GUIDANCE DOCUMENT

Briefly Summarizing Key Findings and Their Practical Application for Managing Free-Roaming Cat Populations

A companion piece to the technical report: "Evaluating Management Alternatives for Free-Roaming Cat Populations Across a Range of Landscapes: An Individual-Based Demographic Simulation Modeling Approach" completed May 31st, 2013

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INTRODUCTION

In 2013, an expert group organized by the Alliance for Contraception in Cats & Dogs (ACC&D) completed work on a detailed computer simulation model for free-roaming cat populations. This model exceeded past efforts in its scope and level of detail, and provided substantial insight into the most effective ways to manage free-roaming cats. In this document, we translate these lessons into guidelines for cat management programs. Those interested in reviewing and evaluating the full rationale for our conclusions should consult the full report for the modeling project, available through ACC&D.

CONCEPTS

Although free-roaming cats are unique in many respects, they are still subject to the same factors that regulate wildlife populations. Some of these factors, such as survival rates and reproductive rates, will be familiar to readers. Others that may be less familiar are introduced in this section. In contrast to most previous efforts, our model incorporated these complex regulating factors in a realistic way.

Carrying capacity: Every environment has an upper limit to the number of free-roaming cats that it can support, which is determined by the amount of resources (food, shelter, etc.) that are available. This limit is called the carrying capacity, which is often abbreviated as "K". Cat populations in some places may be at or near K, which means the population cannot grow. In other places, cat populations may be below K, which means the population has the potential to grow. In some cases, it may be possible to change K for a given area by changing the availability of resources. Often, the management goal may be to reduce cat numbers below their local carrying capacity, sometimes substantially below that level.

Density-dependence: Cat populations can be characterized by their rates of survival, reproduction, and dispersal (i.e. movement out of the cat's original home range), among others. However, these rates are not necessarily fixed for a given population. Instead, they may have one value when the population is at a high density and a different value when it is at a low density. As one example, survival rates of kittens may be lower when the population is at K (and resources are limited), than when the population is below K (and resources are therefore more abundant). Density-dependence tends to operate in a way that keeps the population close to K, and therefore it can potentially make it more difficult to humanely reduce the size of a target population.

Dispersal and Abandonment: Most often, the population we are targeting for management has some degree of contact with neighboring populations, allowing cats to disperse from one population to another. As our target population drops below K, resource limitations will be relaxed, and immigrating cats will be more likely to become successfully established. Dispersal can, therefore, work to counteract our attempts to reduce population size. Abandonment of formerly owned cats or litters can function in a similar way to supplement our target population.

Lag Times: When we sterilize members of a cat population and then return them to their place of origin, the size of that population does not immediately change. That change only occurs over time, as sterilized animals fail to reproduce, and then eventually die. This is in contrast to "removal" methods of population management, which have an immediate impact on population size. Those seeking to manage free-roaming cats humanely need to be aware that substantial lag times in population response are to be expected when relying solely on sterilization.

RECOMMENDATIONS AND GUIDELINES

Identifying the Target Population and Setting Goals: You should begin any management program by carefully delineating the target population, and defining your management goals. Populations are typically defined by the area that they occupy (several city blocks, a town, a campus, etc.), but can also be defined in terms of specific places where they can be observed (a feeding station). Goals could include reducing the current population size by some percentage, preventing further increases in population size, or maintaining a stable population while preventing "excess" reproduction. Then, a monitoring program should be implemented to measure progress towards your goals. For more information on process and how to do this, see *A Generalized Population Monitoring Program to Inform the Management of Free-Roaming Cats*,[1]).

Managing Carrying Capacity: Before discussing recommendations for reproductive management, it should be noted that where possible or desirable, reducing carrying capacity by removing sources of food and shelter can be a very effective way to reduce population size.

[1] A Generalized Population Monitoring Program to Inform the Management of Free-Roaming Cats, John D. Boone. Ph.D. Senior Biologist, Great Basin Bird Observatory; Board of Directors, SPCA of Northern Nevada and Margaret Slater, D.V.M., Ph.D. Senior Director of Veterinary Epidemiology, ASPCA Shelter Research and Development, available at this **LINK.**

Target Rates for Sterilization: Our model, along with many other studies, supports a conclusion that in order to reduce population size, it is necessary to sterilize approximately 70% of the target population. More specifically, this guideline means that a 70% sterilization rate must be maintained within a population on an ongoing basis. Sterilizing 70% of all animals on one occasion will not result in any lasting population impact. Put into operational terms, maintaining a 70% sterilization rate in a population requires that approximately 30% of all the unaltered cats that are currently present be sterilized every six months (different target rates can be calculated for trapping intervals that are more or less frequent than the six-month interval). If this target rate of sterilization is maintained over time, the population eventually will stabilize at a density somewhat below half of the original carrying capacity. Greater reductions from original carrying capacity require higher sterilization rates. Lowering sterilization rates causes a rapid reduction in effectiveness; the minimum sustained sterilization rate required to achieve a noticeable reduction in population is about 20% of unsterilized animals every six months. Readers should be aware that as the proportion of unsterilized cats left in a population declines, an increase in trapping effort may be required to acquire the remaining unsterilized cats.

