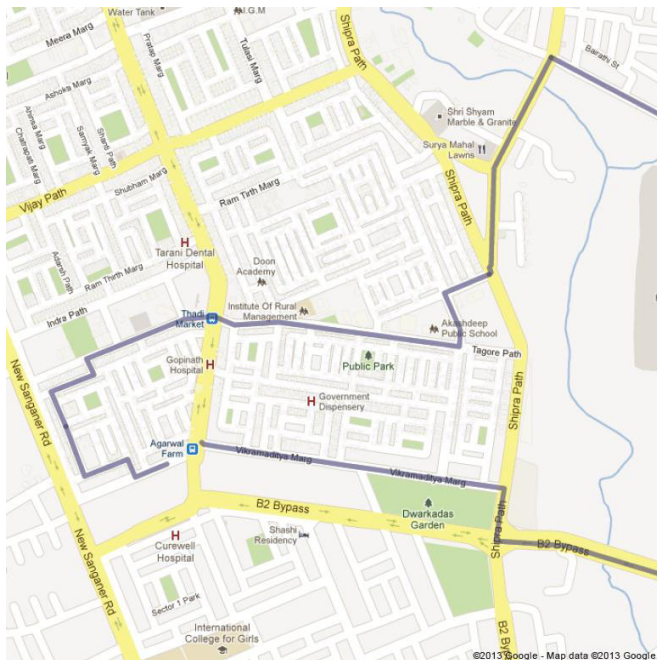
Store one or more standard routes as KML files in the DogDensity\tracks subfolder. They can be created using Google Maps on the PC (www.google.com > Maps > My places > “Or create with classic maps”). The idea is to traverse the city in a consistent direction, choosing at each junction whichever road is closest to that direction so that the route automatically includes a random selection of urban environments (residential, industrial etc.). At the city limit the direction is “reflected” to create a zig-zag route across the entire city. First a zig-zag line is drawn using the “draw a line” option. The following illustration uses a map of Jaipur city in Rajasthan:



Then using the “draw a line along roads” option the track is drawn as closely as possible to the zig-zag, in a contrasting colour:



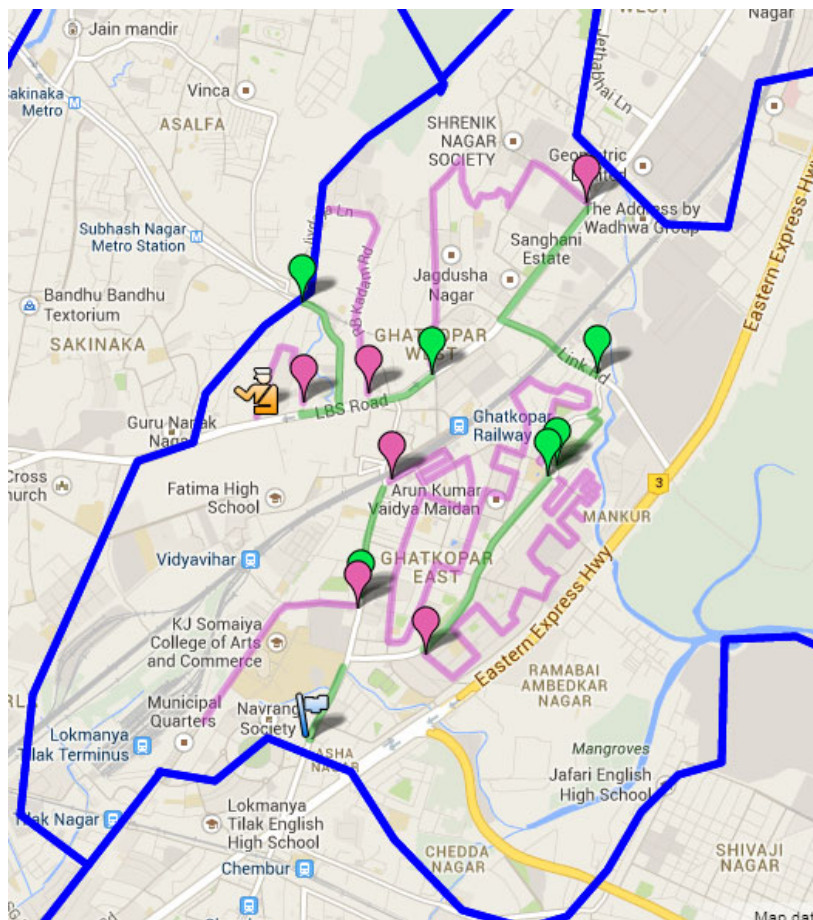
Because of one-way systems, rivers and railway lines the track diverges from the zig-zag in places, the “draw a line along roads” algorithm allowing for those obstructions while taking the shortest possible route between the last mouse-click and the current cursor position. My places reports the illustrated track length as 80km, taking about 8 hours to complete at an average speed of 10 km/hr, which can be split into 4 routes of about 20km each allowing each survey to be completed in around 2 hours at peak roaming time for dogs (usually early morning). The following map illustrates the southernmost hair-pin bend of the route at higher resolution:



