# Urban Wildlife Information Network

# Camera Study Design

# Mission

A primary goal of the Urban Wildlife Information Network (UWIN) is to gather and share data so that partners can quantify differences in the composition of urban wildlife communities both **within** and **among** cities. To achieve this goal, guidelines for study design, data collection, data processing, and data management must be met so that comparisons can readily be made between partners. This document provides such guidelines and outlines the minimum methodological requirements for UWIN partners so that data is systematically collected and able to be compared between partnering cities.

This document is designed to walk UWIN partners through the methodology of our camera trap study. It is intended to be a guide that you can refer to throughout the research process, however it is not your only resource! We are here to help you: contact the UWIN coordinator through their email (currently Kim Rivera krivera@lpzoo.org) or uwin@lpzoo.org, or the Executive Director for UWIN (currently Seth Magle SMagle@lpzoo.org) with any and all questions.

# Site Selection

In their respective cities, UWIN partners will place camera traps along transects that capture gradients of urbanization to quantify how urban systems affect the habitat dynamics and distribution of wildlife (see appendix 1 for an example transect layout). A transect design is used to ensure consistency between partners and to encourage sampling of all the types of greenspaces that exist with the city. A minimum of one linear transect is necessary in each city, but multiple transects may (and often will) be used. When deciding between a single or multiple transects UWIN partners should consider:

(1) The spacing of the urban-rural gradient in their city and the corresponding length of the transect
(2) The number of camera traps available

Each transect should be long enough to sufficiently capture the urban to rural gradient in your city (Table 1; modified from Marzluff et al. 2001). These quantities can usually be calculated from existing, freely available land cover data and GIS software (e.g. USGS LULC data; QGIS). If it is not possible to use GIS software to determine a point at which a city becomes rural, examine the landscape in Google Earth and use your judgment as an ecologist. We are happy to offer GIS support and/or advice to help with this process.

| Term | Percent built | Building density |
|---|---|---|
| **Rural/ exurban** | 5-24 | < 2.5 / ha |
| **Suburban** | 25-50 | 2.5 – 10 / ha |
| **Urban** | > 50 | > 10 / ha |

*Table 1. Standardized terms that describe major points along the urbanization gradient. We define percent built as the proportion of impervious surface within a 2 km buffer. While these reference points are reported at a 2km buffer, they are often highly correlated to measurements at smaller scales (e.g., 1 km buffer). Thus, you could still calculate these metrics at 1 km and use these reference points to determine what part of the urbanization gradient a possible site is. Table modified from Marzluff et al. 2001 pp. 11.*

To ensure statistical rigor, the number of sites sampled should be a function of how detectable and rare wildlife species are (Mackenzie & Royle 2005; Graeme et al. 2014). To accommodate the varying levels of detectability and occupancy of urban wildlife species, we suggest a minimum of 30 to 35 locations be sampled to appropriately parameterize statistical models (e.g. multi-season occupancy models). One camera trap should be set per site. Sample more sites if you have the ability to (i.e. have access to additional camera traps, time, personnel, varying research questions, etc.). Collecting data at 30 to 35 sites will provide comparable data for many of the most common urban wildlife species (e.g. raccoons, coyotes), however, additional sampling would likely be necessary ( > 60 sites) if you are specifically interested in collecting reliable data for rarer or more elusive species (e.g. large carnivores).

Camera traps should be placed within 2 km of a linear transect and are spaced at least 1 km away from each other (Fig.1). As such, two or more camera traps could be placed within the same habitat patch if the patch is sufficiently large. To evenly sample the urban-rural gradient, determine the types of potential habitats present along the transect and choose sites that best reflect the range in habitat patch size and land use types within your gradient. Use a pseudorandom sampling design to identify sites when possible. For example, in Chicago, we sample along three 50 kilometer transects that originate from a central point downtown and radiate outwards in different directions (Appendix 1). We split each transect into 5 km segments and randomly selected a maximum of 4 accessible sites within each segment. Within each site, a random point was selected using GIS software. We then attempted to find the most suitable camera trap location closest to the point, though in some cases landowners or site managers requested the camera be placed in a specific location.

