

Analyzing approaches to feral cat management—one size does not fit all

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How to best solve the diverse issues related to feral cats is a complex question with many facets. Each facet reflects large gaps in our knowledge and understanding. Felid biology; global, regional, and local ecology; human psychology; sociology; economics; and theology are all examples of branches of learning that can contribute knowledge toward finding acceptable solutions to feral cat problems. Unfortunately, our understanding of any one of these disciplines is incomplete, particularly with regard to specific knowledge relevant to feral cats. Making informed decisions is therefore difficult at best.

Discussions about feral cats often become emotionally charged, even when the discussion is among individuals with similar backgrounds. Perceptions based on personal experiences rapidly substitute for missing objective data, and interpretations of options become increasingly monochromatic. Over the years, I have been expounding to students a general rule based on my observations of scientific debate. The “Rule of Inverse Vehemence” states that the vehemence with which proponents of opposing views argue their points is inversely proportional to the quality of data available to support their positions. In other words, highly charged polemic disagreements are often fueled by insufficient, reliable, objectively collected, and properly analyzed data to support a unified position. My graduate student, Dr. Felicia Nutter, had the opportunity to experience discussions held by groups with very different perspectives on feral cat issues during the time she was formulating her graduate studies proposal, and that brought feral cats to my attention as a subject of scientific inquiry. Familiar with my “Rule of Inverse Vehemence,” Dr. Nutter proposed that the application of well-established wildlife biology research techniques to the study of feral cats could supply knowledge that may help reduce discord between respected colleagues. She pursued this question, and that is why I am speaking with you today.

A review of the existing literature suggested that the “Rule of Inverse Vehemence” might apply. Although much has been written about feral cats, most reports are based on observations or extrapolations that do not follow well-established rules of scientific inquiry. Diary entries observing a single cat would be extrapolated by simple multiplication into the world or US population of cats—estimations that seriously defied accuracy in our experience. Reliably estimating populations of any animal, even on much smaller scales (counties and municipalities), requires carefully

designed sampling studies. We frequently encountered multiple-fold differences in statistics in the popular press, and there seemed to be a complete willingness to report these spurious numbers in otherwise scientific reports. Although an improvement over observations of a single cat, published scientific studies routinely examined only a single feral cat colony or created a pseudo-metastudy, ignoring major differences in experimental procedure and design. In almost all cases, even well-designed studies were conducted for very short times, limiting the potential for examining annual or, in many cases, even seasonal variations.

Having reviewed the state of our knowledge, more questions arose than we could possibly study well. We hypothesized that variation between colonies could be responsible for much of the discord in published small-scale studies. Therefore, we chose to design our research to examine as large a sample of feral cat colonies as our limited resources could reliably support. A key goal was to better understand the scale of variability we should expect across colonies. Of the many questions of interest, 4 rose to the top of our list as veterinarians and seemed to fit within an integrated study design. These questions included the following: 1) how reliable is our understanding of feral cat reproduction potential, 2) what is the relative zoonotic risk of involvement with feral cats, 3) what is the feasibility of reliably implementing current recommendations for high-end management of feral cat colonies, and 4) how does management of feral cat colonies affect the populations of colonies? What we found and are continuing to find is appropriately being published in detail in the peer-reviewed scientific literature, but I am exploring these same questions during this presentation to illustrate 3 key points: 1) There is still much to learn about feral cats, 2) all feral cat colonies are not equal, and 3) high-intensity management of feral cat colonies can successfully reduce colonies to extinction, but the process requires a long-term commitment of resources and may be appropriate and successful for colonies in some situations but not for others.

What Do We Know About Feral Cat Reproductive Potential?

Data on cat reproductive parameters have been collected by several investigators and generally support the concept that domestic cats are prolific. How prolific is a more complicated question. Females can bear young prior to reaching 1 year of age and can have multiple litters per year.^{1,a} However, the reproductive capacity of female cats and the consequences of unabated reproduction are often extrapolated to very large numbers by use of maximum rather than realistic litter sizes or by completely ignoring kitten mortality.^{2,3}

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Our recent work looked at reproductive parameters of large numbers of naturally breeding feral and free-roaming cats ($n = 2,409$).⁴ We found that although pregnancy could occur in any season as reported by Prescott,⁵ the vast majority (603/625) of pregnancies identified in our study occurred in the spring and summer months. This supports the hypothesis that births are correlated with optimal environmental conditions.¹ Mean number of litters per year for a queen in our studies in which colonies were managed on high planes of nutrition and health management was 1.4, considerably lower than the possible 3.0. Only 2 cats in our study achieved that lofty goal, and in each case, there was 100% mortality of at least 1 of the first 2 litters of the year.

