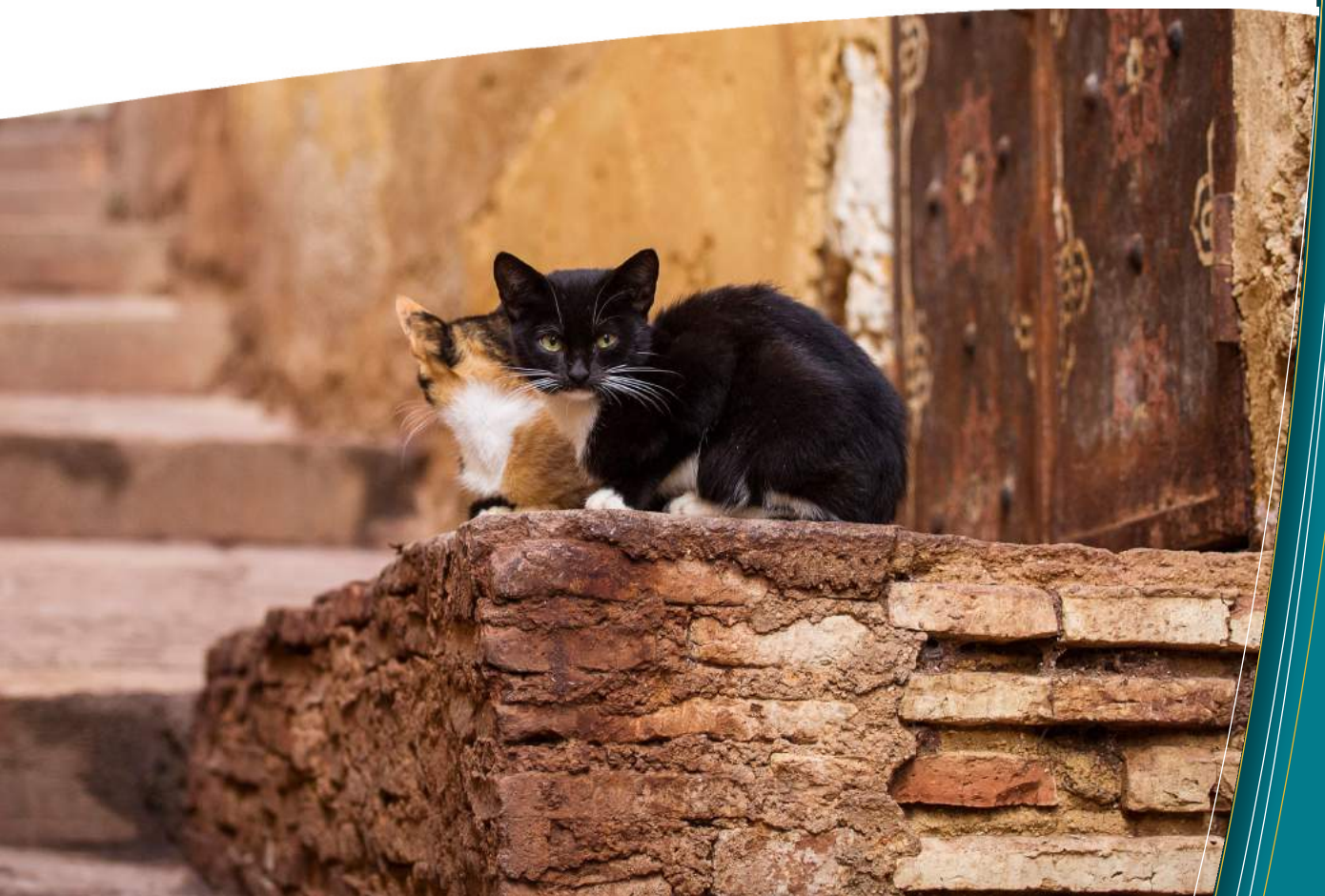
ACC&D
Alliance for Contraception in Cats & Dogs

# COUNTING CATS

## What it is, why we need it, and how to do it in your community



# COUNTING CATS

What it is, why we need it, and how to do it in your community

## Contents




Prepared by the Alliance for Contraception in Cats & Dogs (ACC&D)

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**April 2022**

*(Fully updated; based on guidance originally published by ACC&D in 2014.)*

The publication of *Counting Cats* was supported by a grant from the Kenneth A. Scott Charitable Trust, a KeyBank Trust.