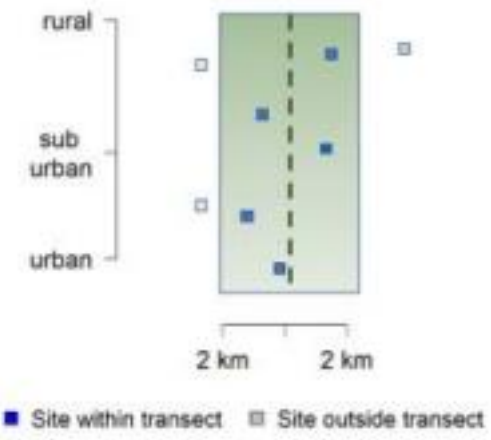



*Figure 1. Potential sample sites are within 2 kilometers of the transect line and are at least 1 kilometer apart from one another. The green rectangle is a 2 kilometer buffer around the dotted transect line, which follows a gradient of urbanization.*

Delineating a transect is a complex process, as cameras need to be placed in locations where there are sites that are both scientifically appropriate and logistically feasible. Potential site types include city parks, cemeteries, forest preserves, golf courses, or private land, but any space used as wildlife habitat within your region likely qualifies. Transects do not need to follow a straight line and could instead follow

other geographic features, such as a river or a road. When beginning to select sites, consider the feasibility of gaining permission or permits, ease of access, safety for equipment and field technicians, and availability of adjacent structures such as trees or fence posts to which you can attach the cameras. For some public green spaces, you may be able to use Google Street view to get some ideas of locations before scouting sites in person.

An ideal location for a camera trap has a medium size tree or post with little ground vegetation in front of the lens (to limit images of moving grass/vegetation). For partners who use bait/lure (more on this in next section), and ideal locations will have two trees spaced 3-5 meters apart with little ground vegetation between the trees to avoid triggering the camera each time the wind blows (see figure 2). Objects like gates and poles can be used in place of trees to support the camera trap. This location selection process can be easily modified by UWIN partners to accommodate the intricacies and size of their cities and the sites available for sampling.


*Figure 2. An example site setup. (1) Wrap cords to keep them tight against the tree. Use pieces of wood to prop the camera at the correct angle; (2) Choose a site that has minimal vegetation between the camera and the [optional] lure to prevent windblown vegetation from falsely triggering the camera; (3) Ensure a stable object (tree, pole, fence, etc.) is within 3-5 meters of the camera to use for holding the [optional] lure in place.*

Since the number of sites you monitor are only a small fraction of the total available wildlife habitat, you must not exclusively select sites based upon pre-existing knowledge of a particular species' occupancy, as doing so would lead to biased estimates. While it is acceptable to sample habitat patches where you have done prior work, the motivation for sampling in a given patch should not be because you know species x, y, or z are present or absent. Bear in mind that sampling low-quality habitat is also critical if we are to understand overall distributions of species.

# Using Bait/Lure

While UWIN originally encouraged the use of lure, we have a far more nuanced view on it's use today. This is because in 2018 we quantified how much lure increases the detection probability of different mammals throughout Chicago and found that lure had a negligible effect on how many days species were detected, how quickly they were detected, and how many images we collected. In fact, the presence of lure could even decrease how detectible some prey species are, such as squirrels or rabbits. As a result, many partners stopped using lure around this time. For more details on this study see:

Fidino, M., Barnas, G. R., Lehrer, E. W., Murray, M., and Magle, S. B. (2020). The influence of lure on detecting mammals with camera traps. *Wildlife Society Bulletin*, 44(3):543–552.