The route should be surveyed at least twice at the same time of year each year, preferably more, to provide an estimate of variability against which to judge the significance of any year to year change in the average number of dogs seen per km. The route should also be checked prior to the first survey to ensure there are no obstructions that would reduce the survey efficiency and to modify the route if necessary.

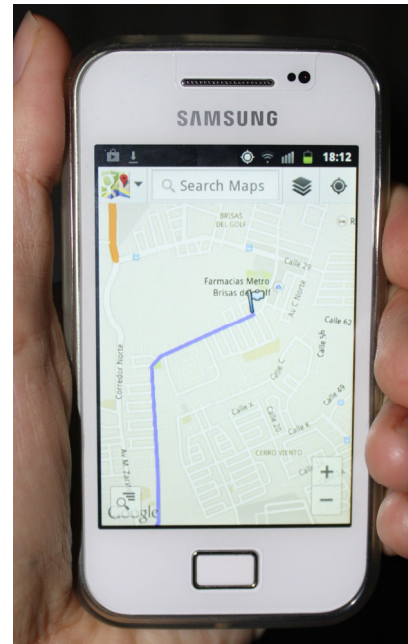
Routes can also be created within separate zones, e.g. wards. Within such a zone there will probably be insufficient space to generate an initial zig-zag track on which to base the design but try to cover the zone as evenly as possible using both highways and residential streets in the same proportion as these road types appear across the whole ward. On completion of a route, name it to reflect the location, including a number if more than one route is prepared within a zone, e.g. in an eastern city zone “east1”, “east2” and “east3”. When the map showing one or more routes is complete name the map, click “Done”, close Maps, reopen and right-click on the small “KML” icon that then appears to download the map as a KML file to the DogDensity\tracks subfolder. The KML files should then be archived to allow surveys to be repeated along the same route later.

Because of one-way systems it is important to follow a route in the direction in which it was designed. The route may also have to be split into sections to allow it to sample areas from which it is not possible to reach other areas without driving back along roads that have already been surveyed. The following image shows an example route from a ward in Mumbai. The track is split into sections with numbered pin icons (the numbers are visible when using Maps app on the Android phone) showing the start of each section. The flag icon is at the start of the track; green icons start green sections along highways; pink icons start pink sections along residential streets; and the policeman icon shows the end of the track.



DISPLAYING A ROUTE ON THE PHONE

To survey along a standard route first import the KML file of that route into a new My Places map on the PC (My Places > “Or create with classic maps” > import > browse to KML file > Upload from File). The same map will then appear in the Maps app of the Android phone if it is set to synchronise with the same Google account used on the PC (on the phone: Maps > My Places > move across to RECENT and select the map showing the desired route). If more than one Google account has been set up on the phone make sure that the Maps app on the phone is set to synchronise with the same account that was used on the PC (on the phone: Settings > Accounts and set to synchronise the phone with the correct account and Maps > menu > More > Settings > Switch Account to synchronise the Maps app with the correct account). (Tip: to delete a map that is currently in My places on both the PC and the phone delete it first from the phone using press-and-hold and selecting “Delete”, then delete it from the PC).