## I. PURPOSE

This document describes how you can collect data (i.e., "count cats") to support, inform, and improve spay/neuter-based management programs for free-roaming cats. Cat counting provides these programs with the data they need for objective impact assessments, for measuring progress, and for identifying ways to improve program effectiveness. Throughout the document, words and phrases in bold type are defined in call-out boxes.

## II. INTRODUCTION

**Trap-Neuter-Return** (TNR) and its variants (e.g., **Trap-Neuter-Vaccinate-Return** (TNVR) and others) are well-known methods of managing **free-roaming cat** (FRC) populations. To its advocates and practitioners, TNR offers a welcome alternative to traditional lethal methods of population control, with the added benefits that it can improve the health and well-being of FRCs, alleviate suffering, and prevent unwanted litters of kittens. However, other groups, including some conservationists and public health officials, have questioned the efficacy of TNR for FRC population management. This disagreement has led to extended debates and conflicts about FRC management and policy.

The only way to objectively answer questions about the effectiveness of TNR for population management is to directly measure how FRC populations respond to TNR – in other words, to "count cats." The Alliance for Contraception in Cats & Dogs (ACC&D; acc-d.org) has long promoted cat counting as a critical component of "best practices" for TNR projects. Towards this end, ACC&D has prepared this guide to help you start counting cats.

In this guide you'll learn about:

- The importance of goal-setting for your TNR project
- Key cat counting concepts and techniques
- Differences between cat counting for smaller projects versus larger projects
- Different options for recording cat counting data
- Basics about more advanced topics, like data analysis and estimating population size.

ACC&D believes that wider and routine use of cat counting in TNR projects will improve their effectiveness and impact, allow groups to better document and promote their successes, and facilitate more constructive and informed engagement and collaboration with diverse stakeholder groups. We hope that this guide will help you to get started!

### DEFINITIONS

**Free-roaming cat (FRC):** Any cat that has unrestricted access to the outdoors. Some FRCs are unowned "community cats," others may be pet cats, and still others may be truly feral.

**Trap-Neuter-Return-Monitor (TNRM):** Like TNR or TNVR, with the addition of explicit, ongoing monitoring of FRC numbers in a particular area to enable adaptive management and ensure optimal outcomes from your TNR efforts. This guide advocates for monitoring of FRC populations as part of any TNR-based project, whether or not the terminology "TNRM" is used.

**Trap-Neuter-Return (TNR):** A series of activities in which FRCs are live-trapped, sterilized, and returned to their point of capture. Often, cats who undergo TNR also receive supplemental food and shelter from community-based caretakers on an ongoing basis.

**Trap-Neuter-Vaccinate-Return (TNVR):** Like TNR, but FRCs are also vaccinated after capture and before being returned to their original location. Other variants of TNR also exist that differ regarding the specific type(s) of care and services provided. For instance, some variants do not release kittens back into their original location, but rather adopt them to new homes.

## III. RELATED RESOURCES

Two resources will significantly supplement and complement the cat counting guidance and recommendations in this document. We encourage you to consult both.

- ***From computer models to communities: Strategies to better manage free-roaming cat populations***: This strategic guidance document is based on ACC&D-facilitated research to predict the likely responses of FRC populations to different kinds of management. Its recommendations will help you to design your TNR project to offer the best chance of achieving your longer-term goals as quickly and cost-effectively as possible. It also includes guidance to help you estimate cats in your population and how many you should aim to sterilize to achieve your goals. While it's extremely useful to design projects based on their *anticipated* outcomes, you'll still need to measure the *actual* outcomes of your project using the cat counting approaches described below.

- **DC Cat Count Toolkit**: The DC Cat Count is a recently completed three-year project that took a "deep dive" into cat counting techniques. The project's findings and recommendations are available in an online toolkit that describes various aspects of project planning, cat counting, and data analysis. We suggest that you use the current document as your introduction to cat counting, and then refer to the Toolkit for more in-depth and technical information as needed. In the sections below, we provide links to relevant Toolkit pages that provide this additional detail.

