IMPACT ASSESSMENT OF A TRAP-NEUTER-RETURN PROGRAM ON SELECTED FEATURES OF AUBURN, ALABAMA FERAL CAT COLONIES

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IMPACT ASSESSMENT OF A TRAP-NEUTER-RETURN PROGRAM ON SELECTED FEATURES OF AUBURN, ALABAMA FERAL CAT COLONIES

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IMPACT ASSESSMENT OF A TRAP-NEUTER-RETURN PROGRAM ON

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VITA

Kimberly Byrd Subacz, daughter of Jackie and Gilda (Wright) Byrd, was born March 16, 1978, in Mobile, Alabama. She attended St. Paul's Episcopal High School and graduated in 1996. She entered Auburn University in 1996 and graduated with a Bachelor of Science degree in Wildlife Science in August 2000. She entered Graduate School at Auburn University in January 2001. She wed Jonathan Lawrence Subacz, son of Lawrence and Theresa (Solowynsky) Subacz on May 17, 2003. They have two sons, Matthew Jonathan age 2 and William Jack born November 27, 2007.

THESIS ABSTRACT

IMPACT ASSESSMENT OF A TRAP-NEUTER-RETURN PROGRAM ON

SELECTED FEATURES OF AUBURN, ALABAMA

FERAL CAT COLONIES

Kimberly Byrd Subacz

Master of Science, May 10, 2008
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Feral cats (*Felis catus*) are defined here as offspring of domestic cats raised without human socialization or cats that were previously owned that have reverted to a wild state not trusting humans. A feral cat colony consists of a group of cats that regularly reside in a particular area which includes a food source and shelter. A non-lethal approach to feral cat control known as Trap-Neuter-Return (TNR) has been used with increasing frequency over the past decade. TNR involves trapping all cats at a location for surgical sterilization and subsequently returning them to their respective colony site. This investigation's main focus was to determine what effects TNR has on feral cats located on Auburn University's campus located in Auburn, Alabama. Specifically, the influence of TNR on population size, home range size and habitat use of 7 colonies of feral cats was evaluated. Population parameters were measured for 1 year before and 1 year after initiating treatment to determine the effects of TNR on the Auburn feral cat colonies.

Seven box-style feeding stations were established at 7 pre-existing unmanaged feral cat colonies (Graywood, Jennings, Mack's, Thach Hall, Ingram Hall, Horticulture and Theta Xi). Photographic sampling using infrared-triggered cameras from inside each feeding box was conducted once every two weeks. During the two-year study, 4,924 photographs were produced and analyzed. A total of 99 individual cats were identified in photographs from the 7 colonies. Total cats identified per colony ranged from 7-30 cats. The Chapman model for mark-recapture used a 95% confidence interval to analyze data in 3-month intervals. The Chapman model was successful for estimating 4 of the 7 colony populations due to their larger colony size (n=5-21). Photographic sampling results from the 3 smaller colonies (Ingram Hall, Horticulture, and Theta Xi) periodically resulted in only 1 cat photographed for weeks at a time. With only 1 cat sited the Chapman model produced a population outcome of n=0. Therefore, the smaller colonies were not analyzed further. Graywood feral cat colony grew significantly larger (p=0.002) from pre-TNR ($\overline{X}$ =9.2, SD=2.2, n=4) and post-TNR initiation ($\overline{X}$ =15.5, SD=1.1, n=4) treatment. Thach Hall had a similar outcome although not significant (p=0.49). Jennings and Mack's had a decrease from pre-TNR to post-TNR initiation however neither difference was significant (p=0.34 and p=0.49). Photographic sampling was an accurate and reliable way to census these colonies of feral cats. Longer study duration is

recommended to determine possible impact of TNR on the population size of feral cat colonies.

The mean home ranges were calculated as minimum convex polygons or (MCP) and then categorized by sex and TNR status. The MCPs were compared using the proc_glm ANOVA with Tukey's multiple comparison test. Overall the model was not significant (F=2.67) with p=0.0668. There were differences among male ($\overline{X}$ =8.5 pre-TNR and $\overline{X}$ =3.6 post-TNR initiation) and female ($\overline{X}$ =2.5 pre-TNR and $\overline{X}$ =2.2. post-TNR initiation) home ranges, but due to a small sample size and high variability the results were not significant.

Lawn, hardscape and structures composed over 65% of the study area with roadway, landscaping, woods, scrub, and water composing the other portion of study area. The most common habitats in the pre-TNR and post-TNR MCP were hardscape, structures, and landscaping. Within the MCP both pre-TNR and post-TNR initiation feral cats significantly preferred woods over other habitat types.

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The author would like to thank Dr. Lee Stribling for his steadfast support throughout the author’s term at Auburn University. I would also like to thank Dr. Brenda Griffin. I do not believe this project would have continued without her endless support, kindness and dedication towards me and the plight of all homeless animals in need today. Additional thanks to Drs. Gary Hepp, Jim Armstrong, Henry Baker, and Jim Wright for their instruction, knowledge and support during the course of this investigation. A great deal of gratitude is due to all of my student technicians and veterinary summer fellows. You know who you are and your help was greatly appreciated. A big thank you goes to Theron Terhune for his vast help with data analysis. The author wishes to thank the following companies whose grants and donations aided this investigation: PETsMART Charities, Sweet Bay Foundation, Nestlé Purina PetCare, Schering-Plough Animal Health Corporation, Merial Pharmaceuticals, IDEXX Laboratories, Inc. and Moultrie Feeders. The author would especially like to thank her dedicated husband Jonathan for the countless nights he spent working more on her project than his own thesis. With your love and support I was able to complete this thesis and start our family with our two sons Matthew and William. Thanks are also due to my parents Jack and Gilda and my brother Lee for their loving support during the author’s term at Auburn University.

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I. INTRODUCTION

FERAL CAT BACKGROUND

Feral cats defined

Feral cats are defined as the “wild” offspring of domestic cats that have been abandoned by their owners (Griffin 2001*a*). According to Levy et al. (2003*b*) feral cats are offspring born without human socialization or were owned cats returned to the wild that do not trust humans. Feral cats generally do not accept handling, will flee if approached, and must be trapped to receive veterinary care. Without proper human socialization as kittens, primarily between the ages of 2 and 7 weeks of age, a cat may never accept handling and may maintain a somewhat feral lifestyle (Turner and Bateson 2000). Feral cats usually establish colonies around areas that suit their basic needs of food and shelter (Griffin 2001b). Some feral cat colonies have a human caretaker who oversees the colony. Caretaker duties vary depending on the person, but some responsibilities may include: monitoring the cats for illness or any new kittens, feeding them regularly, have a general understanding of the colony and its history, and sometimes trapping the cats for participation in a feral cat TNR program.

Feral cat lifestyle

The classification of cat lifestyles between feral and household pet is often not clear cut (Berkeley 2004, Centonze and Levy 2002, Levy et al. 2003*a*, Patronek 1998). Cats can change their status quickly from an owned house cat, to a free-roaming, neighborhood stray. Miller (1996) classifies cat lifestyles into four categories: the true feral or independent cat, the domesticated household pet, and two intermediate zones of interdependent, unowned free-roaming cats (strays) and interdependent, loosely owned domestics (neighborhood cats or barn cats). The distinguishing characteristic between the latter two categories is what Miller refers to as the “touch barrier.” A cat that voluntarily accepts handling crosses this “barrier” reverting from a stray lifestyle to more of a loosely owned domestic cat. During this study, the author witnessed several examples of the flexible and dynamic lifestyles of cats. Perhaps the most dramatic example that was observed occurred when a cat that was well documented to possess a truly feral lifestyle (study cat #1) accepted handling for the first time after sustaining severe traumatic injuries and changed its lifestyle to become a domesticated house cat (Griffin, B., K. B. Subacz, and M. Bohling, Auburn University, unpublished data). The author witnessed cat #1 (an 11-year old spayed female feral cat named “Momma Kitty”) revert to a domestic lifestyle with her caretaker following surgical correction of multiple severe, pelvic injuries which presumably resulted from being hit by a car. In fact, according to the caretaker, she became a lap cat and peacefully coexisted with four other cats in her household until her death in 2006 from complications due to old age.

Feline overpopulation

Feline overpopulation is a complex and multi-faceted issue that is facing the United States. In 2001 there were approximately 70.8 million owned cats in the United States surpassing the number of owned dogs (AVMA 2002). Lack of owner commitment and responsible pet ownership contribute greatly to the pet overpopulation problem (AVMA 2002, Luke 1996, Slater 2000, Griffin 2001*a*). Manning and Rowan’s (1998) surveys conducted in Massachusetts found that 90% of owned cats were sterilized, but those sterilized animals had previously given birth to 0.313 litters before the procedure. The birth rate of the sterilized animals was similar to those of intact animals at 0.40 litters (Manning and Rowan 1998). When owners of non-sterilized pets were asked why they had not had the procedure done the top five reasons were that the pet was confined (32%), they wanted to breed the pet (24%), the belief that the pet was too young (18%) and that sterilization was just inconvenient (11%). Cost of the procedure also plays a factor in the sterilization of cats. In Santa Clara County, California a survey indicated 86.2% percent of owned cats were sterilized, but 16.3% of those had previously had a litter before being altered (Johnson et al. 1994). The reasons for these litters were owners failing to recognize the signs of cat estrus and owners' lack of knowledge on the age when a cat attains puberty. A survey of 12 shelters located in different regions of the United States determined that 65-79% of cat owners relinquishing their pet did not know how often their cat cycled into heat (Salman et al. 1998). Top risk factors for cats being relinquished to shelters included being sexually intact, allowed outdoors, never receiving veterinary care and frequent house soiling (Salman et. al 1998).

It appears that cats are at times treated like second-class pets when compared to dogs by receiving less care (Griffin 2001*a*, Luke 1996, Salman et. al 1998). Cat owners are less likely to view their cats as member of the family than dog owners (AVMA 2002). Pet owner surveys demonstrate that most often cats are not sought out directly for ownership. Often times it is the cat, which finds the people (Luke 1996 and Miller 1996). Public policy regarding registration and licensing of cats is lacking (Luke 1996).

Accurate estimates of the feral cat population do not exist, however it is suspected that their population is similar to that of owned cats in the United States (Levy et al. 2003*a*). The free-roaming cat population in Alachua County, Florida (defined here as both feral and stray cat populations) was estimated to represent as much as 44% of the domestic cat population in that study (Levy et al. 2003*b*). Santa Clara County, California estimates stray cats are 41% of the total known cat population (Johnson et al. 1994). Feral and free-roaming cats are a large portion of the cat population in the United States and must be included in population control strategies.

Once symbols of fertility in Ancient Egypt, cats possess prolific reproductive capabilities. They are long-day cyclers and their breeding season begins in February and ends in late September, with peaks from February to March and May to June (Feldman and Nelson 1996). Feral cats attain puberty between 5 and 9 months of age and typically produce a mean of 1.4 litters per year, with a mean of 3.6 ± 0.2 or a median of 3 kittens per litter (Nutter et al. 2004*b* and Scott et al. 2002*b*). The mortality rate of feral kittens is 75% by 6 months of age (Nutter et al. 2004b).