CONFIGURING THE OSMTRACKER APP

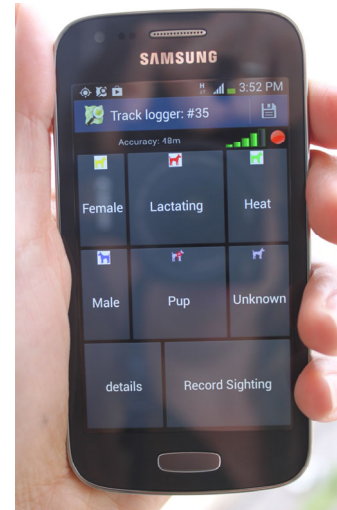
To record the dogs seen download the free OSMtracker app from the Play Store and configure it as follows. Open the app and start a new track. Wait till the phone finds enough satellites and the icons go bright, tap any one to make a record, go to Stop & Save via the phone’s menu button, then tap and hold on the displayed track and select “Save to GPX”. Close the app and connect the phone to the PC via the USB cable (drag the USB icon down the screen, tap "select to copy files to/from your computer" and tap "Connect storage to PC"; or, if using the Kies software, the connection will be automatic), then on the PC browse to the “OSMtracker” folder within the phone’s directory. Then copy the “layouts” subfolder from the DogDensity folder on the PC and paste it into the “OSMtracker” folder within the phone’s directory. Open the OSMtracker app, go to “settings” via the menu and under "Button presets" select the "survey_nophots" option. At the same time tick "Check GPS at startup", set "GPS logging interval" to 5 seconds and remove the ticks from "Background map" and from “one directory per track”. Tidy up the home screen to display only the Maps and OSMtracker apps. Disable the screen Auto rotation facility.

USING THE PHONE DURING A SURVEY

PREPARING THE PHONE

The phone should be protected by a soft plastic casing clipped around the edges and across the back and by a transparent foil across the screen and connected to a lanyard worn around the neck or attached to a buttonhole.

Open the Maps app and display the desired route as described above. Press the “home” button and open the OSMtracker app. Select “New track” from the menu. Wait for a short time for the phone to locate the satellites at which time the displayed icons will brighten and become active. If the phone fails to find the satellites within a few minutes try closing it down and reopening.



USING THE PHONE DURING THE SURVEY

Follow the standard route using the Maps app. On seeing a dog the observer switches to the OSMtracker app via the “home” button and taps the appropriate dog type icon. If body condition score (C1 to C5) or the presence/absence of visible skin infection (“Skin yes” / “Skin no”) is to be recorded (try to do this for every dog, however some dogs will move out of sight too quickly to be scored) the observer taps the “details” icon and, after tapping the appropriate body condition and skin icons, taps the “back” icon and then the “Record Sighting” icon. At that point only the latest taps within the three groups (dog type, body condition score and presence/absence of skin infection) are recorded so the observer can correct a decision by tapping a different icon before the “Record Sighting” icon is tapped.

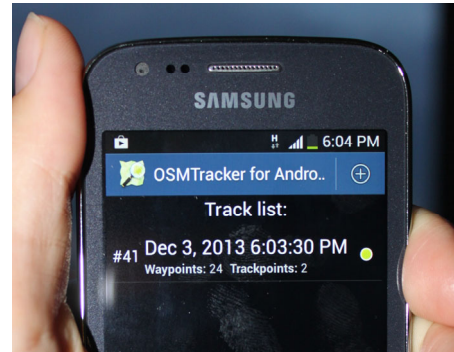
Decide and record the appropriate search protocol. For example, during a survey of Mumbai wards search was from motorcycles and in order to complete a long route in the limited time available it was decided to record a dog as “Unknown adult” if it was not possible to assess the sex and/or notched status without getting off the motorcycle to make the dog stand up.

Survey should start at dawn and stop before traffic becomes too dense, even if a route has not been completed at that time. Recording is stopped by tapping “Stop & save” from the OSMtracker menu and the time noted. Following a “Stop & save” the preceding icon taps will be saved as an OSMtracker “track” and the track name displayed on the “Track list” screen. The survey can be resumed from that point along the same route at dawn the following day by press-and-hold on the track name and selecting “Resume tracking”.