## IV. GOAL SETTING

Setting realistic, clear, and measurable goals for your project is a critical but often overlooked prerequisite for success. Taking the time to think through and formalize your goals will improve your project's efficiency, optimize its outcomes, and enable you to authoritatively document your achievements to your organization, to your supporters, and to your community. A well-constructed set of goals will specify:

1) "Outcome" goals, which describe the positive change(s) you want to see happen as a result of your efforts.
2) The precise location, or **target area**, within which you want to achieve your outcome goals, and the **target population** of FRCs that will benefit from your project.
3) How long you expect it to take to achieve your outcome goals.
4) "Procedural" goals, which are the activities you will perform towards achieving your outcome goals.
5) "Cat counting" goals, which describe how you will measure progress towards your outcome goals and document your impacts using cat counting.

Here's an example of a well-structured set of goals for a hypothetical project in Washington, D.C. Compare this statement of goals to the five criteria for goal-setting just above, and you'll see that it covers all the bases:

> Our outcome goal is to reduce the number of FRCs in the 20019, 20020, and 20032 zip codes of Washington, D.C. by 50% or more over eight years. Our procedural goals for accomplishing this outcome are to conduct targeted TNR, with up to 2,500 surgeries per year. Additionally, kittens under the age of 9 months will be retained for adoption to the extent possible given shelter capacity. To measure progress, our cat counting goals are to conduct standardized counts along 12 randomly placed transects every six months, and to analyze resulting data annually to assess the current sterilization percentage and any changes in population size. Procedural goals may be adjusted if these data show insufficient progress towards the outcome goal.

We stress that in order to effectively use cat counting, you need to create one or more clear outcome goals that can be measured. Cat counting will then become the method by which you compare your actual progress and your actual outcomes to these goals. *No matter what you find out as a result of collecting data, it will be information you can use constructively, either to confirm success or to make the adjustments needed to enable success.*

We've only touched on the topic of goal setting here. If you want to take a deeper dive, we suggest that you read this page from the DC Cat Count Toolkit.

### DEFINITIONS

**Target area:** The geographical location within which your target population of FRCs lives. Examples of well-defined target areas are a city block, a zip code, a county, or a feeding location where FRCs congregate.

**Target population:** The target population is the group of FRCs that you are trying to manage, which lives fully or predominantly within the target area. Defining a target population (and target area) that is a good match for your outcome goals and available resources is a critical prerequisite for success. Where these are well-matched, you can concentrate your TNR effort in beneficial ways. Where there is a mismatch, however, your efforts may be "spread too thin" to achieve your outcome goals (ACC&D's strategic guidance document discusses this further). To learn more about FRC populations, see this Toolkit page.

## V. HOW, WHAT, AND WHEN TO COUNT

To conduct cat counting that effectively measures your achievements and your progress towards your goals, you must decide *how* to count, *what* to count, *when* to count, and *where* to count. The first three decision-points (how, what, and when to count), which are presented in this section, do *not* depend on the size of your TNR project. They apply whether you are counting at a single feeding station or an entire zip code. In contrast, the last decision-point (where to count), which is discussed in the next section, *does* depend very much on the size of your project.

As we discuss these decision points, let's say that you are working in a neighborhood of Chicago, Illinois, and have these three outcome goals: a) reduce the number of kittens born by at least 80% over two years, b) reduce the total number of cats by at least 20% over five years, and c) measurably improve the average body condition score of cats over five years.

To pursue these outcome goals, you decided to conduct intensive and sustained TNVR to reach and maintain a sterilization percentage of at least 90% in the target population, and to provide supplementary veterinary care to individual cats as needed. Now it's time to figure out how, what, and when to count to support these goals and activities.

- ***How to count:*** The key to using cat counting to measure change and assess your project's outcomes is **standardization**. This means that you must count cats in exactly the same way at each time and in each place that you count. In fact, standardizing counting method is much more important than the particulars of the method you use. As for the method itself, the **transect count** method is usually the best approach to use in cities, towns, or suburbs with a well-developed network of roads, alleys, paths, and walkways. To count cats, a team of two counters will walk along one or more transects (we'll talk about how *many* transects in the next section) and use a **standardized protocol** to

Recording data during a Hayden Island, Oregon cat count. Photo credit: Portland Audubon.

record all the cats that they see. A completed recommended protocol for standardized transect counts and guidelines for creating transects is available at this Toolkit page. Other methods of counting FRCs are available and may be more appropriate to use in natural, semi-natural, or rural areas, or in places that focus only on a single location (like a single feeding station). These methods include camera trapping and point-based (rather than transect-based) counts.