Large populations of sexually intact cats are also documented in the clinic records of Operation Cat Nap, Auburn University's feral cat Trap Neuter Return (TNR) program. Of the feral cats entering Operation Cat Nap's surgery clinics from 2000 until 2006, 5.4% of the 1101 feral cats were previously sterilized (Griffin, B. and K. B. Subacz, Auburn University, unpublished data). This is similar to the 2% of the 11,822 feral cats previously sterilized in Alachua County, Florida's TNR program from 1998 until 2004 and the 4% of 14,452 feral cats submitted for TNR in San Diego from 1992 until 2003 (Foley et al. 2005).

FERAL CAT CONCERNS

The primary concern to the public surrounding feral cats would be sanitation and feline zoonotic diseases. Feline zoonotic diseases can be transmitted from cats to humans and include rabies, toxoplasmosis, dermatophytosis and cat scratch disease among others. Rabies is the zoonotic disease that receives the most attention since it is fatal once symptoms are present. Rabies has a long incubation period and can infect any warm blooded animal. The rabies virus is shed in saliva and is spread from a bite or scratch. The human rabies vaccine is strongly recommended for anyone working with stray animals. Vaccination of feral cats for rabies is recommended in endemic areas (Slater 2000).

Toxoplasmosis (*Toxoplasma gondii)* is an intracellular coccidian parasite that is spread to humans from undercooked meat or cat feces. Toxoplasmosis can get into fresh water sources from cat feces and has been linked to infections in certain wildlife species (Dabritz, et al. 2006). Dabritz (2006) found that owned cats being allowed outdoors accounted for 72% of the annual outdoor feline fecal composition with feral cats contributing the remainder. Toxoplasmosis usually does not cause disease in healthy humans, but can affect the immunocompromised and may result in abortion or birth defects in pregnant women. The incidence is very low, but individuals at high risk should take precautions. Cat scratch disease (*Bartonella henselae*) and ring worm (Dermatophytosis) are non-life-threatening zoonotic diseases associated with both feral and pet cats. Nutter et al. (2004a) suggests feral cats have a significantly higher rate of cat scratch disease and toxoplasmosis while other diseases (*Toxocara cati*, *Giardia* spp, and *Cryptosporidium* spp) were similar to those of owned cats.

Other issues involving the public are complaints to animal control agencies over feline nuisance behaviors often associated with breeding including: roaming, territorial marking (spraying and defecating), fighting and yowling. Animal control agencies handling feral cat complaints and control are a high cost to taxpayers (Hughes et al 2002, Levy et al. 2003*b)*.

Predation of feral cats on wildlife is a very controversial issue surrounding feral cats (Ash 2001, Ash and Adams 2003, Berkeley 2004, Patronek 1998, and Turner and Bateson 2000). Rodents make up a majority of prey followed by birds (Berkeley 2004, Turner and Bateson 2000), however cats are opportunists and will feed on whatever prey item is in abundance (Liberg 1984). Predation is a complicated and emotional issue and more scientific studies are needed particularly in the mainland United States to determine their impact on wildlife.

The welfare of the cats themselves is often a concern. The mortality of feral kittens is greater than 75% (Nutter 2004*b*), however once a kitten makes it to adulthood its chances for survival increase. The incidence of diseases such as Feline Leukemia Virus (FeLV) and Feline Immunodifficiency Virus (FIV) in feral cats is very low (<5%) and similar to pet cats (Lee et al. 2002, Luria et al. 2004, Levy et al. 2006). Transmission of both of these diseases are greatly reduced when a feral cat colony is sterilized. Stoskopf and Nutter (2004) conclude feral cats enrolled in TNR programs with vaccination and parasite control do not lead a meager existence or have a greater risk of zoonotic diseases than owned cats. Scott et al. (2002*a*) stated that feral cats gain weight and body fat after sterilization similar to pet cats.

JUSTIFICATION

Past feral cat colony control has often been restricted to exterminations attempts, but TNR is rapidly becoming a more acceptable control method. Public outcry can be a powerful reason not to euthanize feral cat colonies (Passanisi and McDonald 1990) and can be influential in policy making. For example, policies protecting wild horses and burros in the United States and harp seal pups in Canada directly resulted from pressure exerted by the public and animal protection organizations (Levy 2000). Slater (2004) states that public dynamic is shifting towards viewing companion animals as more valuable than just their monetary value. A recent study determined that the general public is slightly more supportive of TNR (54.6%) as opposed to removal (42.2%) for cats located on the Texas A&M University campus (Ash 2001). This same study estimated that 44% of the public agreed feral cat overpopulation was a serious biological issue but did not value the lives of wildlife species more than the lives of the feral cats (Ash and Adams 2003).

TNR has been in practice for over 25 years (Hammond 1981 and Jackson 1981) but is relatively new to the United States. Cats are trapped, spayed or neutered, vaccinated against disease, and then returned to their home colony. The tip of the left ear is cropped as a universal symbol of being enrolled in a TNR program. Caretakers are identified and are responsible for monitoring and feeding the cats in their colony. In Orange County, Florida TNR is a more cost effective means of animal control than impoundment and euthanasia (Hughes et al. 2002). Although more studies (Foley et al. 2005, Lee et al. 2002, Levy et al. *2003a,b,* Nutter et al. 2004*b,* Scott et al. 2002*b)* have recently been published, much is still unknown about the success of TNR as a method of feral cat control. Well-designed studies to document the specific effects of TNR on population dynamics of cats are necessary to provide insight into the impact and effects of this management method. In addition to preventing reproduction of cats, TNR promotes responsible cat stewardship and recognition of the fundamental needs of this domestic species.

RESEARCH OBJECTIVES

The primary objective of this investigation was to determine the effects, if any, that feral cat control using TNR has on the population size, home range size, and habitats used by existing feral cat colonies before and after TNR. In order to analyze population size as the first goal, 7 feeding stations were established in areas where unmanaged feral cats were known to reside. These 7 colonies were located on the Auburn University campus and the immediate areas surrounding campus in downtown Auburn, Alabama. All colonies were monitored for one year before and one year after a TNR program was implemented. Population size was monitored by camera census and visual observations, as well as results from trapping events. Literature review, methods, results and discussion of this portion of the study are presented in Chapter II.

The second goal was to examine the feral cats' home range and to determine preferred habitat and frequency of use. Preferred habitat of individual cats was determined using radio telemetry and visual identification. Home range and habitat use were compared for the year before and after TNR was implemented. Literature review, methods, results and discussion of this portion of the study are presented in Chapter III.

ORGANIZATION

The organization of this report follows the guidelines for a publication style thesis as outlined in the *Guide to Preparation and Submission of Theses and Dissertations* printed by the Auburn University Graduate School. The results of the investigation are provided in Chapters 2 – 3 of this thesis, which are prepared as manuscripts for journal submission.

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II. CENSUSING FERAL CAT COLONIES BEFORE AND AFTER INITIATING TRAP-NEUTER-RETURN

ABSTRACT

Objectives—(1) To determine if infrared-triggered cameras at feeding sites can be used to census feral cat colonies and (2) to determine the effect, if any, of Trap-Neuter-Return (TNR) on the population size of feral cat colonies.

Design— Prospective study.

Sample Population--Seven feral cat colonies located in Auburn, Alabama during 2003-2005.

Procedure—Population estimates were made using infrared-triggered cameras mounted in each feeding station surveying every 2 weeks for one year before and one year after initiating TNR of 7 feral cat colonies (February 2003 - March 2005). Camera census data were analyzed using Chapman model for mark-recapture studies. Pre-TNR population estimates for 4 locations were averaged and compared to post-TNR estimates using proc-TTest in SAS ® version 8.2.

Results-- During the two-year study, 4,924 photographs from the 7 feeding stations were produced and analyzed. A total of 123 individual cats were identified in photographs from the 7 colonies. Total cats identified per colony ranged from 7-30 cats. The Chapman model was successful for estimating 4 of the 7 colony populations due to their larger colony size (n=5-21). Photographic sampling results from the 3 smaller colonies periodically resulted in only 1 cat photographed for weeks at a time. With only 1 cat sited the Chapman model produced a population outcome of n=0. Therefore, the smaller colonies were not analyzed further. Graywood feral cat colony grew significantly larger (p=.002) from pre-TNR (X=9.2, SD=2.2, n=4) to post-TNR initiation (X=15.5, SD=1.1, n=4) treatment. Thach Hall had a similar outcome pre-TNR ($\bar{X}$ =7.9, SD=1.6, n=4) to post-TNR initiation($\bar{X}$ =9, SD=0.6, n=4) although not significant (p=.49). Jennings and Mack's had a decrease from pre-TNR ($\bar{X}$ =9.4, SD=3.5, n=4 and $\bar{X}$ =17, SD=4.3, n=3) to post-TNR initiation($\bar{X}$ =7.5, SD=1.3, n=4 and $\bar{X}$ =15, SD=1.6, n=4) however neither difference was significant (p=.34 and p=.49).

Conclusions and Clinical Relevance— The method of photographic sampling was an accurate and reliable way to identify individual members in feral cat colonies, however, the Chapman model was not effective in estimating colonies with smaller cat populations. Longer study duration is recommended to determine the impact of TNR on the population size of feral cat colonies.

Key words: feral, cat, cameras, population, management, trap neuter return

INTRODUCTION

In recent years, public awareness regarding the large numbers of feral cats residing throughout the United States has increased and interest in controlling them is growing. Feral cats are defined here as offspring of domestic cats raised without human socialization or cats that were previously owned that have reverted to a wild state not trusting humans (Griffin 2001 and Levy et al. 2003*b*). Feral cats generally do not accept handling, will flee if approached, and must be trapped to receive veterinary care.

Although accurate estimates of the feral cat population do not exist, it is suspected that their population size is similar to that of owned cats which was 70.8 million in the United States in 2001 (Levy et al. 2003*a*, AVMA 2002).

Over the past decade, Trap-Neuter-Return (TNR) programs have been used to control colonies of feral cats with increasing frequency in the United States. Cats are trapped, spayed or neutered, vaccinated against disease, and then returned to their home colony. The tip of the left ear is cropped as a standard symbol of being enrolled in a TNR program (Figure 1). Caretakers are identified and are responsible for monitoring and feeding the cats in their colony.

TNR is supported by many organizations including the American Association of Feline Practitioners (AAFP) and the American Animal Hospital Association (AAHA) as a method to control existing colonies of feral cats provided they are not located in wildlife refuges. A private non-profit humane organization called Alley Cat Allies (ACA 2006) serves as a national resource for information on TNR of feral cats.

Within the last decade an increasing number of universities have used TNR to control campus feral cat populations. The transient nature of college students and abundance of food and shelter for cats on campuses may lead to feral cat colony establishment. Stanford University was a pioneer in the effort to humanely manage its campus ferals. The initial 1989 population was estimated at 1,500 and was successfully reduced to approximately 200 cats by 2002 through TNR and adoptions (SCN 2002). A University of North Texas TNR program reduced their population of over 100 feral cats to 34 cats in only 3 years (UNT 2002). Texas A&M also experienced a reduction in campus cat numbers using TNR (AFCAT 2002). After management using TNR and adoptions for 11 years Levy et al. (2003*a*) determined this method to successfully reduce the feral cat population at the University of Central Florida.

According to Passanisi and McDonald (1990), past measurements of the effects of neuter and return programs are uncertain because a majority of the information available is anecdotal and called for further scientific study. Passanisi and McDonald (1990) concluded that for TNR programs to be effective, long-term caretaker commitment is critical, otherwise, managed colonies will potentially rebound over time.