ON COMPLETION OF A STANDARD ROUTE

SAVING THE DATA ON THE PHONE

When survey along a standard route has been completed, press-and-hold on the track name and select “Export as GPX” to save the recordings as a GPX file instead of “Resume tracking”. A green dot next to the track name will show that the track has been saved successfully as a GPX file. When the track has been saved it can be cleared from the OSMtracker “Track list” display using “Delete all tracks” from the menu. Then connect the phone to the PC using its USB cable as described above.

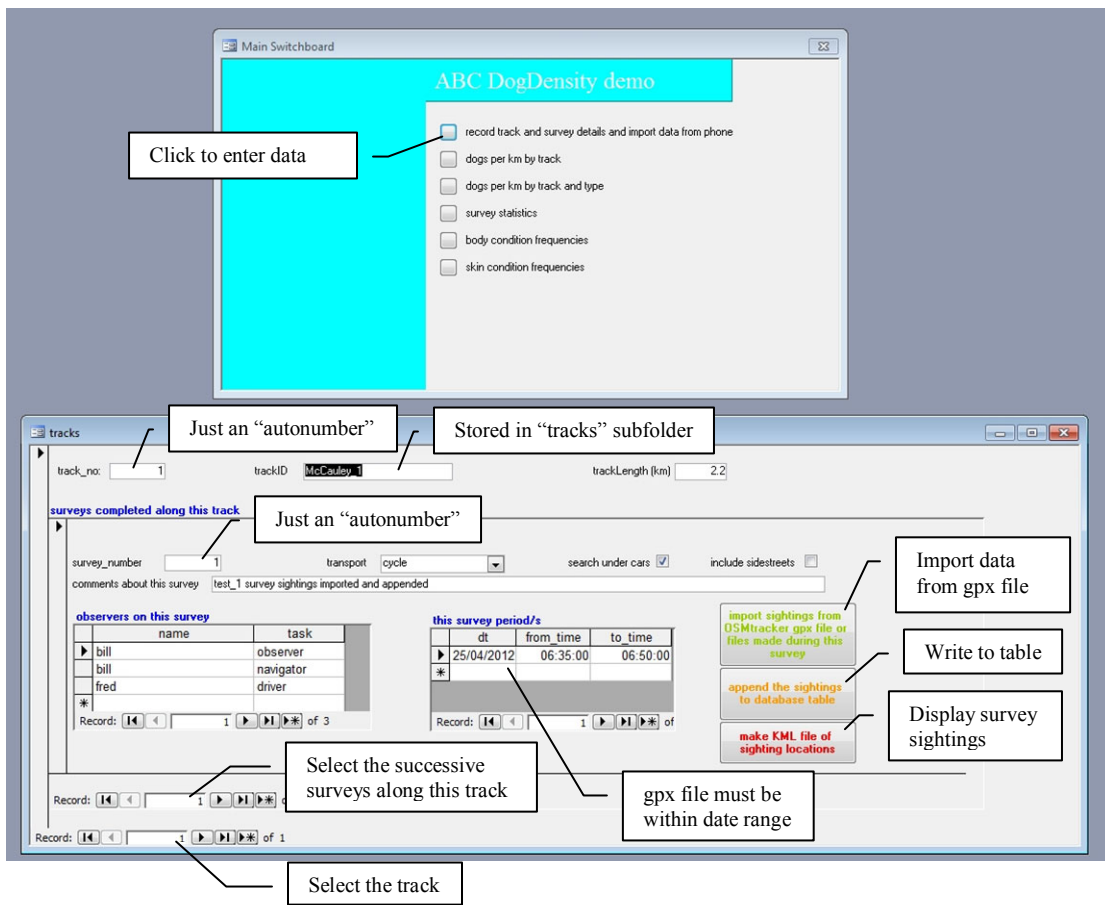


RECORDING DATA IN THE DATABASE AND IMPORTING DATA FROM THE PHONE

Next open the database by double-clicking the DogDensity.mdb file in the DogDensity folder (ignore the security warning) and a “Main switchboard” dialog will be displayed. Click the first switchboard button to open a data entry form. At the top of the form the name and length in km of each standard route can be recorded. To see some example data open the DogDensity_demo.mdb database. It includes only a single route, otherwise the “tape-recorder” buttons at the bottom of the form can be used to move through previously recorded routes, the asterisk icon at the right being used to enter a new route.