- ***What to count:*** During your cat counts, you'll always want to record every cat you see, along with its location. In addition, you will probably need to record several characteristics, or **attributes**, of each cat you see so that you can evaluate progress towards your project's goals. Thinking back to the outcome goals of the Chicago example, it would make sense to record the ear-tip status of each cat, whether it is an adult or kitten, and its estimated body condition score (remember that it's always okay to leave an attribute blank for a given cat if your counter can't see it well enough to make a clear determination). These attributes then become the basis for creating metrics to directly evaluate your progress and outcomes. In this case, those **metrics** will be:

  a. number of cats counted per transect,
  b. number of kittens counted per transect,
  c. percentage of ear-tipped (sterilized or neutered) cats among those counted on a transect, and
  d. average body condition score of cats on a transect.

  It is recommended that at least one of the people doing counting uses binoculars. You can learn more about the various kinds of data and attributes you can record for each cat during transect counts at this Toolkit page.

- ***When to count:*** Because you are counting cats to measure how your target population changes as you make progress towards your goals, you'll have to count cats at multiple time points. This process is called **monitoring**. You might identify your effort as Trap-Neuter-Return-Monitor (TNRM) to explicitly encompass the monitoring component. It makes sense to conduct your first count right before you start your TNR project, if possible. This gives you a clear picture of the situation as it existed before you started trying to affect change. Because you want frequent feedback on progress, in the Chicago example you decide to conduct cat counts once per quarter (in mid-January, mid-April, mid-July, and mid-October) for the duration of your project, with an option to reduce the frequency to twice per year if you later decide that is sufficient.

Now you've made all the critical decisions about how, what, and when to count for this cat counting effort. However, it's important to stress that these are not the only decisions you could have legitimately made. For instance, you might have decided to perform two independent counts on each transect during each quarter on sequential days (rather than a single count) and average the results. This produces more accurate results, but

it is also more work. You could have decided to measure some additional attributes of each cat, like their coat condition or your assessment of their sociability, if you think that information would be useful or interesting. You could have decided to conduct counts once every six months (in mid-January and mid-July) on your transects instead of every quarter to stay within budget. If you are working in a more natural or rural area, you might have decided to count cats at a series of camera trapping locations, rather than along transects. There isn't a single right way to count cats, only pitfalls you'll want to avoid. So long as your counting approach is standardized and produces enough information to fairly evaluate your goals (see next section), it's all good.

## VI. WHERE TO COUNT

Now that you've figured out how, what, and when to count, you'll need to decide *where* to count. If you have a small project, this decision point is easy because it's feasible to count more or less everywhere within your target area. Good examples of small target areas are a cluster of a few city blocks, a single small-ish urban park, or a set of closely spaced feeding stations. You'll simply delineate one or more transects that cover all (or most) of the roads, pathways, and alleys in your target area, and you're done!

Things get more complicated for larger projects with target areas like zip codes, cities, or counties because it's simply not practical (or frankly

### DEFINITIONS

**Attributes:** Characteristics of the cats that can be optionally recorded during cat counts.

**Metrics:** Quantities that are calculated from raw cat count data. Metrics are related to your project's goals and the basis for evaluating progress and outcomes. Metrics can be created by summarizing data or performing calculations on data. For more information about metrics, visit this Toolkit page.

**Monitoring:** Conducting cat counts repeatedly over time at fixed intervals in order to document changes in the target population.

**Standardization:** The process of ensuring that all elements of cat counting are done exactly the same way, each time and in each location. If cat counting is not standardized, there is no way to tell whether differences in results over time or in different places are due to project activities, or an artifact of inconsistent counting methods.

**Standardized protocol:** A standardized cat counting protocol lays out all the rules for cat counting that ensure standardization. These include the times of day or times of year when it is legitimate to count cats, how the cat counters should (or should not) look for cats to record, and many other details.

**Transect count:** A transect count is a cat count that occurs along a transect. A transect is an officially designated and delineated route along which you count cats. Transect delineation is a necessary part of standardization which ensures that each count will be conducted along exactly the same transect, each time. In most situations, transects will be delineated along existing roads, alleys, and pathways (see this Toolkit page for more on how to delineate transects, and recommendations for typical transect length). However, off-road transects can also be established in more natural or rural areas, including farms and farmland.

necessary) to count everywhere. Instead, you'll count only on transects (or camera trapping sites or points, depending on the counting method you chose) that occur within a geographical subset, or **sample**, of your overall target area. To use data from this sample to draw conclusions about your overall project, the sample must be **representative** of your entire target area and target population. How do you select samples that are adequately representative? By using a combination of **random sample selection** and sufficient **sample size.**

Understanding these concepts can take some effort if they are new to you, but they are presented in depth along with illustrative examples in this Toolkit page. We strongly recommend that you review this page prior to attempting to create a representative sample of transects in your target area. Conversely, you can enlist help from a staff member, volunteer, or consultant who has an appropriate background in statistics, sampling, and study design.