# Moving a Camera Post Site Selection

Sites may change over time, requiring adjustments to where the camera is set up. A camera can be moved up to 100 m and still be considered the same site. As such, a new camera location name is not necessary. However, if a camera is moved further than 100 m, this is considered a new camera location and should be tracked under a new site location name with updated coordinates. An updated site name can simply be [original site name]2 with an abbreviation of [original abbreviation]2. For example, one of UWIN's Chicago sites, Humboldt Park (abbreviation D02-HUP1) saw continued theft, so researchers moved the camera to the other side of the large park, 200 m away. This camera location was given a new site abbreviation of D02-HUP2. Another Chicago site, Bloomingdale Trail (abbreviation D02-BMT1) underwent landscaping which meant the camera needed to be moved about 40 m away from the original spot. As a result, the site abbreviation was kept as D02-BMT1.

# Alternate: Grid Design

In some cases when the spatial extent of the urban gradient is small enough and investigators have enough cameras to sample a greater coverage of their city, a grid design may be appropriate. In these cases we suggest first laying down a grid of points across the area of interest. We suggest 1-2km apart. The grid will offer a level of randomness that will reduce spatial bias even if you have to place a camera at a specific spot within a green space out of convenience.

*Figure 3. Example grid of regular points placed 2km a part in the Washington, DC*

Next, spatially join each point with the nearest habitat patch/green space. The habitat patches associated with each point will then become your initial sample of study areas.

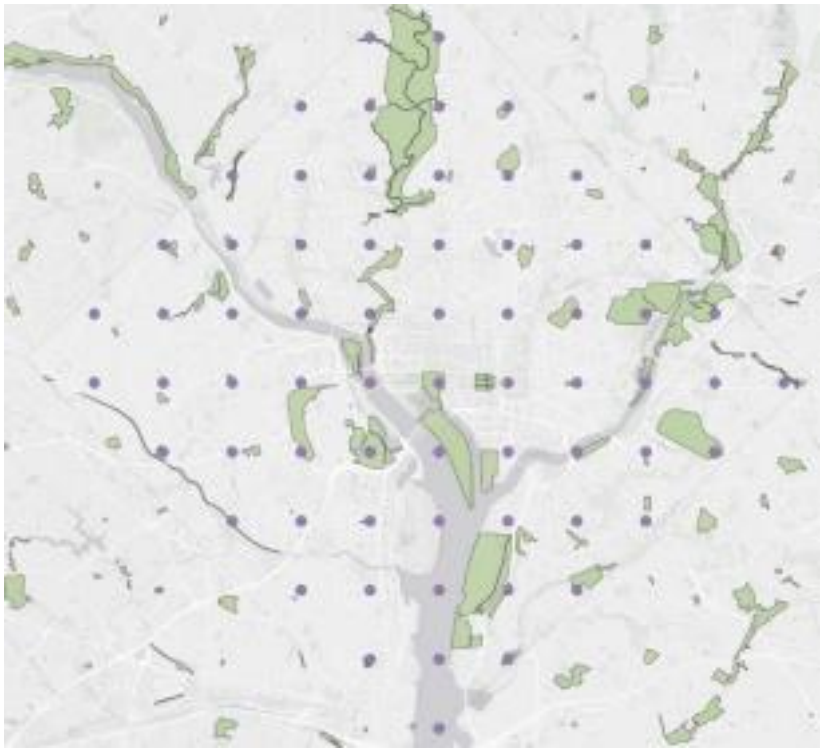


*Figure 4. Original grid of regular points and associated habitat patches in the Washington, DC metropolitan area.*

In some cases, a patch may be associated with more than one grid point. Therefore, you may end up with fewer patches than original grid points. Once you have your initial set of habitat patches, put a random point in larger habitat patches or choose the centroid of smaller patches as your camera location. In many cases, this may be more sites than you are able to sample. If you wish to reduce the number of sites, we suggest selecting a subset of your larger sample using a stratified random sampling design. For example, you can calculate impervious cover around each site and randomly choose a set amount of sites from different bins of impervious cover.