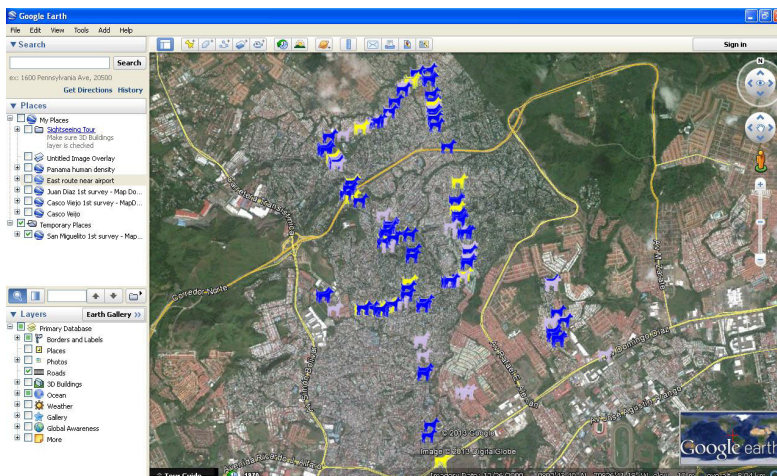
Below the route name and its length the details of surveys completed along that route can be recorded, the radio buttons at the bottom of that section of the dialog being used to move through previously recorded surveys or record a new survey. In the example database two surveys of the McCauley_1 route have been recorded, conducted almost a year apart. The fields record the mode of transport used and the protocol (in this case searching under cars but not including dogs seen down side streets) to ensure that successive surveys use the same protocol. The “observer” dialog (which appears as soon as the mode of transport has been entered) records the people involved and what they did (selected via a drop-down list), the “survey periods” dialog records the dates and times of the survey periods used to complete each survey. In the example two surveys were completed, each in a single period.

Having entered details of a new survey the green “import sightings...” command button is used to import the data from the GPX file stored on the phone to the database. Click the green button. Browse to the gpx file in the phone’s OSMtracker folder and click the “read from gpx file” command button (the GPX file will be archived to the DogDensity\save_gpx subfolder on the PC). However if the phone is connected via the Kies software first copy the files from the phone to the “demo phone” subfolder and browse to the gpx file there. Then click the orange button to append the imported records to the “sightings” table for the current survey (a check that the dates in the imported GPX file fall within the sample period dates is made at this stage).



MAPPING THE ROUTE AND SURVEY DATA

The red "Make KML file..." button is used to output a MapDogs.kml file of the dog sighting locations for the current survey. Double-clicking that file will display those locations in GoogleEarth. Double clicking the standard route KML file in the DogDensity\tracks subfolder will then display the route as well as the dog locations. Alternatively import the MapDogs.kml file followed by the standard route KML file into a My places map on the PC to show the dog locations on a map of the standard route. If you want to keep this KML file it needs to be renamed, as MapDogs.kml will be overwritten the next time "Make KML file..." is hit.



DISPLAYING SURVEY STATISTICS OVER TIME

The remaining database switchboard buttons will display for each standard route the dog counts and condition frequencies for each survey completed along that route, in survey start date order. The counts will be displayed as average number per km of street length so that the change in density over time can be assessed. The first change to be expected as a result of an intervention that includes sterilisation of roaming dogs should be a reduction in density of lactating females. The “survey statistics” button will display the average speed maintained over each successive survey to check for consistency between surveys conducted along the same standard route. Each form displays an option to export the results to an Excel spreadsheet.

ROUTES AS SAMPLES FOR ESTIMATING TOTAL ABUNDANCE

This document emphasises the use of dogs seen per km as a means of *monitoring* roaming dog density, however there may also be interest in using the route counts as samples for estimating spatial distribution and abundance. If total street length is available, either for the entire city or by ward, the dogs seen per km can be extrapolated to estimate the total number of dogs on the streets at any one time during the survey period. It may also be possible to relate dog counts to any additional information available by ward, such as housing type frequencies or socioeconomic factors, in order to derive a ratio estimator for estimating the number of dogs that would have been counted in wards that were not surveyed.