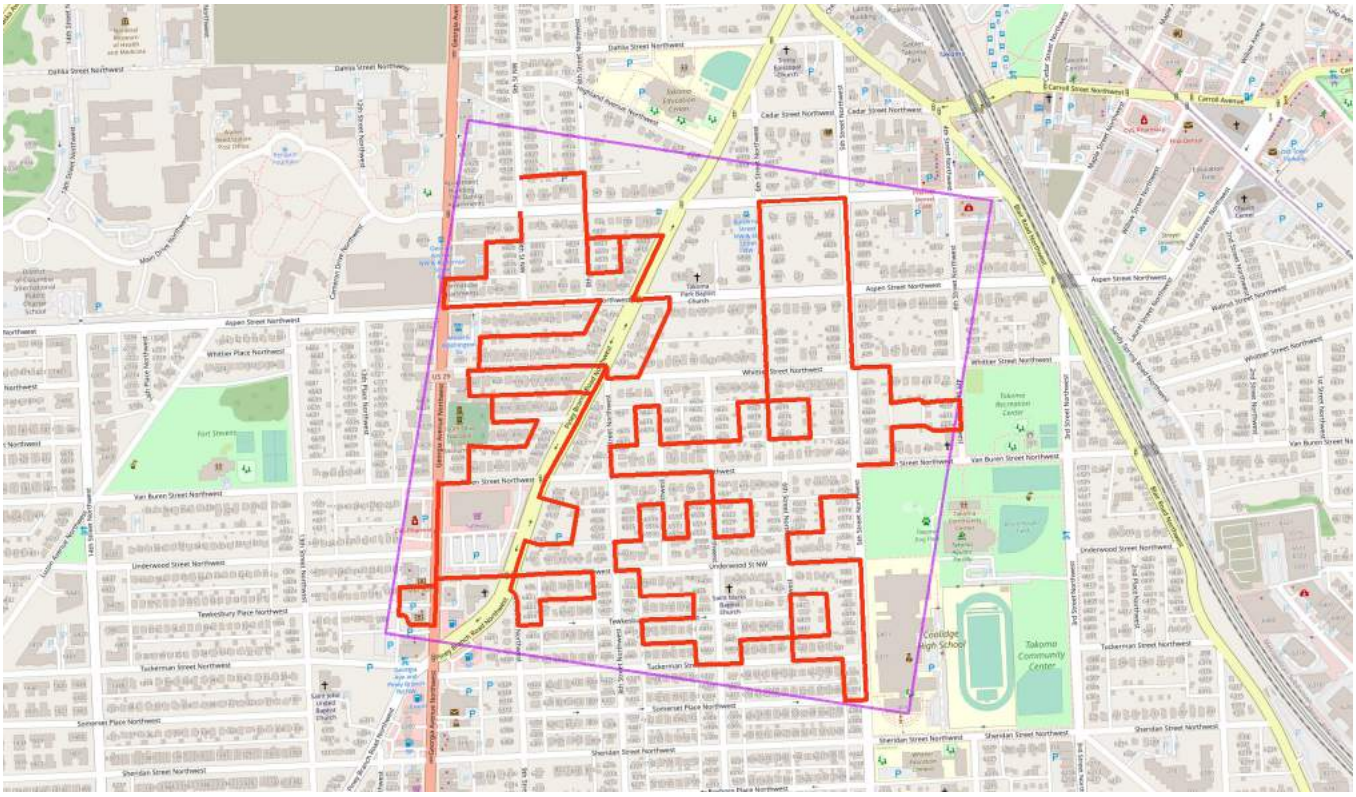
Let's revisit the Washington D.C. example on page 3 to illustrate how you will determine where to count. Remember that your target area in this example was comprised of three zip codes. This qualifies as a large target area because it would be impractical to count cats along every single road, alley, and walkway. Instead, you need to decide where to establish transects and how many of them to establish in order to obtain a good sample. After talking to a staff member who has some experience in statistics (we'll call them your "expert"), you decide to establish four randomly positioned transects in each of the three zip codes (12 transects in all). Each transect will be approximately 5–7 km (3.0–4.2 miles) long, a distance that a pair of cat counters can usually cover within a 2–3 hour period (remember that you can review guidelines for transect length and layout on this Toolkit page).