# Data Collection Methods

Collecting camera trap data:

1) Cameras are recommended to be set over four seasons in January, April, July, and October
2) Check the camera trap two weeks after set up. During a check, replace the full SD card with a fresh one, check if batteries need changing and make any adjustments to the camera trap. Be sure to download all pictures into the online UWIN database upon returning to your office.
3) Pull the camera two weeks after the camera check. During a camera pull, remove camera and all other equipment from the site. Be sure to download all pictures into the online UWIN database upon returning to your office.

*Some partners sample year-round or for less seasons based on project aims and staffing availability. These collection methods are acceptable but should be communicated with the UWIN coordinator and director. Remember that sampling year-round will require much more data entry, data storage, and processing time.

Each camera trap is generally placed at each site for approximately 4 weeks per sampling season (i.e. spring, summer, fall, and winter). We sample 4 seasons per year and prefer that partners do the same, but fewer sampling periods are acceptable as long as data is collected during the same period as other UWIN partners (e.g. summer sampling is conducted in July). Longer sampling periods are not a problem if data collected out of the UWIN seasonal periods are intended only for local use, since the data would not be comparable across partners. In these cases, the data that overlap with UWIN collection periods would be subset to make cross-city comparisons.

Each individual camera trap should be given a unique identifier so that the camera's functionality can be tracked throughout the study. Relevant metadata to collect for each camera trap includes the year the camera was built (as this may influence the trap's ability to detect species), its make, and model. It is imperative to track the camera that was set out at each site so that UWIN partners can easily query these data if necessary. The UWIN database allows users to record information related to camera model, camera deployed at a site, and all metadata related to a camera location (see the Data Entry Overview section on page 12).

*Figure 5. Example of well-used memory card*

Since camera traps are given a unique identifier (e.g., CHIL 103) we place a matching label on the memory card that is inserted into the camera. This allows us to match the memory card with the site when we download photos in the office. To do so, we place a small sticker on each SD card and write the unique camera ID on the sticker before placing it in the camera when we 1) deploy it at the beginning of a season and 2) when we replace the memory card halfway through a season with a new one. We use the same label for numerous seasons, crossing off what was previously written (Figure 3).

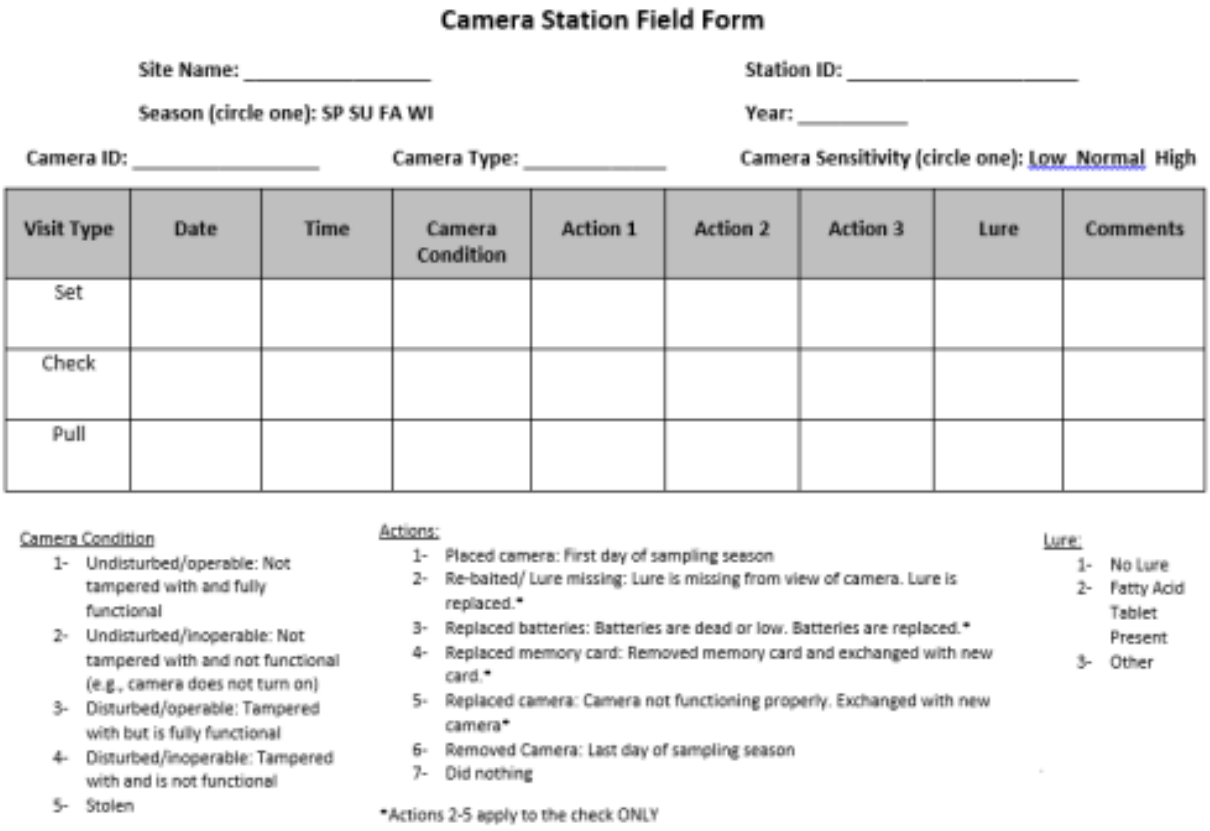
UWIN partners may *optionally* use a scent lure placed 3-5 meters in front of the camera. We recommend the fatty acid tablets purchased through the USDA Pocatello Supply. The lure is non-toxic and increases the probability of detecting species which are near the camera, but may not necessarily walk in front of the lens independently. If you choose not to use lure, be sure to check that your camera is still angled toward a spot 3-5 meters from the camera so that wildlife close to the ground will be captured. The UWIN database asks users to record whether or not lure was used at each camera deployment so lure presence can be factored into multi-city analyses.