A few studies have examined the usefulness of TNR at reducing the population of feral cat colonies. One study conducted in a London park successfully controlled the population of 2 feral cat colonies. This TNR program decreased the colony numbers, reduced aggressive behavior within the colony, and eliminated cat predation of waterfowl (Neville and Remfry1984). In contrast, a Miami, Florida study found TNR ineffective at controlling feral cat populations over 1 year due to influx of abandoned cats at the site (Castillo 2001). This study was conducted at 2 south Florida public parks with highly visible, well-fed, and well-publicized feral cat colonies. Levy et al. (2003*a*) evaluated an 11-year long TNR and adoption program on the University of Central Florida with the following results "A comprehensive long-term program of neutering followed by adoption or return to the resident colony can result in reduction of free-roaming cat populations in urban areas." After Orange County Florida's animal control service implemented a TNR program, complaints leading to impounded cats and euthanasia of impounded cats decreased while surgeries and adoption rates increased, saving the county money (Hughes et al. 2002).

Nutter et al. (2004) studied over 2,300 free-roaming cats in North Carolina and determined their reproductive capacity was high with queens producing a mean of 1.4 litters/year with a median of 3 kittens/litter. Kitten mortality was high (75% by 6 months of age) with trauma being the most common cause of death. These results are similar to a survey of a Florida TNR program (Scott et al. 2002) with over 5,300 feral cats producing a mean litter size of 3.6±0.2 fetuses. Pregnancy rates peaked in March and April in both studies (Nutter et al. 2004 and Scott et al. 2002).

There are many methods used to estimate feral cat populations. A majority of the previous studies have used public surveys using either phone interviews or written questionnaires to estimate feral populations (Centonze and Levy 2002, Johnson et al.1994, Levy et al. 2003*b*). The free-roaming cat population in Alachua County, Florida (defined here as both feral and stray cat populations) was estimated to represent as much as 44% of the domestic cat population (Levy et al 2003*b*). Santa Clara County, California estimates stray cats are 41% of their total known cat population (Johnson 1994). Other population estimations have been made based on TNR surgery clinic intake data. Levy et al. (2003*a*) used reports from volunteers and caretakers recorded over a period of 11 years to determine the feral cat population and track its changes at the University of Central Florida campus. Foley et al. (2005) created a population model using data from 2 large-scale TNR clinics. Anderson et al. (2004) used published feral cat vital rates to model a comparison of feral cat populations managed with TNR against euthanasia.

Auburn University's Operation Cat Nap (OCN) is a TNR program which was started January 2000 with support from Auburn University's College of Veterinary Medicine and the Scott-Ritchey Research Center. Operation Cat Nap is endorsed by the

Dean of College of Veterinary Medicine and by the Office of the Provost as the University Program used to control feral cats on main campus. Auburn University had an estimated population of 150 feral cats when this study began in 2003. This population was estimated using OCN surgery clinic intake forms and corroborated with caretaker reports and email requests. In November of 2005 the Auburn University campus cat population was approximately 45 feral cats estimated from visual sitings, caretaker questionnaires and OCN records.

Because little information exists to support that TNR is an effective method for controlling cat populations, a reliable, non-invasive model for long-term censusing of cats would represent a valuable tool in future studies designed to measure the effects of TNR on cat populations. A camera census technique has been developed to estimate white-tailed deer (*Odocoileus virginianus*) and bobcat (*Lynx rufus*) populations (Jacobson et al. 1997, Koerth and Kroll 2000, and Heilbrun et al. 2003). In these studies infrared-triggered cameras were installed at white-tailed deer feeding stations and bobcat scent stations to attract the animals in the area and capture them in photographs. To the authors' knowledge this method had not been used to estimate feral cat population size. The first objective of this study was to determine if this technique could be used with feral cat colonies.

The second objective was to use this census technique to determine the effect, if any, of TNR on the affected population size of 7 feral cat colonies in Auburn, Alabama. Population size was monitored by photographic sampling, visual observations and results from trapping events for 1 year before and 1 year after TNR was implemented.

Studies are needed to clearly measure the impact TNR has on feral cat populations. Involvement of veterinarians is central to TNR programs, therefore such studies can aid veterinarians in making informed decisions about the success of TNR as a management method.

MATERIALS AND METHODS

Description of Site

Seven feral cat colonies located on the Auburn University campus (Figure 2) and the immediate areas surrounding campus in downtown Auburn, Alabama were selected for the 2003-2005 study. These colonies were surrounded by a relatively dense human population. On average 23,000 students are present on campus at any time with 3,680 (16%) of them residing on the 745 hectare campus (AU 2006*b*). Auburn University employs approximately 9,400 faculty and staff. At the time of this study, the combined population of Auburn and its adjoining city Opelika was approximately 66,000 (AU 2006*a*). Feral cat colonies have been documented on the campus for at least 30 years preceding the study (Griffin, B., Auburn University, personal communication).

The 7 feral colonies (Graywood, Horticulture, Ingram Hall, Jennings, Mack's, Thach Hall and Theta Xi) chosen for this project (Figure 2) were selected because to the authors' knowledge they had no regular caretaker or previous management efforts. To aid in photographic censusing, a feeding station was installed in the area where these feral cats were known to reside. Each colony was assigned a volunteer caretaker. Caretakers were provided with basic information about feral cats and TNR as well as a description of the project. Appendix A contains the orientation materials and instructions for the caretakers. A standardized commercial dry cat food (Purina ONE Salmon and Tuna flavor, Nestlé Purina PetCare Company, St. Louis, MO) was provided as needed for the duration of the study. Caretakers were told to provide food and fresh water daily, preferably in the morning to minimize the amount of food left in the shelter during the night when wildlife species were more likely to be present. Caretakers were also asked to record descriptions of cats sited at their feeders. All 7 feeders and colonies were cared for and monitored for 1 year before and 1 year after the TNR program began. Besides designated caretakers, feeding stations were maintained and monitored by the authors and student assistants as needed.

Methodology

Feeding station establishment

Feeding stations (Figure 3) were installed at the 7 locations in December of 2002. The feeding station design (Figure 4) was a modified version of a feral cat shelter design from the Alley Cat Allies website (ACA 2002). The design is a (½”) plywood base (3’ wide X 2’ deep) covered with vinyl tile flooring with siding 18” high sloping down to 12” supported by 2” X 4” X 11” (or 17”) supports and an overhanging hinged (½”) plywood roof (3’ 3” wide X 2’ 7” deep) covered with asphalt shingles. Cats accessed the feed and water through an opening (7” high X 7” wide) in the front of the box. Each feeding station was equipped with a commercially available pint-sized pet food bowl or a larger reservoir-type automatic feeder and automatic waterer (Figure 5). The quantity of food consumed varied among colonies. For colonies where the food supply was consumed almost immediately a larger reservoir-type automatic feeder was used in place of the bowl to ensure an adequate feed supply. For colonies with less feed consumption, pint or quart-sized bowls were maintained to limit the amount of food left in the shelter overnight. Shelters were monitored daily for approximately 2 weeks, then checked a minimum of 3 times a week. Food and water were replenished as needed by the feral cat caretaker, the authors, or student assistants.

Photographic sampling methods

Population estimates were made using infrared-triggered cameras (Moultrie Gotcha Cam, © Copyright 2003 – 2005 EBSCO Industries, Inc., Birmingham, AL) mounted in each feeding station. Cats triggered the camera to take a picture by breaking the infrared beam emitted from the camera. The cameras may be set for either a shot delay interval of 6 seconds or 6 minutes in order to prevent using all frames on one individual that remained feeding for several minutes. We selected a shot delay of 6 seconds for our sampling because cats generally do not devote 6 minutes to feeding and new cats entering immediately behind would be missed with the longer setting. The camera imprinted the date and time on each picture (Figure 6). As developed for white-tailed deer and other species, the camera census uses the photos as a mark-recapture method of population estimation. During the first round of photographic sampling, cats are identified by coat color and pattern and any other distinguishable features. Once a cat is photographed and identified it is considered to be a “marked” individual. These "marked" cats were considered "recaptured" if they were photographed and identified in subsequent photographic sampling periods. Additional data obtained from photographs included: feeding station location, date, time and number of identifiable cats. In this study one author (Subacz) analyzed all photographs. Photographic surveys (one 24-exposure film roll) were conducted approximately every 2 weeks from February 2003 through March 2005. Length of survey period varied from several minutes to 2 weeks depending on how long it took for the 24 exposure film roll to be used. Eighty four percent of the surveys were completed within 24 hours. The variability in length of time surveyed was inversely correlated to colony population size. The 4 colony locations with larger populations (5-21 individuals per colony during a sampling period) and frequent visual and photographic sitings (Jennings, Thach Hall, Macks, and Graywood) completed their surveys within 24 hrs. >95% of time surveyed.

Pre-TNR (year 1) trapping methods

Based on photographic censuses and visual sitings, it was estimated approximately 31 cats were regularly seen at the 7 feral cat colonies. During the pre-TNR phase of the project, these 31 cats were trapped during 6 different trapping events spanning from March through July of 2003. All cats trapped during the study were assigned a number (1-90) with the pre-TNR cats being numbers 1-31 respectively. The goal was to monitor these 31 initial cats for 1 year before the TNR program and 1 year after the TNR program via radio telemetry as part of a companion study to assess home range and habitat use. Caretakers were advised to withhold food and empty feeding stations of any remaining food 2 days prior to each trapping period. Cats were trapped from dusk until dawn over the course of several days according to protocol of the Auburn University feral cat TNR program, Operation Cat Nap (Appendix B). Trapping occurred around the established feeding stations using baited Tomahawk live traps model #606 (approximately 26” long X 9” wide X 9” high) (Tomahawk Live Trap Company, Tomahawk, WI). Bait used included canned mackerel and a standardized commercial dry cat food (Purina ONE Salmon and Tuna flavor, Nestlé Purina PetCare Company, St.

Louis, MO, USA) the cats were already eating. Other bait techniques such as used kitty litter were attempted with unsuccessful results.

Pre-TNR (year 1) laboratory protocol

Captured cats were transported to the multi-purpose laboratory of the College of Veterinary Medicine (an IACUC approved facility) and held in their cages for the duration of each trapping phase and data collection. In order to transport feral cats safely, personnel handling the cats were vaccinated against rabies and wore thick leather gloves. There were no scratch or bite incidents during this study. Cats were held for no longer than 4 days in their traps. Each trap was covered with a thick, waterproof pad, outfitted with a food and water bowl, and elevated off the ground for removal of waste during holding (Figure 7).

Anesthesia

Captured feral cats were anesthetized with an anesthetic cocktail called TKX (Telazol + Ketamine + Xylazine) at a dosage of 0.15 - 0.25 mL per cat depending on their size (Williams et al. 2002 and Cistola et al. 2004) prior to removal from trap. Cats were handled in a humane manner and all procedures complied with the requirements of the Institutional Animal Care and Use Committee for Auburn University (IACUC # 2002-0137). Cats were injected while in the traps by using a trap divider to confine the cat to one end of the trap to allow intramuscular (IM) injection into the hind limb musculature. If additional anesthetic time was required, isoflurane and oxygen via mask or endotracheal tube were administered as needed.