You might wonder why your expert recommended establishing three shorter transects in each zip code instead of one longer transect. This is a


Map of Washington, D.C. showing the selected sample blocks in which cat counting was conducted for the DC Cat Count project. Image credit: DC Cat Count.

great question, and the answer relates to sample size. Think for a moment about the metrics you need to generate from your cat counting data in order to evaluate your goals – an **index** of cat numbers, an index of kitten numbers, a sterilization percentage, and an average body condition score. All these metrics refer to the *group* of cats that you count along a transect, not to the individual cats themselves. Each transect therefore functions as *one sample* from your target area, and the number of transects you establish determines your sample size. Because a sample size of 12 is much better than a sample size of three when it comes to data analysis, your expert went with the larger number of transects. Of course, there is a limit to this approach. If you opted for too many tiny transects, the **variation** among transects could become so large that it is problematic. What's needed is a good balance between optimizing sample size and keeping the accuracy of each sample within reasonable bounds, and your expert concluded that an overall sample size of 12 transects was the right balance.

Now that you know how many transects you'll establish in Washington D.C., you'll need to decide where to put them. There are several ways to go about this, but one fairly easy way is to create a grid of equal-sized cells, or **plots**, covering your project area. The exact size of these plots is not critical,



Typical cat counting transect (red) within one sampling block of the DC Cat Count. The transect covers all areas within the block and contains a mix of different road types, so it is considered representative of all the roads within this block. Image credit: DC Cat Count.

but to keep things tidy, let's say you'll use plots that are 2.5 x 2.5 km (roughly 1.5 x 1.5 miles). You can draw these in on a paper map using a ruler, create them in Google Maps, or create them in Geographic Information System (GIS) software. For the first zip code, you'll number every plot sequentially, throw these numbers into a proverbial (or literal) hat, and pick four randomly. In each of the selected squares, you will then draw a transect of roughly 6 km in length that winds throughout the plot, encompassing a mix of larger roads, smaller roads, alleys, and paths in proportions that roughly match those present within the plot. Repeat this process in all your zip codes, and you'll have created a sample of 12, randomly selected transects for counting cats in three zip codes in Washington D.C. Remember that this Toolkit page will help guide you through the transect delineation process.

Once again, we want to emphasize that you could have legitimately made different decisions about where to count, but the decisions you made were both logical and practical.

## VII. DATA RECORDING OPTIONS

Traditionally, cat counting data would have been recorded in the field on paper data sheets, and later entered into electronic data forms back in the office. Now, however, there are multiple apps available that allow you to electronically record cat-counting data in the field using smart phones or tablets and thereby bypass the whole data entry step. Although it takes a little time and effort to get familiar with one of these data entry apps, the advantages make it well worth the effort. These advantages are as follows:

- Apps automatically record the location of each cat you see, along with the date and time. This means you don't need to carry a separate GPS unit to determine the geographic coordinates

## DEFINITIONS

**Index:** An index is a metric that indirectly tells us something we'd like to know, but that is hard to measure directly and completely. For instance, we might want to know the total number of cats in our target population, but because cat counting methods miss some cats, it's difficult to establish the true number. Instead, we can regard the number of cats we record during standardized transect counts as an index of the true number. When the index goes up over time, we assume that the true number is also going up, and vice versa. Although it's important to acknowledge that the relationship between an index and the true underlying value is based on an assumption, in most cases that assumption will be valid. For that reason, indexes are widely used to track the number of animals in wildlife populations. You can read more about the use of indexes on this Toolkit page.

**Plot:** A plot is an area of a standardized size in which data collection occurs. Plots provide a convenient framework for selecting samples, but other approaches are possible and widely used. For instance, within a target area comprised of a whole city, you could use the census block groups designated by the U.S. Census as your potential samples, and choose randomly from among them to generate your sample. For more on choosing samples, see this Toolkit page.

**Random sample selection:** A random sample is one in which samples are chosen with no bias. In other words, every potential sample within your target area or target population has an equal likelihood of being chosen as part of the actual sample.