In order to confirm compliance with these sterilization targets, some form of ongoing population monitoring is needed, along with some form of marking to identify sterilized animals. ACC&D provides guidance on both topics, which is available at www.acc-d.org. Monitoring and marking serve two related functions. First, they allow us to directly confirm that a target population is in fact being maintained at its target sterilization rate. Secondly, they allow us to estimate the number of unsterilized cats remaining in the target population, which in turn allows us to set capture targets of unsterilized cats for each trapping session. Since the number of unsterilized cats remaining in the population will change over time, these targets will change as well. A worked example for determining trapping targets is shown in the Appendix.

Non-Permanent Sterilization: ACC&D is actively fostering the development of non-surgical sterilization alternatives. As they become available, some of these new methods may produce permanent sterilization, and others may produce temporary sterilization. Permanent non-surgical sterilization will have the same population-level impacts as traditional surgical sterilization, with the anticipated added benefit of lower cost and faster treatment times that may allow more cats to be treated. Temporary sterilization of a cat will necessarily have less impact on population size than permanent sterilization of that same cat, assuming that the cat lives long enough to return to fertility. We therefore investigated the difference between permanents sterilization and a temporary method featuring three-year effectiveness. We found that the temporary method would effectively reduce population size if applied to 40% of unaltered cats every six months. This is a higher rate of treatment than the 30% rate described above for permanent methods. However, achieving a 40% rate of treatment using a lower-cost and faster non-surgical method may be more feasible in many cases than achieving a 30% treatment rate using traditional surgical techniques. We anticipate that there may be scenarios when it is most effective to use both surgical and non-surgical techniques in a complementary fashion.

Lag times: Once a management effort is undertaken, it will take about five years for a target population to begin to stabilize at a new population size, and about 10 years to fully stabilize. Therefore, management programs that last for fewer years may not produce a measurable population impact.

Dispersal and Abandonment: All of the recommendations presented above are based on supplementation of our target population by a modest level of dispersal and abandonment (i.e. < 5% of K per year for females). If dispersal and abandonment can be reduced significantly as part of our management efforts, the effectiveness of a population control program can increase dramatically. Conversely, if dispersal or abandonment is present at higher levels, or if it increases as our target population begins to decline, it can easily reverse any positive impacts of our management efforts. There are several lessons implicit in this finding:

1) Management efforts will be most effective for target populations that are relatively isolated from neighboring populations;
2) As dispersal and abandonment rates increase, population control programs are less likely to be effective. Accurately

measuring dispersal rates is a specialized and labor-intensive activity, but colony caretakers may be able to get some sense of relative dispersal rates by observing the frequency with which new individuals are observed within their target population;

3) Educational and outreach efforts to reduce abandonment can significantly aid in population control, and may be a critical management approach in many situations.

Removal versus Sterilization: Under the assumptions of our model, removal of an individual cat from a population (by adoption or euthanasia) has a greater impact on population size reduction than sterilizing and then returning that individual. This finding is intuitive in that removal immediately subtracts the individual's reproductive capacity AND that individual itself from the population, whereas sterilization subtracts only its reproductive capacity. This finding emphasizes the importance of seeking adoption outlets for free-roaming cats that can be socialized, typically kittens and juveniles. Given widespread ethical objections to euthanizing healthy animals, and the costs associated with traditional municipal animal control methods, it is unlikely that lethal removal will be routinely implemented on a level required to significantly reduce population size (i.e. removal of ~ 25% of individuals present on a semi-annual basis in order to reduce population size to ~ 50% of K). Furthermore, as described above, high levels of dispersal and abandonment might necessitate even higher levels of removal. Fortunately, sterilization strategies can be effective if employed as described in this document.

Kittens versus Adults: Sterilizing a single young cat which has an entire reproductive life lying ahead of it has a greater long-term impact on population size than sterilizing a single older cat. However, targeting only juveniles (< 6 months of age) for sterilization is a poor strategy for two reasons. First, juveniles typically comprise a distinct minority of the reproductively active cats within the target population at any one time. Therefore, an exclusive focus on juveniles would fail to address most of the cats that are generating litters. Second, mortality of juveniles can be higher in many circumstances than mortality of adult animals in their prime reproductive years. Therefore, the impact of sterilizing juvenile animals is "diluted" by their typically higher removal rate from the population. Our results clearly indicate that it is better to target all reproductively capable cats for sterilization regardless of age.