Data Collection

Once trapped, each cat was assigned a sequential identification number for the length of the study (1-90). Individual data on each cat was collected during physical examination including: cat #, date trapped, date of data collection, date released, location trapped, size of cat (small, medium, large), sex, coat color and pattern, distinguishing features, eye color, domestic short hair or domestic long hair (DSH, DLH) coat length, estimated age, body weight (lbs), general body condition, reproductive status, administration of subcutaneous (SQ) fluids, results of Feline Leukemia Virus and Feline Immunodeficiency Virus (FeLV/FIV) testing, rabies vaccination, penicillin injection, microchip number, radio collar, and frequency (Appendix C). Coat color and pattern were determined using the Cat Coat Color Chart developed by Operation Cat Nap (Subacz and Griffin 2002). General body condition was determined using Purina's Body Condition Chart (Purina 2002). In addition, each cat was photographed to aid in future identification. Rabies vaccinations (Imrab 3, Merial Pharmaceuticals, Duluth, GA) were administered subcutaneously in the right hind limb of each cat and blood was collected via jugular venipuncture and tested for FIV and FeLV (snap IDEXX Laboratories, Inc., Westbrook, ME).

Radio Transmitters and Microchips

As part of a companion study to assess home range and habitat use, cats of varying ages (14 weeks to 9 years) were fitted with transmitters attached to adjustable collars model TS-24 (Telemetry Solutions, Concord, CA). The radio transmitter batteries were designed to last 24 months at 55 pulses/min, weighed 13 grams, and were equipped with a mortality/activity switch. Each collar had a nylon covering to protect the built in antenna. This nylon cover was spray painted a distinct color to help with identification of similar looking cats at the same colony site. The radio collars were visible in the photos and frequently helped with cat identification. Finally, all cats were implanted with identification microchips subcutaneously on the dorsum between the shoulder blades (Home Again, Schering-Plough Animal Health Corporation, Kenilworth, NJ).

Anesthetic Reversal and Release

Anesthetic reversal was achieved with yohimbine (2mg/ml; 0.5 ml/cat IM or IV). An additional dose of yohimbine was given after 30 minutes if reversal results were inadequate. The cat was returned to the trap immediately after reversal. Carefully monitored heat lamps were used to ensure adequate body warming during recovery. Cats were monitored overnight following anesthesia to assess any effects from sedation. Once it was determined the cats were awake, alert, and eating they were released at their individual colony location.

Post-TNR initiation (year 2) Laboratory Protocol

For the study, Trap-Neuter-Return program procedures began in April of 2004. Trapping and general laboratory procedures were repeated according to previous methods during 9 separate trapping events spanning from April 2004 until April 2005. All cats trapped during this period (11 previously radio collared cats and all new cats #32-90) were managed according to Operation Cat Nap guidelines as described above.

Data Collection

The method of data collection in 2004 was similar to that in 2003. The following information was added to the data collection sheets due to management: eartip, sterilize, FVRCP, Ivomec, Frontline, packed cell volume, and total solids. Cats were given a complete physical examination, Rabies vaccination, Feline Viral Rhinotracheitis, Calicivirus, Panleukopenia (FVRCP) vaccination, Ivomec 1% solution 0.1 ml/cat subcutaneously (to treat ear mites, round and hook worms), FeLV/FIV testing, Frontline Plus Top Spot (for flea control), Procaine Penicillin G dose, the distal tip of the left ear was removed (Figure 6), and every cat was surgically sterilized (males underwent surgical castration, females ovariohysterectomy). In order to help with the identification of cats in locations where several cats had very similar markings, we used different ear crops to distinguish these cats. For example, in the case of 2 solid black cats, we cropped the left ear on the first cat and the right ear on the second cat. Cats that were pregnant or dehydrated also received 150 ml lactated ringers solution subcutaneously. Cats were monitored for 24 hours post surgery and then released at their colony locations. At the end of the study in 2005, radio collars were removed and data was collected from 5 of the 14 remaining radio collared cats. The remaining cats with radio collars were too trap savvy at this point in the study to capture a third time despite employing alternative trapping methods such as a drop traps.

Data Analysis

Camera census data was analyzed using Chapman (1951) model with a 95% confidence interval (Seber 1982) for mark-recapture studies. Each year was divided into 4 periods of 3 months. The first 3 month sampling period (n_1) was compared to the following 3 month sampling period (n_2) and recaptured individuals were determined (m_2) resulting in a population estimation (N) for that 6 month time period. The Chapman model for capture-recapture uses the following equation:

$$\hat{N} = \left[\frac{(n_1 + 1)(n_2 + 1)}{(m_2 + 1)}\right] - 1$$

Confidence intervals were calculated using Seber (1982) equation for the variance of N:

$$Var(\hat{N}) = \frac{(n_1 + 1)(n_2 + 1)(n_1 - m_2)(n_2 - m_2)}{(m_2 + 1)^2(m_2 + 2)}$$

This procedure was repeated throughout the study on all 7 colonies. This method of estimation could not be applied to 3 (Horticulture, Ingram Hall, and Theta Xi) of the 7 colonies due to low population size (only 1-3 cats regularly sited during 2 year study). Colonies with only 1 cat sited in 6 month sampling period caused the Chapman formula to produce a population outcome of $\hat{N} = 1$ and $Var(\hat{N}) = 0$. Those colonies were not included in the analysis. Pre-TNR population estimates for each of the 4 larger (5-21 individuals) colonies (Graywood, Jennings, Mack's, and Thach Hall) were averaged and compared to post-TNR estimates using PROC_ TTEST in SAS ® version 8.2 (SAS Institute Inc. Cary, NC, USA). Camera census began Feb. 14, 2003 and continued until March 30, 2005. Photographic sampling was compared to the cat populations trapped in those areas, the cats' radio telemetry results, as well as visual cat identification acquired within those time periods.

RESULTS

During the two-year study, 4,924 photographs (3,007 pre-TNR and 1,917 post-TNR) from the 7 feeding stations were produced and analyzed. Of the 4,924 photographs 69% were feral cats and 31% were non-target species. Non-target species included 15% raccoons (*Procyon lotor*), 13% opossums (*Didelphis virginiana*), 1% gray squirrel (*Sciurus carolinensis*), <1% eastern chipmunk (*Tamias striatus*), and <1% brown thrashers (*Toxostoma rufum)*. During the 2-year study, 90 cats were trapped while a total of 123 individual cats were captured in photographs. Thirty-one of the 123 cats (25%) photographed were not trapped during any of the trapping sessions throughout the study (Tables 1-7). Twenty-three of the 90 cats trapped (26%) did not appear in photographs taken during the study (Table 8). Four feral cat colonies (Horticulture, Ingram Hall, Thach Hall & Theta Xi) were adjacent to areas that were managed using TNR prior to this study. Cats captured in photographs that were already managed with TNR prior to the study are marked in the tables as “already TNR’d.” Six of the 31 cats caught in photographs but not trapped during the study, were trapped for TNR prior to the study and were apparently too trap-savvy to be caught again. The smallest colony (Horticulture) had 7 cats sited during the entire two-year study while the largest of the 7 colonies (Mack’s) had 30 cats sited. Distinction of individual cats within a group that had the same coat colors and marking pattern was difficult in some cases, and may represent a challenge in this method of population estimation. However, careful study and other markings allow differentiation of >99% of feral cats. For example, in our study, 31 of the cats were fitted with colored radio collars, which were visible in the photos and helped with their identification.

The population estimates and trapping results for the 4 colonies tested using the Chapman model are reflected in Figures 8-11. The only colony of the 4 tested to have a significant difference (p=.002) among pre-TNR ($\overline{X}$ =9.2, SD=2.2, n=4) and post-TNR initiation ($\overline{X}$ =15.5, SD=1.1, n=4) treatment was Graywood. Graywood’s feral cat population averages during the pre-TNR sampling period increased significantly when compared to the post-TNR initiation sampling averages. Thach Hall had a similar outcome pre-TNR ($\overline{X}$ =7.9, SD=1.6, n=4) and post-TNR initiation ($\overline{X}$ =9, SD=0.6, n=4) although not significant (p=.49). Jennings and Mack's had a decrease from pre-TNR ($\overline{X}$ =9.4, SD=3.5, n=4 and $\overline{X}$ =17, SD=4.3, n=3) to post-TNR initiation ($\overline{X}$ =7.5, SD=1.3, n=4 and $\overline{X}$ =15, SD=1.6, n=4) however neither difference was significant (p=.34 and p=.49).

DISCUSSION

In this study, population size was monitored by photographic sampling, visual observations and trapping events. Variability was found among these methods. For example, 23 (26%) of the 90 cats trapped did not appear in any of the 4,924 photographs taken during the study. Evaluation of these 23 cats greatly helps to explain these discordant results. Eleven of these 23 cats were actually not trapped at the colony study sites, but instead were captured in nearby adjacent areas during year 2. These cats never entered the nearby feeding stations for photographing and were not likely to have been residents of the study colonies. The reason why traps were set outside of the immediate colony sites was that 18 of the initial 31 cats that were identified at the outset of the study were known to have migrated to these adjacent areas. These cats were outfitted with radio collars as part of a companion study and were being monitored with radio telemetry. Traps were set in adjacent areas since a goal of the companion study was to monitor the collared cats before and after TNR. In addition to the collared cats (n=18) any other cats captured in adjacent areas (n=15) were enrolled in TNR regardless of whether they were known to reside at the colony sites. In this study, movement of cats among neighboring colony sites was common especially with pre-TNR adult male tomcats.

Seven of the 23 cats that were trapped but did not appear in photographs were tame cats, which were either returned to their owners or adopted during year 2. In addition, 2 of the 23 cats that were trapped but did not appear in photographs died in the field almost immediately following release due to collar strangulation at the outset of year 1. These deaths occurred despite careful, secure fitting of the radio collars. The authors strongly recommend that future studies involving the use of radio collars in cats include provisions for frequent monitoring of the cats during the initial week following collar placement to ensure the safety of the cats. This accounts for a total of 20/23 cats that were trapped but never photographed: 11 cats from adjacent areas, 7 adoptions and 2 deaths. Thus, only 3 cats were actually trapped in the study colonies during year 2 but never photographed. These 3 cats were not visually sited by the author at any time and may not have been "regular" inhabitants. Thus, photographic sampling did account for 67 (96%) of the 70 cats trapped at the colony feeding stations during the 2-year study period. When compared to the adjusted trapping results, photographic sampling was an accurate method of measuring population size in this study.

Thirty-one of the 123 cats (25%) photographed were never trapped during any of the 17 trapping events throughout the 2-year study. Six of the 31 cats not trapped during the study were trapped prior to the study and may have been too trap savvy to have been trapped during the study. Twenty-four of the 31 cats photographed, but not trapped were not regular residents of the colonies based on visual sitings and photographic surveys. Only 1 cat out of the 31 not trapped was a colony regular at Thach Hall, but was elusive enough to never be trapped. Thus more cats appeared in photographs than were trapped. However, with the exception of those cats that were either trap savvy (n=6) or did not regularly reside in the colony (n=24), 99% of the resident cats photographed were trapped at some point during the 2 year study.