When you are first setting up cameras, it is helpful to take a look at a few 'practice' pictures before leaving the camera for the season so that you can immediately make any adjustments to the orientation. Over time you should be able to just look at the angle of the camera to determine if the lure or proxy spot is within the viewshed and adjust from there.

# Field Forms

The next page holds a copy of the camera station field form that partners can use and adapt for their fieldwork. We also have this form as a word document that can be edited to fit your own needs at urbanwildlifeinfo.org/. In Chicago, we downloaded this form onto an online form application. This allows us to log data on-site in the field via tablets, making the workflow more efficient. This is an option for all partners, but not required. There are a few options of form platforms available, including Streebo, FastField, IForm, FormStack, Zoho Forms, and Appenate. The main requirements for a digital form

platform is that it has offline functionality, so that when you are in the field you can log data and uploaded once you return to Wi-Fi.



**Camera Station Field Form**

**Site Name:** _____ **Station ID:** _____

**Season (circle one): SP SU FA WI** **Year:** _____

**Camera ID:** _____ **Camera Type:** _____ **Camera Sensitivity (circle one): Low Normal High**

| Visit Type | Date | Time | Camera Condition | Action 1 | Action 2 | Action 3 | Lure | Comments |
|---|---|---|---|---|---|---|---|---|
| Set | | | | | | | | |
| Check | | | | | | | | |
| Pull | | | | | | | | |

Camera Condition
1- Undisturbed/operable: Not tampered with and fully functional
2- Undisturbed/inoperable: Not tampered with and not functional (e.g., camera does not turn on)
3- Disturbed/operable: Tampered with but is fully functional
4- Disturbed/inoperable: Tampered with and is not functional
5- Stolen

Actions:
1- Placed camera: First day of sampling season
2- Re-baited/ Lure missing: Lure is missing from view of camera. Lure is replaced.*
3- Replaced batteries: Batteries are dead or low. Batteries are replaced.*
4- Replaced memory card: Removed memory card and exchanged with new card.*
5- Replaced camera: Camera not functioning properly. Exchanged with new camera*
6- Removed Camera: Last day of sampling season
7- Did nothing