**Representative:** Samples that are chosen randomly and without bias are considered representative samples, meaning that they provide reliable information about the larger target area or target population. Biased samples, in contrast, may provide misleading or inaccurate information that can over- or under-count cats in unpredictable ways. To learn more about how to choose representative samples, see this Toolkit page.

**Sample:** A sample is a subset of your target area and/or target population within which cat counting occurs. You can draw valid conclusions from samples so long as they are representative of the larger target population / target area. It may be helpful here to distinguish between geographical sampling and population sampling. Geographical sampling, which is our main focus in this document, involves counting cats in only parts of your target area, and using that data to draw conclusions about the entire target area. Population sampling, in contrast, refers to the fact that most cat counting methods cannot detect and record every single cat present in the areas where cat counting is conducted. For most projects and most purposes, incomplete detection when counting cats is not a problem and can be safely ignored, as we'll describe below. However, incomplete detection becomes a critical consideration if you want to estimate the true FRC population size within your target area, something we touch on briefly near the end of the document. To learn more about sampling, see this Toolkit page.

**Sample size:** Replication is the collection of multiple samples in order to develop a representative data set. If there are too few replicates in the dataset, the ability to draw inferences is highly limited. If there are sufficient replicates, then the variation (see below) among individual samples can be "averaged out" to develop an understanding of the target population and target area.

**Variation:** Samples will invariably differ from one another with regard to the metrics of interest. Deciding how to interpret these differences and determine whether they are meaningful or not is what statistics is all about (see Section VIII below).

of the cats you see, nor transcribe those coordinates by hand onto a paper data set.

- Apps greatly reduce errors in data entry, both during the process of recording data in the field, and because there is no need to later transcribe it in the office.
- Once you learn to use an app for data recording, it saves significant time overall.
- Apps make it possible to view and navigate along your assigned transect while in the field.

If you want to use an app specifically designed for cat (and dog) transect counts, we highly recommend the Talea app created by our friends at the International Companion Animal Management (ICAM) Coalition. It offers the functionality you'll need along with a relatively easy learning curve.


If you are comfortable configuring apps and would like the associated flexibility, Epicollect offers a very functional option.

Finally, the "Cadillac" option is to use GIS-based apps from ESRI, such as ArcGIS Survey123 or ArcGIS Field Maps. These options provide the most functionality and configurability, but also involve a significant learning curve. If a staff member or volunteer has a GIS background, we recommend you consider this option. This option also connects to other functionality that can make it helpful for tracking or managing larger or more complex projects.

More information about using ESRI apps, "pen and paper" data collection, and apps to support camera surveys is available at the very bottom of this Toolkit page under the "Additional Resources" heading.

## VIII. DATA ANALYSIS

You might wonder at this point, "now what am I supposed to do with all this cat counting data?" It's an excellent question, because until you do something with your data – specifically analyze it – you can't learn anything from it. Data analysis is a technical undertaking best undertaken by someone on your team who has appropriate training and experience. While this section will not turn you into a data analyst, it will give you enough of the basics to collaborate more effectively and knowledgeably with a qualified analyst.

Many people think of data analysis as "statistics," but that's not the whole story. Data analysis actually involves the following series of steps:

- ***Data review:*** In this step, cat counting data are reviewed to identify errors (or omissions). Ideally, data review happens on an ongoing or episodic basis, perhaps after each seasonal counting session. Using apps for data collection will greatly reduce, but not completely eliminate, errors in your data set. Putting your data set into a spreadsheet to examine the averages, ranges, and values that have been entered for each attribute can help to identify possible mistakes. In some cases, it will be possible to correct errors with appropriate data, but in other cases, you might simply have to delete clearly erroneous data. You should never "make up" data, only edit data in cases where the correct value is clear. For instance, it is acceptable to correct a data entry of "Kitenn" to "Kitten." However, it is not acceptable to enter a value for a cat's ear-tip status if the original cat counter failed to enter a value.
- ***Calculate metrics:*** Sometimes you'll be able to analyze raw cat counting data, but more often you'll first need to calculate the metrics you will be analyzing by adding, averaging, or obtaining percentages from raw cat counting data. Transect-level sterilization percentage and

number of kittens per transect are two examples of the many possible calculated metrics. For more on metrics, especially those that must be derived from raw cat counting data, see this Toolkit page.