Identifying feral cats using photographic surveys was a viable method to supplement visual identification and trapping events. The camera census was in the author's opinion a better method of colony surveys than visual sitings alone because the census revealed many more cats than those sited by the author. Cats were commonly sited by the author at the feeding stations of Ingram Hall, Jennings', Mack's, and Thach Hall, but the number of cats sited visually were less than the number of cats revealed by the photographic sampling results taken over time. The author filled the feeding station feeders in the mornings and sited slightly more cats at that time period of the day. Data from this study demonstrate that a single photographic survey could give the observer an idea of the number of cats in a colony, but multiple photographic surveys must be made to estimate colony populations more accurately. Cost of film development and maintenance of the cameras over the 2 year period were the largest disadvantages. Use of digital cameras would greatly reduce costs for this method. A combination of methods similar to this study (using a dedicated daily caretaker, photographic sampling, and trapping events) could be the most accurate means to estimate feral cat colony populations.

The Chapman model population estimates for the 4 larger colonies are higher, but generally consistent with total trapping captures during each time period. For example, Graywood's year 1 trapping total is 7 cats (Table 1) and the Chapman estimate is 6.5 - 9 cats during this same time period (Figure 8). Graywood's year 2 trapping total is 12 cats (2 of which did not appear in photographs) and the Chapman estimate is 14 cats and peaks at 16.5 cats during this same time period. This may indicate that the second round of trapping in year 2 was less effective at capturing all the cats at this location possibly because the cats became trap savvy at this point. The Chapman population model was unsuccessful with the 3 smaller colonies when n1, n2, or m1 was equal to 1 or 0.

Keeping an actively participating caretaker for the feral cat colonies represented a significant limitation to this study. The author inspected each feeding station every 3 days as part of a separate objective to this study, and discovered a lack of consistent feeding by some of the caretakers. Food and water were replenished as needed throughout the 2-year study by the authors and staff if it was not done by the caretaker. None of the 7 colonies had a single caretaker throughout the study, and only 1 caretaker completed cat descriptions on the cat identification sheets.

Each colony site had a small group of cats seen regularly by the author and in photographs for a number of months (3-5) in a row. A majority of the cats in the photographs were "regulars" with other cats appearing less frequently (once or twice or seasonally). The cats that were regulars in the photographs were also regularly sited by the author. Visual sitings by the author usually did not include cats that were captured in photographs once or twice seasonally. Some colonies had the same regulars throughout the study while other colonies' regulars changed due to emigration and immigration. By the end of the study all of the regular cats seen at the feeders, with the exception of cat #30 and the "kitten" at Thach Hall that was never trapped, were participating in the TNR program. The author believes cat #30 was not enrolled in the TNR program because she was too trap savvy from the initial trapping in 2003 to be trapped for TNR in 2004. On rare occasions, some colony regulars were sited at other colony feeding stations and were included in the colony population analysis of each location. Eleven cats were photographed at more than one location during the study. One cat (#14) was actually trapped at more than one location during the study.

Each colony was unique in its population. The smaller colonies (Horticulture, Ingram, and Theta Xi) were located in areas surrounded by previously managed colonies on campus. This might have kept these colonies' populations small and under control since both immigration of new cats and reproduction may have been less likely. Horticulture, for example, had 2 cats that were sited regularly in the photographs from the Horticulture feeder, but also were regular members of the Terrell Hall colony located nearby. Theta Xi's colony feeder was in an isolated patch of woods surrounded by fraternity houses with resident dogs. This feeding station was the only one that was vandalized during the study and the author was shot at with a pellet gun during feeding. The author does not recommend maintaining a colony in this location due to the hostile environment. The author visually sited 2 cats at this location only 3 times while the cameras revealed more cats (n=9) with 2 of the 9 photographed regularly. Ingram Hall was home to 5 resident cats sited both visually and in photographs. This colony was located on the fringe of campus in downtown Auburn adjacent to a previously managed colony. Three of the four larger colonies (Graywood, Jennings & Mack's) were located off campus and did not have many managed colonies nearby. The 3 off-campus colonies had multiple dumpsters near the feeders. Since these locations were at or near apartment complexes, the author speculates the dumpsters were filled with more leftover food than a typical dumpster on campus might be. The author noticed the apartments also had the occasional occupant that left cat food outside for the feral cats. Jennings and Mack's colony feeding stations were placed in what seemed to the author to be the center of each colony. There was shelter (buildings with crawl spaces and wooded vegetation) and dumpsters nearby. The cats were almost always visible in the area surrounding the feeders when the author arrived at her scheduled visits. The cats at Graywood however, were not centered around their feeder and seemed to roam in between different feeders and colony areas. Graywood had a significantly larger average population post-TNR initiation. This is possibly due to influx of kittens late in 2004 from a cat(s) not documented and not enrolled in the TNR program. Our intent for the study was to trap out each colony during March and April of 2003 and again in 2004 to be able to compare before and after effects of TNR. In reality it took many months (some colonies all year) to be able to trap out most or all the cats at each location during year 2. It was particularly difficult to re-trap cats that had been trapped previously. A longer study period post-TNR initiation is needed to make an assessment of the “after” effect of TNR on individual feral cat colony populations. Overall the Auburn University campus feral cat population did decrease from approximately 150 feral cats in 2003 to approximately 45 feral cats by April 2005 based on visual sitings, caretaker questionnaires and OCN records. Since photographic sampling was not used to census these colonies, it is possible the population was underestimated especially at locations where a regular caretaker was not present. Only 5/19 campus colonies had consistently active, diligent caretakers, however campus cat complaints decreased during this time period as well as reports of new cats. Auburn University officials were pleased with the results of the program each year.

At the 4 large study colonies, kittens were seen in feeders at approximately 4-6 weeks of age during peak kitten season in March and April of 2003 and 2004. No kittens were observed in March 2005. The most probable reason for this is a majority of the feral cats were participating in TNR, and therefore did not reproduce. Pregnant queens were noted in visual monitoring at three of the larger colonies Jennings, Mack’s, and Thach Hall during the pre-TNR phase of the project. Only 2 litters were found by the author prior to emerging from their nests. One litter was in a row of bushes between apartments and the other was under a set of concrete stairs surrounded by overgrown vegetation. The litter in the bushes had 4 kittens: 1 died at 2 days old, 1 was adopted by the author, 1 was found dead in the parking lot and the other kitten went missing around the same time frame of 3 months of age. Following the initial siting by the author, the mother moved the litter under the staircase after the nearby vegetation was cleared by the property manager. The mother was sited for another 2 months before her disappearance and the kittens were never seen after the initial siting. Often times queens in the same colony were pregnant at the same time and multiple kittens would emerge at 12-14 weeks of age. It would be very difficult to quantify the rate of kitten mortality in this study, but the author believes it to be similar to those found by Nutter et al (2004) of 75%. Therefore, the authors recommend spaying all pregnant queens and taming and adopting all small kittens during TNR management. Furthermore, we believe that mortality of all feral cats can vary depending on certain factors such as: diligence of the caretaker, location of colony, and TNR status. Male cats were the first and most numerous cats to disappear from colonies before TNR was implemented. Of the original 20 male cats, 30% of them were still sited by the end of the study as compared to 55% of the females. In this study cats that were enrolled in TNR at a young age (>3 months and <1 year) had the best chance of survival.

These cats seemed to stay entrained to the colony feeding station, roam very little, and have few if any offspring depending on time of TNR enrollment.

Initial trapping events were valuable in estimating feral cat populations, but subsequent trapping events created trap savvy cats. The author recommends trapping out an entire feral cat colony at once to implement TNR so it does not result in intact, trap savvy cats being left behind in the colony.

TNR management during 2004 and 2005 included 33 spays, 32 neuters, 1 euthanasia, and 11 adoptions (5 kittens and 4 tame adults). By the end of the study the author estimates 96% of the cats regularly residing in the area (n=58) were successfully managed using TNR (n=56). Continued management using TNR must be maintained in order for population control to be effective, but this holds true for any form of population management.

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Table 1. Graywood Photographic Results. Individual cats identified in photographs compared to trapping records during the study in Auburn, Alabama 2003-2005. Cats with a specified number were trapped during the study. Cats trapped during pre-TNR (year 1) were numbered 1-31 and additional cats trapped during TNR management (year 2) were numbered 32-90. All cats that were photographed, but not trapped were named or described by their coat patterns for identification purposes. Cat numbers denoted by an asterisk were captured at more than one colony site.

Cats captured in photographs (cat #, name or description)	**Cat trapped (year 1) pre-TNR**	**Cat trapped (year 2) for TNR**	**Comments**
5*	yes (3/28/2003)	no	missing from photos by year 2
7*	yes (3/30/2003)	yes (5/6/2004)	
8	yes (3/30/2003)	yes (5/12/2004)	
13*	yes (4/2/2003)	yes (4/8/2004)	
20*	yes (5/9/2003)	no	missing from photos by year 2
23	yes (6/2/2003)	no	missing from photos by year 2
27	yes (7/17/2003)	no	missing from photos by year 2
42	no	yes (4/8/2004)	already TNRd
47	no	yes (5/6/2004)	
48	no	yes (5/6/2004)	
50	no	yes (5/6/2004)	
73	no	yes (7/21/2004)	
74	no	yes (7/21/2004)	
75	no	yes (10/30/2004)	euthanized according to OCN protocols 10/30/2004 (poor body condition, icteric, FIV+)
77	no	yes (10/30/2004)	
89	no	yes (3/12/2005)	
Rocky*	no	no	not a colony "regular", photographed 11 times during year 1, missing from photos by year 2
Mystery*	no	no	not a colony "regular", photographed 7 times during study
Ash	no	no	not a colony "regular", photographed 5 times during study
Spots Momma	no	no	not a colony "regular", only photographed 8/29/2004
Black tuxedo	no	no	not a colony "regular", only photographed 3/25/2005
Black bicolor	no	no	not a colony "regular", only photographed 3/25/2005
Total cats trapped	**7**	**12**	

Table 2. Horticulture Photographic Results. Individual cats identified in photographs compared to trapping records during the study in Auburn, Alabama 2003-2005. Cats with a specified number were trapped during the study. Cats trapped during pre-TNR (year 1) were numbered 1-31 and additional cats trapped during TNR management (year 2) were numbered 32-90. All cats that were photographed, but not trapped were named or described by their coat patterns for identification purposes.

Cats captured in photographs (cat #, name or description)	**Cat trapped (year 1) pre-TNR**	**Cat trapped (year 2) for TNR**	**Comments**
Horticulture torti	no	no	already TNRd
10	yes (3/30/2003)	yes (5/6/2004)	
55	no	yes (5/12/2004)	not a colony "regular", photographed 2 times during study
Nubby	no	no	not a colony "regular", only photographed 2/21/2003
Hunter	no	no	not a colony "regular", photographed 2 times during study
Black Tuxedo	no	no	not a colony "regular", only photographed 2/2/2005
Harlequin	no	no	not a colony "regular", only photographed 3/15/2005
Total cats trapped	**1**	**2**	

Table 3. Ingram Hall Photographic Results. Individual cats identified in photographs compared to trapping records during the study in Auburn, Alabama 2003-2005. Cats with a specified number were trapped during the study. Cats trapped during pre-TNR (year 1) were numbered 1-31 and additional cats trapped during TNR management (year 2) were numbered 32-90. All cats that were photographed, but not trapped were named or described by their coat patterns for identification purposes. Cat numbers denoted by an asterisk were captured at more than one colony site.