After litters per year, litter size has the most dramatic impact on extrapolations of domestic cat reproductive potential. Mean litter sizes reported in the literature for free-ranging cats range from 2.1 to 5 kittens/litter,⁵⁻¹³ and our study⁵ found mean litter size to be 4.1 ± 1.3 (mean \pm SD) on the basis of fetus number or 3.5 ± 1.2 on the basis of live births. These numbers, of course, do not take into account kitten mortality. Used alone, they would grossly overestimate population growth. In the first 2 years of our colony-based studies, we observed a 3-month kitten mortality rate of 48%, contributing to 75% cumulative kitten mortality at 6 months. This falls within the range of previously reported mortality rates and is not particularly difficult to achieve, considering the wide range of mortality rates reported (up to 90%).^{8,9b} Kitten mortality rates can depend strongly on environmental variables. High variation in mortality rates and causes of kitten mortality among otherwise similar colony sites in our own studies convinced us of the important need to study multiple colonies over more extensive time frames to achieve meaningful estimates of expected kitten mortality. This also emphasizes how challenging it can be to generalize these parameters across colonies existing in different environmental conditions. Juvenile mortality figures in our studies are consistent with previously reported rates^{14,15} for small wild carnivores other than feral cats. This suggests that the feral cat's reproductive potential is not that far removed from other carnivores we work with in the wild. It also tends to support the notion that it is appropriate to assess feral cat reproductive potential by use of methods developed for studying other small wild carnivores and that similar time frames will be required to achieve accurate understanding—basically, a decade or more, not just a few years. This does not mean that I advocate waiting for decades to make decisions about feral cats. Complete understanding of very complex questions rarely occurs, and decisions related to complex questions must often be made with incomplete data. The key is to take into account the level of uncertainty in our current understanding as we evaluate the risks and benefits of different actions.

How Much Zoonotic Risk Do Feral Cats Pose?

Concerns about the potential for feral cats to serve as vectors of human disease are fairly frequently

expressed in editorials and letters to the editor.¹⁶⁻¹⁹ How large is this risk? Certainly potential zoonoses have been associated with feral cat populations,²⁰ but how does the risk of disease compare to risks from human exposure to other animals, owned pet cats for example? Cats may play a role as a reservoir of *Bartonella* infections,²¹ and *Bartonella* infection is reported to be common (28% prevalence) in pet cats across the United States.²² Fleas and possibly ticks play a role in the transmission of *Bartonella* organisms, so it was not too surprising to find in a study²³ of pet cats and feral cats with no flea control management from the same locality that feral cats had a somewhat higher prevalence of the disease (93% feral and 75% pet). The dramatic difference in what we found, compared with previously reported prevalences of *Bartonella* infection, probably points to the need to examine feral cat zoonoses issues locally or at least with careful attention to environmental and ecologic conditions. For example, the vigorous biting insect life of North Carolina is radically different than that found in high chaparral environments in the western United States. Interestingly, in our North Carolina studies in which we admittedly looked at feral cat colonies under very high levels of management, feral cats had similar baseline health status to pet cats, as reflected by hematologic parameters. Although there was documentable evidence of infection or exposure of feral cats to all 7 pathogens we examined, prevalences were similar to and not statistically different from prevalences in owned cats for 5 of the 7 pathogens.²³ It would appear that in situations where trap-neuter-return (TNR) programs can be intensively managed, including vaccination and parasite control, feral cats need not experience a "mean existence" with regard to overall health and need not pose a markedly greater risk of zoonotic disease, compared with owned cats. Clearly this would vary with the environment and the design of management protocols. Remember, variability is an important theme in this presentation.

What Are the Economics of High-End TNR Management?

Though not much research gets done without money, cost analyses and economics do not seem to be a popular avenue of inquiry when looking at the veterinary literature. This is unfortunately true with regard to assessment of feral cat management. The most detailed information available on how to trap feral cats seems to come from instructions provided to participants in TNR programs.²⁴⁻²⁶ There seems to be good agreement among these groups on the use of wire box traps, but details of set strategy are harder to come by. Some useful information on baits is available (smelly is better).²⁷ Unfortunately, trapping details are rarely reported in the wildlife literature for any species, let alone for feral cats. It seems reasonable to urge those researching feral cats to report more detail on this issue as well as on actual costs of maintaining various components of TNR programs. The paucity of information we could retrieve from published work hampered our own budgeting efforts, and we decided to incorporate some analyses of trapping costs into our studies when it could be done without compromising

scientific objectives. The first controversy we looked at returned some surprising results.²⁸ We were concerned about trapping efficiency, a common Achilles heel in wildlife studies. We asked, how much does it cost to catch a cat and does it work better if you invest in baiting unset traps for a time before actually trapping cats? Perhaps because of the nature of the colonies we were trapping (well acclimated to humans and used to being fed in particular locations) and less likely because of our trapping acumen, we had remarkable success trapping feral cats, compared with other wildlife. In 1 study, we trapped 107 cats from 9 colonies with 98% trapping efficiency and 98% of the cats were captured in < 9 trap nights/cat, with no statistical or practical difference between the percentage of cats captured per colony or the trap effort per cat if we prebaited traps for 3 days or simply cold set.²⁸ The cost differences were significant, with prebaited trapping costing nearly double what a cold set strategy cost. Much more work examining the economics of managing feral cats needs to be done and published. Again, what works best and most economically is likely to vary from region to region and habitat to habitat, and certainly by the nature of the colony, but sound economic analyses of components of feral cat management efforts can help guide practical decision-making. High-level TNR management requires the application of substantial resources over a prolonged time to be successful. Planners need to ensure that long-term efforts can be sustained through careful budgeting and fiscal planning.