Females versus Males: In principle, it would be more effective to target females for sterilization than males. However, because it is not possible to selectively capture females, we recommend that all captured females and males be sterilized. An exception could occur if more cats are trapped during a given trapping session than can be sterilized. In that case, females should be sterilized preferentially. Depending on the method of sterilization and the need to address issues other than pure population control, surgical sterilization of males may have the benefit of decreasing nuisance behaviors and improving their welfare.

Integrated Management: Combining reproductive intervention with outreach efforts to reduce abandonment, adoption programs for cats that can be socialized, and management of resources (food and shelter) is likely to be more effective than any single approach in isolation.

UNKNOWNS AND NEEDS FOR BETTER DATA

Our modeling effort and the recommendations derived from it are based on the best information we could obtain about the dynamics of free-roaming cat populations. We acknowledge, however, that this information is incomplete. As our understanding of cat populations improves, our recommendations can improve as well. In this section, we describe the most important information gaps that currently exist, and suggest topics for further study.

Behavioral Role of Altered Animals: It is often stated that altered cats "fill up" space in a population and prevent other, unsterilized animals, from moving in. However, there is in fact very little data that demonstrate the degree to which this phenomenon actually occurs. In particular, we do

not know whether neutered males have any capacity to discourage remaining unaltered males from having free access to receptive females. We currently assume that no such interference exists within our model. Further study of how sterilized animals function within a population is necessary to clarify this matter.

Dispersal: Some information is available for cat dispersal rates, but it is limited. Better information about typical dispersal rates, the range of dispersal rates under different conditions, and the survival rates of dispersing cats is needed. In particular, we assume that dispersal is strongly density-dependent, but do not have enough information to explicitly model this process. In our modeling effort, we only explored two alternatives; a modest fixed level of dispersal, or no dispersal. Further exploration of the impacts of higher levels of dispersal would be informative.

Frequency of Abandonment: Similarly, better data regarding typical abandonment rates under different conditions is needed. We also need o better understand the socio-economic and attitudinal factors that contribute to higher abandonment rates and prevention of abandonment.

Metapopulations: As previously mentioned, most of the cat populations that are targeted for management are actually part of a larger, inter-connected network of populations that is called a metapopulation. We have not yet explicitly modeled these larger systems, and therefore cannot determine the optimal management approaches. More explicitly, we need to investigate whether it is better to intensely manage cats within a small part of the metapopulation, or to manage a larger part of the metapopulation at lower intensity.

Cost-Benefit Analysis: A comparison of different management strategies should explicitly incorporate cost, especially when attempting to determine the relative merits of current surgical approaches and the non-surgical approaches that are beginning to become available. At present, we have not considered cost in our analysis. However, we are currently in the process of conducting a cost-benefit analysis for surgical vs. non-surgical methods.

APPENDIX: A SIMPLE METHOD TO ESTIMATE TRAPPING AND STERLIZATION TARGETS

The method described in this appendix can be used to generate a rough estimate of the number of unsterilized cats that are present in your target population. This, in turn, allows you to set trapping and sterilization targets for each trapping session. The method depends on having previously sterilized and marked some cats, so it cannot be employed at the very beginning of a management program, only once it is underway. We acknowledge that this method makes a number of assumptions that may be imperfectly met, and therefore suggest that its results be interpreted with caution.

This method assumes that every sterilized cat is marked in a way that is readily visible. It requires that you count or estimate three quantities:

1) The number of sterilized cats in your target population. In early stages of your program, this is simply the cumulative number of sterilized cats. Later, you will have to subtract estimated mortality from this total, or use the monitoring and survey methods described in *A Generalized Population Monitoring Program to Inform the Management of Free-Roaming Cats*.
2) The actual number of sterilized cats that you count during an observation session or trapping session.
3) The actual number of unsterilized cats that you count during that same observation or trapping session.

Example: During the first year of a TNVR program, 150 cats were sterilized. Based on typical annual survival and dispersal rates, we estimate that of these 150 cats, 10% have died or left our target population, leaving 135 (item #1 in the list above). During an observation period preceding our upcoming trapping session, we counted 40 marked (sterilized) cats (item #2 in the list above) and 45 unmarked (unsterilized) cats (item #3 in the list above). In order to estimate the number of unmarked and unaltered cats remaining in our population, we perform the following calculation:

Estimated total number of marked and altered cats (TM) = 135
Observed number of marked cats (OM) = 40
Observed number of unmarked cats (OU) = 45

Estimated total number of unmarked, unsterilized cats (TU) = (OU x TM) / OM

So, TU = (45 x 135) / 40 = 151

Therefore, since we estimate that there are 151 unaltered cats within our target population at the present time, if our goal is to sterilize 30% of the unsterilized cats during each semi-annual trapping session, we should aim to capture and sterilize 151 x 30% = 46 cats.

Over time, we can use simple observation of marked and unmarked cats to determine if the target rate of 70% sterilization is being achieved and maintained. This is based on determining the proportions of unmarked and marked animals that are observed, averaged over several different observational periods.