*Actions 2-5 apply to the check ONLY

Lure:
1- No Lure
2- Fatty Acid Tablet Present
3- Other

*Figure 6. Example field form*

## Site Overview Information

Site Name: _____ Site Abbreviation: _____

Landowner: _____

UTM East: _____ UTM North: _____ UTM Zone: _____

Location Description:

_____

_____

Parking Information:

_____

_____

Contact Person: _____ Contact phone: _____

Special Instructions:

_____

_____

Comments:

_____

_____

Is this a replacement Site? Y / N

What did it replace: _____

*Figure 7. Example site overview*

# Equipment

Bushnell trail cameras tend to be relatively low-cost while meeting performance standards for UWIN research. Network partners are welcome to use different models if they already have them, so long as they match or outperform the technical specifications of the Bushnell camera traps (Appendix 2), record date and time, and can take photos in infrared. The settings we use on Bushnell camera traps are listed below (Table 2).

| Set Mode | Settings |
|---|---|
| **Mode** | Camera |
| **Image Size** | 4K pixel |
| **Capture Number** | 1 photo |
| **Video Size** | NA |
| **Video Length** | NA |
| **Interval** | 30 sec |
| **Sensor Level** | Normal |
| **Format** | Execute (format memory card every time before deploying camera trap or when replacing memory cards during a season) |
| **Time Stamp** | On |
| **Set Clock** | 24 hr, year-month-day. Must be set accordingly. |
| **Default Set** | Cancel |

*Table 2. Settings to use for Bushnell motion-triggered infrared Trail Cameras.*

Additional equipment for deploying a camera trap includes a metal security case, cable lock, 8 rechargeable batteries, a battery charger, and 2 GB SD cards. The entire setup costs approximately $200 per camera. Since some rechargeable batteries need to be changed at the camera check (especially during the winter), we recommend purchasing batteries for 1.5x the number of cameras. While it is possible to download photos in the field, it requires bringing laptops or IPads with sufficient storage or cloud storage capabilities and slows down field work substantially. We therefore recommend bringing a cleared memory card to the site and switching that card out with the full memory card on site. Taking SD cards to your office and downloading pictures then is the easiest and fastest method. Thus, we recommend purchasing SD cards for 2x the number of cameras.

To help prevent theft and community concern, we recommend placing a label on each camera case. These labels should include brief information on the project, the organization leading the monitoring effort, and contact information in case anyone would like to learn more (e.g. “Wildlife Research in Progress; Please Do Not Disturb; Lincoln Park Zoo; For more information, please reach out to research@lpzoo.org”). This can also be done using a QR code or sticker.

Lastly, if you are using lure in your study design, we recommend purchasing lures for 1.5 times the number of cameras to account for missing lure pouches during the check (usually taken by raccoons or coyotes). We do not replace a lure unless it is missing at the check.

# Applying Camera Settings


*Figure 8. Interior of Bushnell TrophyCam*

1. Turn camera on to “SETUP” mode (middle setting between ON and OFF)

2. Press the MENU button on the right hand side

3. Scroll through the menu using the < and > buttons. The ^ and V buttons allow you to change a setting while the < and > buttons scroll through the menu options.

4. To change a setting once you have selected it you must push the OK button.

5. Most settings can be changed by scrolling to the appropriate section, pushing the up or down button to select the appropriate setting, and then hitting OK. However, formatting (“Execute”) and setting the date are a little different

6. To format the card, scroll to the format section, hit OK to “Execute”, select Yes, and hit OK again.

7. To set the date, scroll to the set clock section, hit OK, set the date and time (24 hr), and hit OK again

8. Once you have returned to the first menu option, press the MENU button to exit and verify that the date and time are correct, the memory card is empty (0/xxxx) and that the memory card is not locked (the symbol shaped like a memory card should not have a small lock in it). To unlock the memory card turn off the camera trap, remove the memory card, and push the small slider on the side so that it is closest to the top of the memory card (pictured below).