- ***Summarize, visualize, or map data:*** Not all data analysis involves conducting statistical tests. You can learn a lot by summarizing your data in a table, visualizing it with a graph, or mapping it. Collectively, these three approaches are sometimes called *exploratory data analysis*. If you don't have access to a qualified data analyst, exploratory data analysis is probably your safest bet. It's also your only option in small projects, where statistical analysis is generally not relevant since you aren't sampling. This Toolkit page gives you an introduction to some of the ways you can summarize, visualize, or map your data, along with examples and references to explore further.

- ***Statistical analysis:*** When your data represent samples taken from your target area or target population, statistical analysis is the most formal way to ask and answer questions about your progress and your outcomes. The results you get from a statistical analysis, however, will be expressed in terms of confidence and probability, not as definitive answers. For example, you might conduct a statistical analysis to investigate whether or not the number of cats present in your target area after five years of TNR is lower than the number was when you started. The answer you'll get might sound like this: "a reduction in cat numbers probably occurred, but there's a 10% chance that it actually didn't." Conducting statistical analyses and correctly interpreting results like the one just described requires a good understanding of statistical methods and theory, so it's advisable to get appropriate assistance if necessary. If you'd like to know more, this Toolkit page will help you to understand the basics of statistical analysis and help you to have a productive dialogue with a data analyst.

## IX. ADVANCED TOPIC: POPULATION SIZE ESTIMATION

Up until now, we've talked about sampling mostly in a geographical context, specifically with regard to where you'll count cats within your target area. We've touched on the fact that cat counts also sample the target population because they "miss" some of the cats living in the counting areas, but noted that the cats that you *do* count provide an adequate index of cat population size.

For most projects and goals, this approach is perfectly sufficient. But what if you want, or need, to estimate how many cats there really are within your target area? There are ways to go about estimating the true number, or population size, of an FRC population, but they are complicated and imperfect.

Here's the process of population size estimation in a nutshell. First, you'll need to estimate how effectively your counts sample the target population in the areas where counting is conducted. There are many ways to estimate this population sampling efficiency, or **detection rate**. Nearly all require

### DEFINITIONS

**Detection rate:** Detection rate is the proportion of all cats that could, in principle, be counted that are actually counted. A detection rate is specific to a particular counting method, and it may also vary with the type of area or the time of day in which counting occurs, among other things. For instance, if there are really 100 FRCs living within visual range of a transect, and you actually record 27 of them, then the detection rate for that particular transect and cat count is 27%. Of course detection rates will inevitably be a little different from transect to transect due to random factors, so we usually think of detection rates as an average taken across multiple transects that are counted using a standardized cat counting protocol.

**Model:** A general word for the kinds of statistical approaches that are usually used to estimate population size.

**Predictor**: A characteristic of the environment that is related to the number of cats present. For instance, we might find that there are generally more FRCs in areas where the density of alleys is high than in areas where the density of alleys is low. If so, alley density is a predictor of FRC population density. Other potential predictors might be median household income or the predominant type of human housing. Statistical models seek to identify relationships between cat counting data and predictors like these, and those relationships (along with information about detection rate) are the basis for developing population size estimates for an entire target area from sample data.

that you conduct a series of counts along transects rather than a single count. Many also require you to identify and then re-identify individual cats whenever possible across sequential counts, or to somehow "mark" individuals on the first count and then note whether individuals in the subsequent counts are marked or unmarked.

All these methods make certain assumptions about the target population, and if these assumptions are wrong, estimates of survey detection are also wrong.

Once an estimate of detection is made, it can be combined with the usual geographical sampling concepts and incorporated into a statistical analysis (usually called a **model**) that generates an estimate of FRC population size across the target area, along with an expression of how confident you can be in that estimate. These models usually require that you find good **predictors** of cat density in your target area based on your sample data, which then help to inform estimates of population density across the whole target area.

Hopefully you can already see that population size estimation is a complicated and tricky business, and not something to be taken lightly. Unfortunately, it's way easier to generate a bad (and inaccurate) population size estimate than a good (and accurate) one, so be wary of estimates until you understand where they are coming from.

If you do need to estimate population size in your target area, you can learn more about it at this Toolkit page. After reviewing it, we strongly recommend that you seek qualified technical assistance to help you with the next steps.

## X. CONCLUSION

We hope this guide has helped you better appreciate the value of cat counting and given you some good ideas about how to get started.

We know that this can be a challenging topic, and we are happy to answer questions or accept suggestions for improving these guidelines; please e-mail us at info@acc-d.org. Happy counting!