How Does Management of Colonies Affect Population Dynamics?

Cats are an extremely plastic species capable of adapting to widely variant environments. If for no other reason than this plasticity, extrapolation and generalization about feral cat colonies are dangerous. Considerable variation occurs in every aspect of their existence. What we have found with colonies meeting relatively strict inclusion criteria in a single modestly populated rural county in North Carolina may have little predictive value when applied to colonies in urban settings, wilderness areas, different climates, or even on different management plans. In pilot studies for a longer-term study in progress, we have been looking at 9 and now 12 colonies of feral cats being managed for maximum potential for growth. All colonies receive food and water daily, have shelter available, are treated with an anthelmintic annually, and were vaccinated against rabies and common feline viral diseases when enrolled in the study. Altering specific components of the management plan allowed us to examine the contribution of those components to the population shifts we observe. What have we learned so far?

➤ Trap-neuter-release programs can stabilize colonies and cause population declines over time when compared with control colonies in which cats are not neutered. All 6 surgically sterilized feral cat colonies initially enrolled in our studies have decreased in population during the first 2 years of study (mean decrease of 36%) and continue to decline. During the same 2 years, the mean

change in population for the 3 control colonies was a 47% increase.

➤ There is extreme variability in population dynamics between similarly sized colonies despite efforts to control variables by use of restrictive inclusion criteria for enrollment in studies.

The extent of variation between even similar colonies in similar habitats is a key issue that must be dealt with when planning and analyzing results of feral cat studies. That variation must also be considered when attempting to use data from 1 situation to guide management in another. How to best deal with variation depends considerably on the questions being asked, but to ignore it invites failure. Early in our ongoing study, populations in control colonies (unneutered cats) varied more dramatically than did populations in reproductively managed colonies. Though the mean population change for all 3 control colonies during the first 2 years was a gain of 47%, looking at means can give an incomplete picture. In reality, population shifts for individual control colonies during the first 2 years of the study were 31%, 127%, and 283% of original colony size, respectively. All 6 TNR colonies decreased in size relatively uniformly (range, 30% to 89% of original size) during the same period. Clearly, stochastic events can dramatically change population dynamics within individual colonies.

This means that a precise and definitive answer to the most common questions we are asked by people interested in our research will likely remain elusive and very challenging, even after we have a decade of information available on multiple colonies. These questions include, can TNR take a feral cat colony to extinction and how long does it take for a TNR-managed colony to extinguish itself? To date, one of our experimental colonies has already gone extinct and another is approaching extinction. Others have reached relatively low numbers of cats but seem to have stabilized as what might be termed “microcolonies.” As we continue our work, it wouldn’t be totally unexpected if immigration pushed the population of a TNR colony up again, though this has yet to happen. Fluctuations in colony populations should occur, and such fluctuations are not unique to feral cats. Wildlife biologists are used to this challenge. Working in complex and variable systems with incomplete knowledge is one of the underpinnings of the concept of adaptive management, which is familiar to all wildlife professionals. In many ways, it is also the foundation of decision analysis in relative risk assessment.

Different solutions will fit different situations. For potentially contentious situations in which radically different perspectives must be accommodated, optimizing results requires a willingness to establish goals and strategies by analytically examining the perceived risks of management options as held by all interested parties. It then becomes important to continually assess data to evaluate progress toward goals and make adjustments in management efforts and methods to fit changes in real world dynamics. Trap-neuter-release programs can, under circumstances similar to those we are studying,

bring a feral cat colony to extinction. We have observed that happen. But as to how long will it take, the best answer we can provide at this time is somewhere between 4 or 5 years and more than a decade. Trap-neuter-release programs as currently managed are not likely to be good solutions when acute issues (eg, severe impacts on highly endangered species) can only be addressed by rapid extinction of a feral cat colony.

What Needs to be Done From Here?

As a research scientist, I have to make a plea for more study and more knowledge. However, that will not be enough. There are important questions that our studies will not address. The actual impact of feral cats on wildlife species can be determined only by analysis of carefully collected data. Our experience suggests that impacts will vary dramatically with the wildlife species being examined, the prey base and predator make-up of the ecosystem involved, the feral cat management strategies employed, and other factors. Better and more practical research on trapping of feral cats, including initial bulk trapping and sustained immigration management, would likely benefit feral cat management efforts. Our work is designed to look at a uniform colony type managed with close human contact. The cats in our colonies are not like some other feral cats, which are almost completely wild creatures living far from human contact. Studies similar to ours, but conducted in other environments and with other management variables examined, could help improve our ability to predict the impact of managing feral cat colonies under different conditions.

The most important plea I feel I can make for the future is for the dedicated and experienced individuals involved in feral cat management to recognize that 1 solution probably will not solve all feral cat challenges. Individuals holding different views on feral cat management must find ways to work together in a rational atmosphere of cooperation. A varied array of tools needs to be available to facilitate humane solutions to a highly varied set of problems posed by the amazingly adaptable feral cat. High-level TNR management as currently defined and administered can be one of these tools in certain situations in which time and resources are available.

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