Cats captured in photographs (cat #, name or description)	**Cat trapped (year 1) pre-TNR**	**Cat trapped (year 2) for TNR**	**Comments**
Miss Kitty	no	no	already TNRd
Scratch	no	no	already TNRd
Blue Mackeral Tabby	no	no	not a colony "regular", only photographed 2/16/2003
9	yes (3/30/2003)	yes (5/6/2004)	
14*	yes (4/21/2003)	yes (5/6/2004)	
28	yes (7/17/2003)	no	not a colony "regular", only photographed 6/17/2003, died 2/16/2004
39	no	yes (4/8/2004)	
78	no	yes (10/30/2004)	
Solid black	no	no	not a colony "regular", only photographed 2/17/2003
Rogue	no	no	not a colony "regular", photographed 2 times during study
Black tuxedo	no	no	not a colony "regular", photographed 2 times during study
Fluff's daddy	no	no	not a colony "regular", only photographed 12/19/2003
Ansel's baby	no	no	not a colony "regular", only photographed 6/18/2004
Solid black	no	no	not a colony "regular", photographed 2 times during study
Total cats trapped	**3**	**4**	

Table 4. Jennings Photographic Results. Individual cats identified in photographs compared to trapping records during the study in Auburn, Alabama 2003-2005. Cats with a specified number were trapped during the study. Cats trapped during pre-TNR (year 1) were numbered 1-31 and additional cats trapped during TNR management (year 2) were numbered 32-90. All cats that were photographed, but not trapped were named or described by their coat patterns for identification purposes. Cat numbers denoted by an asterisk were captured at more than one colony site.

Cats captured in photographs (cat #, name or description)	Cat trapped (year 1) pre-TNR	Cat trapped (year 2) for TNR	Comments
2*	yes (3/28/2003)	no	missing from photos by year 2
3*	yes (3/28/2003)	no	missing from photos by year 2
4*	yes (3/28/2003)	no	died 12/12/2003
5*	yes (3/28/2003)	no	missing from photos by year 2
6	yes (3/28/2003)	no	missing from photos by year 2
7*	yes (3/30/2003)	yes (5/6/2004)	
24	yes (6/2/2003)	yes (4/8/2004)	
25	yes (6/2/2003)	no	died 10/13/2003
26*	yes (7/17/2003)	no	missing from photos by year 2
32	no	yes (4/8/2004)	
37	no	yes (4/8/2004)	
40	no	yes (4/8/2004)	
41	no	yes (4/8/2004)	
Rocky*	no	no	not a colony "regular", only photographed 12/18/2003
Mystery*	no	no	not a colony "regular", photographed 8 times during study
Black tuxedo	no	no	not a colony "regular", only photographed 3/26/2005
Total cats trapped	**9**	**6**	

Table 5. Mack's Photographic Results. Individual cats identified in photographs compared to trapping records during the study in Auburn, Alabama 2003-2005. Cats with a specified number were trapped during the study. Cats trapped during pre-TNR (year 1) were numbered 1-31 and additional cats trapped during TNR management (year 2) were numbered 32-90. All cats that were photographed, but not trapped were named or described by their coat patterns for identification purposes. Cat numbers denoted by an asterisk were captured at more than one colony site.

Cats captured in photographs (cat #, name or description)	**Cat trapped (year 1) pre-TNR**	**Cat trapped (year 2) for TNR**	**Comments**
2*	yes (3/28/2003)	no	missing from photos by year 2
3*	yes (3/28/2003)	no	missing from photos by year 2
4*	yes (3/28/2003)	no	died 12/12/2003
5*	yes (3/28/2003)	no	missing from photos by year 2
7*	yes (3/30/2003)	yes (5/6/2004)	
13*	yes (4/2/2003)	yes (4/8/2004)	
16	yes (5/9/2003)	no	missing from photos by year 2
17	yes (5/9/2003)	no	missing from photos by year 2
18	yes (5/9/2003)	yes (4/8/2004)	
19	yes (5/9/2003)	no	last sited 7/30/2004
20*	yes (5/9/2003)	no	died 10/1/2003
26*	yes (7/17/2003)	no	missing from photos by year 2
30	yes (7/29/2003)	no	
31	yes (7/29/2003)	no	died 7/18/2003
36	no	yes (4/8/2004)	
38	no	yes (4/8/2004)	
44	no	yes (4/8/2004)	
58	no	yes (6/5/2004)	
61	no	yes (6/5/2004)	
67	no	yes (7/20/2004)	
68	no	yes (7/20/2004)	
69	no	yes (7/20/2004)	
71	no	yes (7/20/2004)	
84	no	yes (3/5/2005)	
85	no	yes (3/5/2005)	
86	no	yes (3/5/2005)	
Tuxedo torby	no	no	not a colony "regular", photographed 3 times during study
Mystery*	no	no	not a colony "regular", photographed 13 times during study
Blue	no	no	not a colony "regular", photographed 2 times during study
Brown classic tux tabby	no	no	not a colony "regular", only photographed 1/15/2004
Total cats trapped	**14**	**15**	

Table 6. Thach Hall Photographic Results. Individual cats identified in photographs compared to trapping records during the study in Auburn, Alabama 2003-2005. Cats with a specified number were trapped during the study. Cats trapped during pre-TNR (year 1) were numbered 1-31 and additional cats trapped during TNR management (year 2) were numbered 32-90. All cats that were photographed, but not trapped were named or described by their coat patterns for identification purposes. Cat numbers denoted by an asterisk were captured at more than one colony site.

Cats captured in photographs (cat #, name or description)	Cat trapped (year 1) pre-TNR	Cat trapped (year 2) for TNR	Comments
1	yes (3/28/2003)	yes (4/8/2004)	already TNRd, adopted 5/2004
Bruiser	no	no	already TNRd
11	yes (3/30/2003)	yes (5/6/2004)	
12	yes (3/30/2003)	yes (7/20/2004)	
14*	yes (4/21/2003)	yes (5/6/2004)	
33	no	yes (4/8/2004)	adopted 4/9/2004
34	no	yes (4/8/2004)	adopted 4/9/2004
35	no	yes (4/8/2004)	
43	no	yes (4/8/2004)	
45	no	yes (5/6/2004)	
49	no	yes (5/6/2004)	
52	no	yes (5/12/2004)	
DLH classic tabby kitten	no	no	
black with locket kitten	no	no	not a colony "regular", photographed 3 times during study
red classic tabby	no	no	not a colony "regular", only photographed 1/21/2004
cream mack tux tabby	no	no	not a colony "regular", only photographed 3/15/2005
Total cats trapped	**4**	**11**	

Table 7. Theta Xi Photographic Results. Individual cats identified in photographs compared to trapping records during the study in Auburn, Alabama 2003-2005. Cats with a specified number were trapped during the study. Cats trapped during pre-TNR (year 1) were numbered 1-31 and additional cats trapped during TNR management (year 2) were numbered 32-90. All cats that were photographed, but not trapped were named or described by their coat patterns for identification purposes.

Cats captured in photographs (cat #, name or description)	Cat trapped (year 1) pre-TNR	Cat trapped (year 2) for TNR	Comments
Theta Xi Momma	no	no	already TNRd
15	yes (4/21/2003)	no	not a colony "regular", photographed 2 times during study
22	yes (5/9/2003)	no	not a colony "regular", only photographed 6/5/2004
56	no	yes (6/5/2004)	
81	no	yes (3/5/2005)	not a colony "regular", only photographed 2/15/2005
82	no	yes (3/5/2005)	not a colony "regular", only photographed 2/26/2005
pet cat	no	no	not a colony "regular", only photographed 2/23/2003
red smoke mack tabby	no	no	not a colony "regular", only photographed 2/27/2003
blue tuxedo	no	no	not a colony "regular", photographed 2 times during study
Total cats trapped	**2**	**3**	

Table 8. Cats Trapped and Not Photographed. Individual cats identified during trapping events compared to photographic surveys during the study in Auburn, Alabama 2003-2005. Cats with a specified number were trapped during the study. Cats trapped during pre-TNR (year 1) were numbered 1-31 and additional cats trapped during TNR management (year 2) were numbered 32-90.

Cats captured in photographs (cat #, name or description)	Location	Cat trapped (year 1) pre-TNR	Cat trapped (year 2) for TNR	Comments
21	Mack's	yes (5/9/2003)	no	died from collar 5/2003
29	Mack's	yes (5/9/2003)	no	died from collar 5/2003
46	Terrel Hall	no	yes (5/6/2004)	adjacent to Horticulture
51	Graywood	no	yes (5/12/2004)	not a colony "regular"
53	Funderburk	no	yes (5/12/2004)	1 block from Mack's
54	Funderburk	no	yes (5/12/2004)	1 block from Mack's
57	Funderburk	no	yes (6/5/2004)	1 block from Mack's
59	Glen Oaks	no	yes (6/5/2004)	next to Mack's, kitten adopted
60	Mack's	no	yes (6/5/2004)	kitten adopted
62	University Gardens	no	yes (6/5/2004)	next to Mack's
63	Business Building	no	yes (6/5/2004)	1 block from Thach Hall, tame adult adopted
64	Miller Hall	no	yes (7/20/2004)	1 block from Thach Hall, cat #12's kitten returned
65	Miller Hall	no	yes (7/20/2004)	1 block from Thach Hall, cat #12's kitten returned
66	Miller Hall	no	yes (7/20/2004)	1 block from Thach Hall, cat #12's kitten returned
70	Miller Hall	no	yes (7/20/2004)	1 block from Thach Hall, cat #12's kitten returned
72	Poultry	no	yes (7/21/2004)	1 mile from Horticulture, kitten returned
76	Mack's	no	yes (10/30/2004)	kitten adopted
79	Graywood	no	yes (10/30/2004)	not a colony "regular"
80	Miller Hall	no	yes (3/5/2005)	1 block from Thach Hall, cat #12's kitten returned
83	RR	no	yes (3/5/2005)	behind Graywood, tame adult returned to owner
87	RR	no	yes (3/12/2005)	behind Graywood, tame adult returned to owner
88	Mack's	no	yes (3/12/2005)	not a colony "regular"
90	Jennings	no	yes (3/28/2005)	tame adult adopted
Total cats trapped		**2**	**21**	

Figure 1. Ear-tipped cat. The tip of the left ear is removed as a standard symbol of a cat that has been sterilized in a TNR program. This cat (named “Scratch” by his caretaker), was sterilized through Auburn University’s TNR program Operation Cat Nap on July 29, 2001.