9. Switch camera to the ON position (don’t forget!) and you are ready to go. Infrared sensor will blink 3 times and will then start taking photos every 30 seconds if there is constant motion.

# Data Entry Overview

The Urban Wildlife Information Network provides an online database created specifically for the network. This cloud-based tool allows users to store, manage, and tag camera trapping photographs in a consistent manner across all participating cities. The online tool can be found at http://www.urbanwildlifenetwork.org/. To access the application, you must have a Google account. A global admin (UWIN coordinator at their @lpzoo.org email, uwin@lpzoo.org, or Mason Fidino at mfidino@lpzoo.org) will provide you will access to the webpage. An in-depth guide to the UWIN data management tool can be found on our website: https://www.urbanwildlifeinfo.org/


*Figure 9. Slider should be set like this so that the memory card is not locked (i.e. you can save photos to the card).*

# Tagging photos via community science

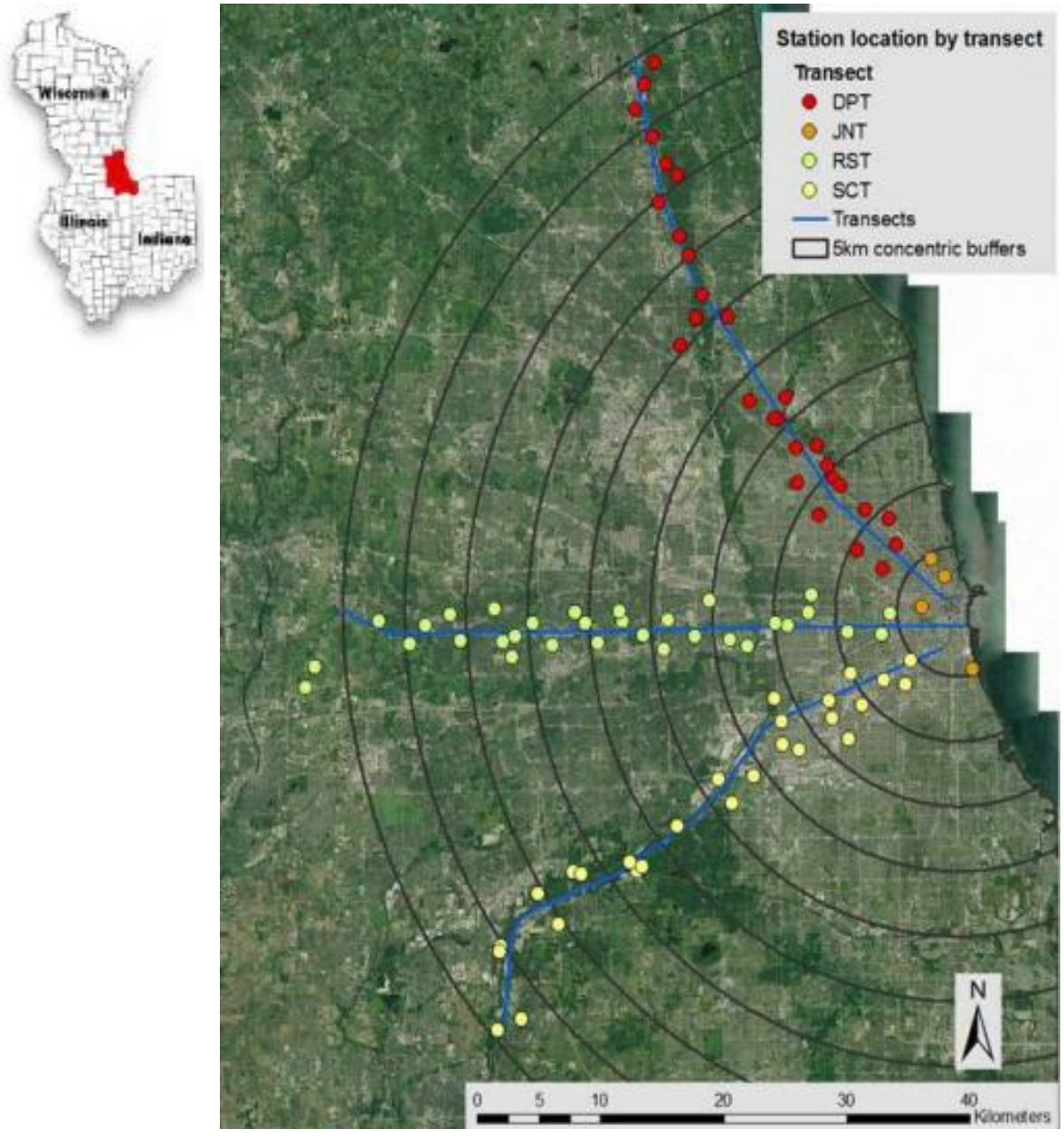
While the UWIN database is an efficient tool for uploading, tagging, and summarizing camera trap data, there are other avenues that can be taken to tag photos. Zooniverse allows researchers to build their own community science projects where photos can be uploaded and made accessible for community scientists to process. Zooniverse projects require researchers to construct a work task (e.g. assigning species detections to photos), upload photos, and engage with the community (e.g. taking part in the project's forum and writing blog posts). Creating a Zooniverse project does require some technical skill, however, here in Chicago we have code that can be modified by other researchers to help in creating their own site. Keep in mind that successful community science projects do require a significant amount of community engagement, and some photos will still need to be verified by experts.