To go on to estimate the total number of roaming dogs is problematic because the population may be made up of many different types, for example unowned dogs that spend all their time on the streets to owned dogs that are unconfined for limited periods and dogs that are always seen at or near a certain location to those that roam over a large area. If it is safe to assume that all dogs are owned, then one approach is a questionnaire to estimate the total number of unconfined owned dogs in one or more sample wards and compare to the street count estimates for those wards.

Another approach is to conduct sight-resight experiments, based either on paint-marking or photographing individually distinct dogs. The simplest “Petersen” estimator uses the number of dogs marked on one day that are seen during an exhaustive search of the streets in the ward on the following day. Marking or photographing dogs towards the centre of the ward avoids the risk of marked animals having left the ward by the following day. However the estimate will almost certainly be biased downwards because of the variation in dog types: those that spend a lot of time on the streets are most likely to be marked or photographed and are also most likely to be seen again.

To address that situation (known in the mark-recapture literature as model M_h or M_{th}) requires a long series of resighting surveys during which every dog is individually identified (and thus precludes the use of paint marking). It is doubtful that the effort required involved is generally worthwhile. Nevertheless the following section explains how the phone can be used to provide sight-resight data over a number of surveys.

USING THE PHONE TO MATCH PHOTOS AND MAKE A HISTORY MATRIX

Selecting “survey.xml” instead of “survey_nophots.xml” via the “Button presets” setting will cause OSMtracker to display “take picture” and “text note” buttons in addition to the dog type icons. If the

“take picture” button is tapped the camera app on the phone will open to allow a photo of the dog to be taken at any time before “record sighting” is tapped. Any number of photos can be taken and will be stored on the PC when the data is uploaded using the green and orange buttons on the “record track...” form. Those photos can be used to identify the same dogs on future surveys and therefore generate an “encounter history” for each dog over a series of surveys over the same ward. Those surveys need to be “tied together” as a sight-resight series so if the intention is to generate an encounter history matrix then enter a unique code in the “SR_code” box (not visible in the previous image of the data entry form) for each survey in the series.

When survey data is uploaded to the PC each sighting is assigned a “match_id” as an identification number for the dog seen. Those numbers are assigned sequentially but if a dog is seen again on a later survey the match_id of that new sighting can be set to the match_id assigned previously to that dog rather than to the next sequential number. There are two ways of using the system to record a dog as one seen on a previous survey and therefore assign its existing match_id.

1. The “look for matches in sight-resight” button will display a dialog with a “SR series code” box. Select the code from the dropdown list and click the “view sightings in selected SR series” button to display all sightings in that series. Moving from row to row will display the photos, if any, taken on each sighting, so if more than one photo was taken there will be more than one row for that sighting. Suppose a photo of a lactating female had been taken during survey 2 of the series. Moving to that row will display that photo and double-clicking that photo will copy it to the right. Moving to the rows showing the lactating females seen on survey 1 will then display the photos of those dogs, which can be compared with the photo on the right. If the photo on the right shows the same dog its match_id can then be edited to the match_id assigned to that dog when the survey 1 data was uploaded. (Double-click the photo on the right to remove it.) Depending on the resolution of the camera phone and the range from which photos were taken it may be worth first cropping and resizing the dog images (stored in the “photosound” subfolder).
2. Following upload of the records and photos made during a sight-resight series survey click the “show photos of individuals on phone” button. The resulting dialog allows the photos taken during all completed surveys of that sight-resight series to be copied to the phone’s “camera” folder. The advantage is that a dog seen during a subsequent survey can be compared in real time, and thus from any angle, with those previous photos by reviewing the photos on the phone. As the photos are copied they are renamed as the dog type (e.g. “Fn” for notched female) followed by the match_id. If the free “Quickpic” app is used to scan the photos copied to the phone the new name is displayed so if a match is identified the match_id of the new photo can be set to the existing match_id of the matching photo by tapping the “text note” button before tapping “record sighting”.

Either method results in the sightings recorded during a sight-resight series of surveys to each be linked to a match_id number tying together those sightings that were of the same dog and thus to hold an “encounter history” for each dog seen. To generate an encounter history matrix (as required for example by programs MARK or CAPTURE) click the “generate history matrix” button. Each dog will generate a row of the matrix and its presence or absence in each successive survey of the specified sight-resight series will be indicated by a “1” or a blank in the column for that survey.