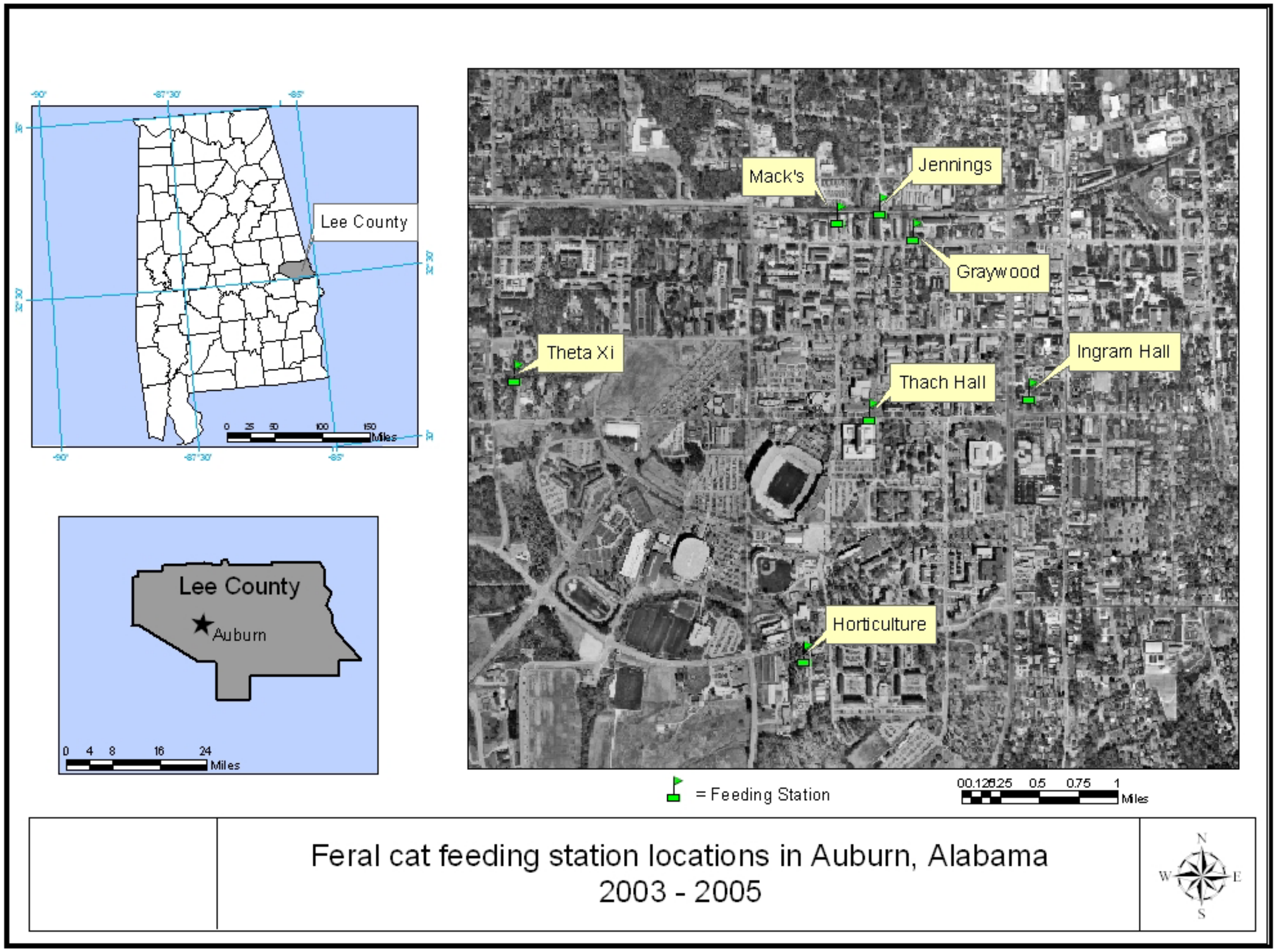

Figure 2. Feeding Station Map. Feral cat feeding station locations in Auburn, Alabama 2003-2005.

Figure 3. Feeder Installation. Establishment of feeding station during December 2002 at Graywood Apartments' feral cat colony in Auburn, Alabama. All wooden feeders are raised off the ground with bricks and securely installed using 4' metal fence posts. Feeders are equipped with a reservoir-type waterer, pet food type bowl or reservoir-type feeder (not pictured), and an infrared-triggered camera. A latch was used to lock the roof down for security.

Figure 4. Feeding Station. Feral cats using a feeding station at Thach Hall on the Auburn University campus, 2003-2005.

Figure 5. View of feeder interior. View from above of the interior of a feral cat feeder in Auburn, Alabama, 2003-2005. Note the infrared-triggered camera (left) and reservoir-type waterer and pint-sized pet food bowl (right).

Figure 6. Camera Census. Representative photograph from a feeding station. In this photograph, cat #4 (identified by coat color and radio collar) is recaptured on film on April 10th, 2003 at 5:41 pm in the Jennings feeding station on the Auburn University campus.

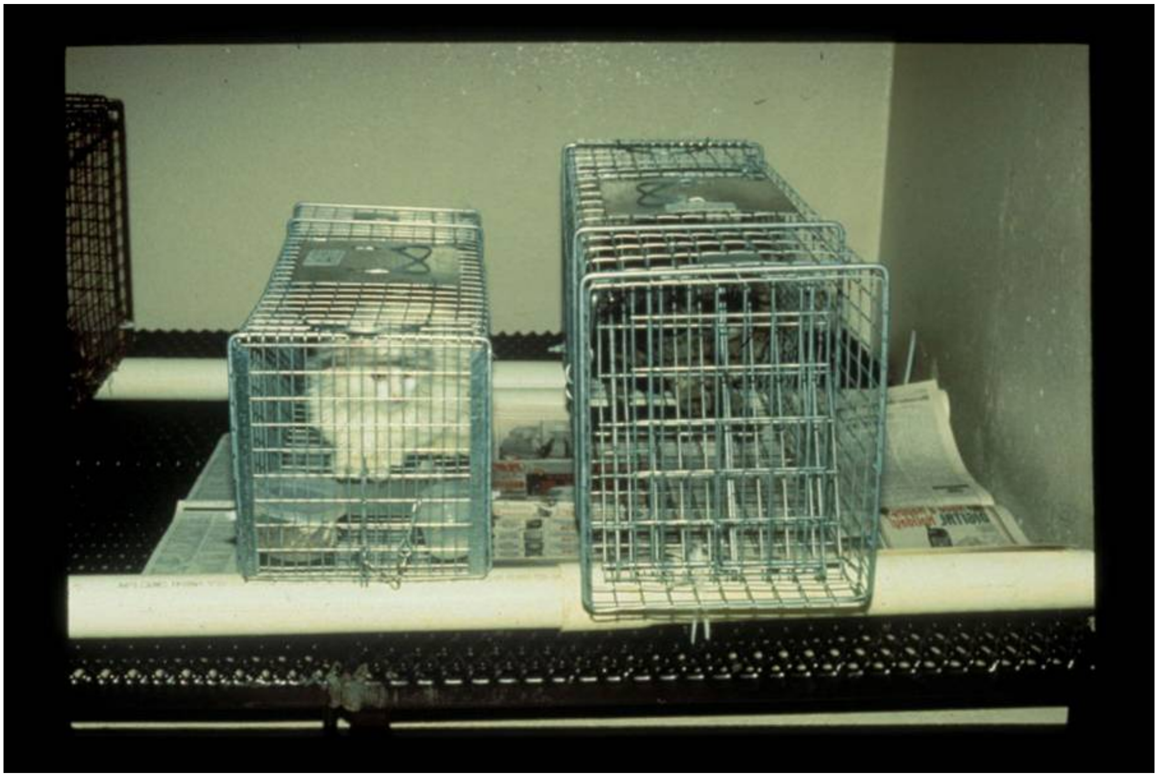

Figure 7. Holding Procedures for Feral Cats. Feral cats inside Tomahawk traps (model #606 and #608) fitted with food and water bowls (waterproof pads to cover traps not shown) during holding for study in Auburn, Alabama 2003-2005. Note elevation of traps above floor for sanitary purposes.

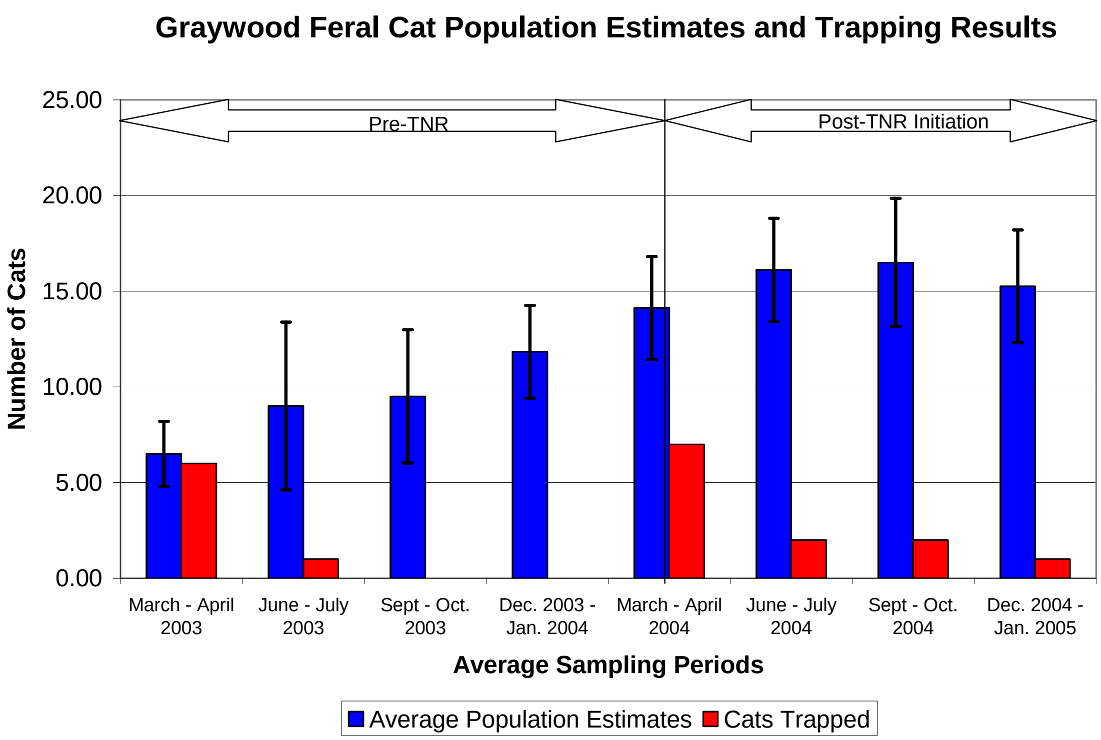

Figure 8. Graywood Feral Cat Population Estimates and Trapping Results. Feral cat population estimates using the Chapman model with 95% confidence interval as well as trapping results for Graywood feral cat colony in Auburn, Alabama 2003-2005. A total of 12 cats were managed by TNR in year 2.