# Conclusion

This document is intended to be an outline of the UWIN camera trap study design. If you need or want to make adjustments for your location, check in with the UWIN director (Seth Magle) and UWIN coordinator to ensure you would maintain adequate methodological consistency. We are open to city-specific alterations. Most importantly, thank you for your interest in UWIN! With your help, we are building the largest coordinated dataset of urban wildlife research! Again, please do not hesitate reach out with questions, concerns, or suggestions. We look forward to seeing the data you collect and the education, publications, and knowledge that will come out of your contributions.

# Appendices

Appendix 1. An example transect set-up. Sites sampled along the three transects in greater Chicago Metropolitan area. As the three transects originate from the same point, we only sampled four sites within the first 5 km segment between all transects to keep distances between sites > 1 km.



Appendix 2. Technical specifications of Bushnell motion-triggered camera traps (Model #119436C)

## TECHNICAL SPECIFICATIONS

| | |
|---|---|
| **Image Sensor** | 3 Megapixel Color CMOS |
| **Maximum Pixel Size** | 4624x3468 (16 MP) |
| **Lens** | F = 2.8; FOV=38°; Auto IR-Cut-Remove (at night) |
| **IR-Flash Range** | 36'-100' (12m-30m) |
| **Display Screen** | Std B&W Display: 24x32mm(1.5") |
| **Memory Card** | SD or SDHC Card, Maximum capacity 32GB |
| **Internal RAM** | 64MB |
| **Picture Size** | HD=1920x1440, 4K=3840x2880, 16M=4624x3468 |
| **Video Size** | 1280x720, 640x360 |
| **PIR sensitivity** | PIR with 4 sensitivity levels: Auto/High/Normal/Low |
| **Operation** | User selectable: 24 Hour, Day only, or Night only (based on ambient light level) |
| **Response Time** | 0.3 sec |
| **Triggering Interval** | 1 sec. - 60 min. programmable |
| **Shooting Numbers** | 1 – 3 programmable |
| **Video Length** | 5-60sec. programmable (15sec max for night video) |
| **Power Supply** | 8xAA required |
| **Stand-by Current** | < 0.08mA (<7mAh/day) |
| **User Interface** | LCD display |
| **Interface** | USB; SD card holder |
| **Security** | Strap; ¼-20 attachment |
| **Operating Temperature** | -20 - 60°C (Storage temperature: -30 - 70°C) |
| **Operating Humidity** | 5% - 90% |