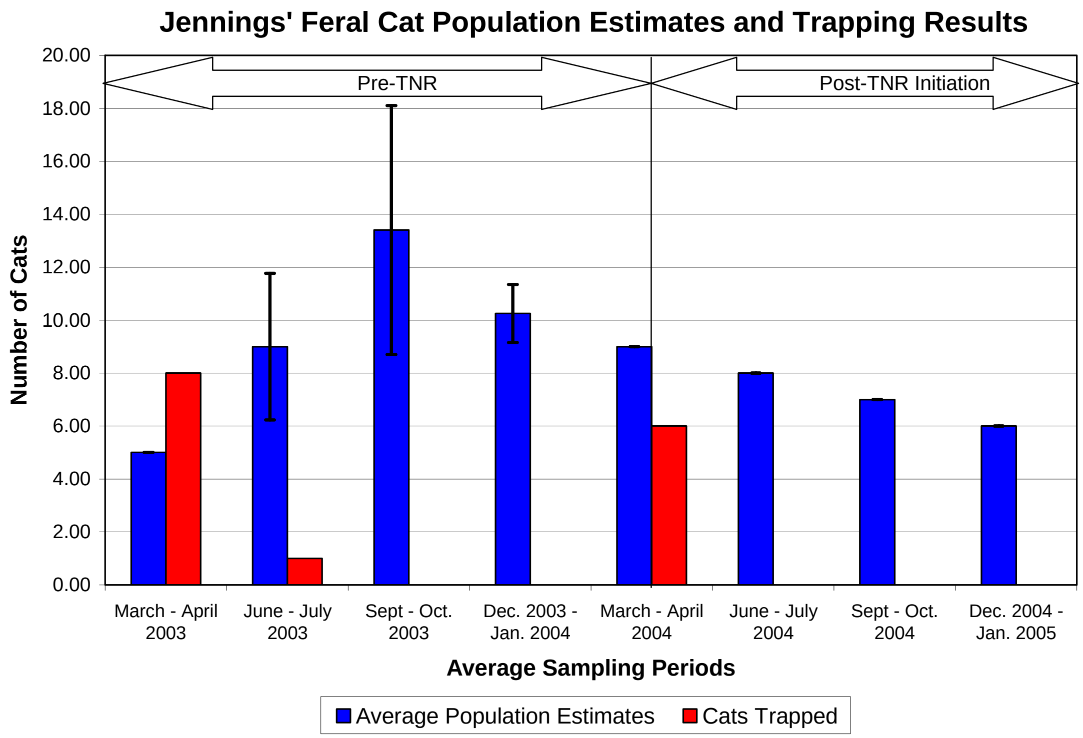

Figure 9. Jennings' Feral Cat Population Estimates and Trapping Results. Feral cat population estimates using the Chapman model with 95% confidence interval as well as trapping results for Graywood feral cat colony in Auburn, Alabama 2003-2005. A total of 6 cats were managed by TNR in year 2.

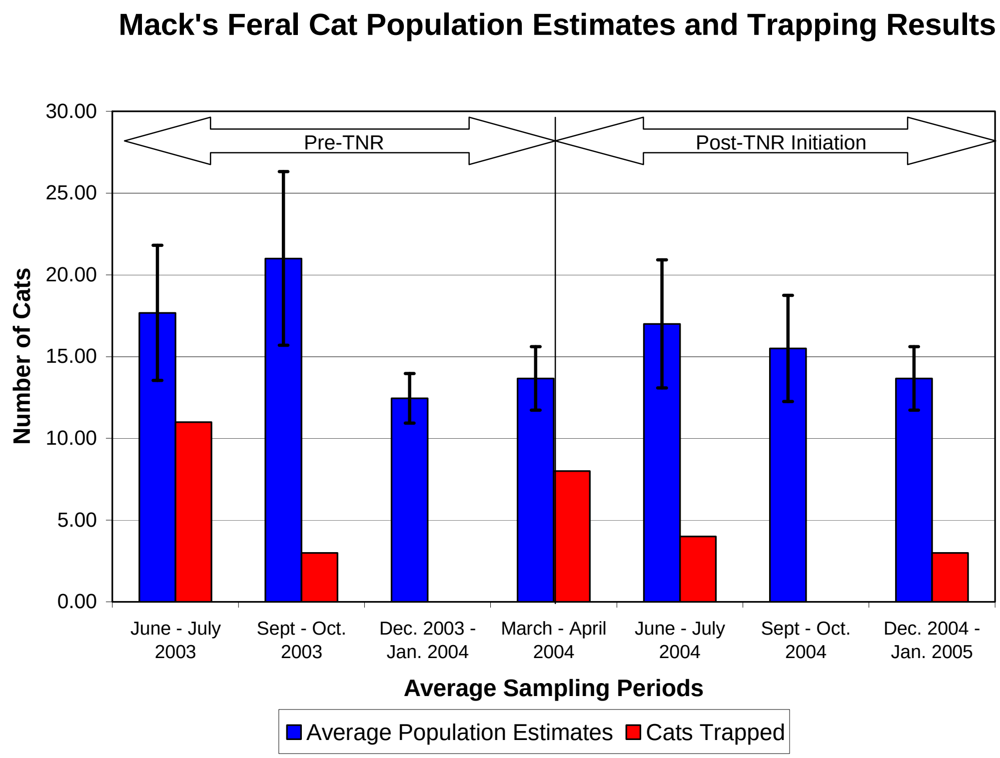

Figure 10. Mack's Feral Cat Population Estimates and Trapping Results. Feral cat population estimates using the Chapman model with 95% confidence interval as well as trapping results for Graywood feral cat colony in Auburn, Alabama 2003-2005. A total of 15 cats were managed by TNR in year 2.

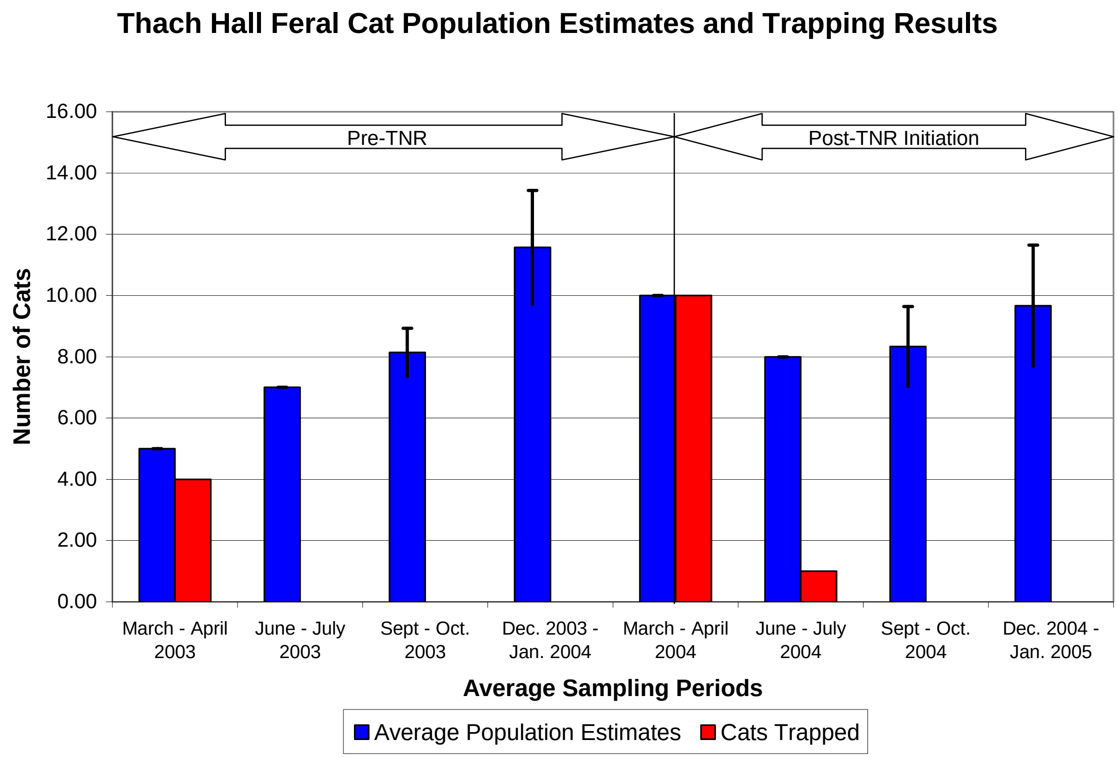

Figure 11. Thach Hall Feral Cat Population Estimates and Trapping Results. Feral cat population estimates using the Chapman model with 95% confidence interval as well as trapping results for Graywood feral cat colony in Auburn, Alabama 2003-2005. A total of 11 cats were managed by TNR in year 2.

III. FERAL CAT HOME RANGE AND HABITAT USE IN AUBURN, ALABAMA

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Abstract:

The goal of this study was to examine the feral cat's home range and determine preferred habitat and use frequency in relation to a Trap Neuter Return (TNR) program. Home range and habitat use data were compared for 1 year before and 1 year after implementing TNR.

The mean home ranges were calculated as minimum convex polygons or (MCP) and then categorized by sex and TNR status. The MCPs were compared using the proc_glm ANOVA with Tukey's multiple comparison test. Overall the model was not significant (F=2.67) with p=0.0668. There were differences among male ($\bar{X}$ =8.5 pre-TNR and $\bar{X}$ =3.6 post-TNR) and female ($\bar{X}$ =2.5 pre-TNR and $\bar{X}$ =2.2. post-TNR) home ranges, but due to a small sample size and high variability the results were not significant.

Preferred habitat of individual cats was determined using radio telemetry and visual identification. Lawn, hardscape and structures composed over 65% of the study area with roadway, landscaping, woods, scrub, and water composing the other portion of study area. The most common habitats in the pre-TNR and post-TNR initiation MCP were hardscape, structures, and landscaping. Within the MCP both pre-TNR and post-TNR initiation feral cats significantly preferred woods over other habitat types.

Key Words: feral cat, home range, habitat use, Alabama, *Felis catus*, trap neuter return.

INTRODUCTION

Feral cats are defined as "wild" offspring of domestic cats that have been abandoned by their owners (Griffin 2001). According to Levy et al. (2003*b*) feral cats are offspring born without human socialization or were owned cats returned to the wild that do not trust humans. Accurate estimates of the feral cat population do not exist, however it is suspected that their population is similar to that of owned cats which was 70.8 million in the United States in 2001 (Levy et al. 2003*a*, AVMA 2002). The free-roaming cat population (defined here as both feral and stray cat populations) was estimated to represent as much as 44% of the domestic cat population in Alachua County, Florida study (Levy et al 2003*b*). Santa Clara County, California estimates stray cats are 41% of the total known cat population (Johnson et al. 1994).

Trap-Neuter-Return (TNR) has been in practice for over 25 years (Hammond 1981 and Jackson 1981) but is relatively new to the United States. Cats are trapped, spayed or neutered, checked for and vaccinated against disease, and then returned to their home colony. The tip of the left ear is cropped as a standard symbol of being enrolled in a TNR program. Caretakers are identified and are responsible for monitoring and feeding the cats in their colony.

Past feral cat colony control has often been restricted to exterminations attempts, but TNR is rapidly becoming a more acceptable control method. Public outcry can be a powerful reason not to euthanize feral cat colonies (Passanisi and McDonald 1990) and can be influential in the policy making. For example, policies protecting wild horses and burros in the United States and harp seal pups in Canada directly resulted from pressure exerted by the public and animal protection organizations (Levy 2000). Slater (2004) states that public dynamic is shifting towards viewing companion animals as more valuable than just their monetary value. A recent study determined that the general public is slightly more supportive of TNR (54.6%) as opposed to removal (42.2%) for cats located on the Texas A&M University campus (Ash 2001). This same questionnaire determined the public valued the lives of wildlife and the lives of feral cats with the same importance (Ash and Adams 2003). This same study estimated that 44% of the public agreed feral cat overpopulation was a serious biological issue but did not value the lives of wildlife species more than the lives of the feral cats (Ash and Adams 2003).

A few studies have examined the usefulness of TNR at reducing the population of feral cat colonies. One study conducted in a London park successfully controlled the population of 2 feral cat colonies. This TNR program decreased the colony numbers, reduced aggressive behavior within the colony, and eliminated cat predation of waterfowl (Neville and Remfry1984). In contrast, a Miami, Florida study found TNR ineffective at controlling feral cat populations over 1 year due to influx of abandoned cats at the site (Castillo 2001). Castillo's (2001) study was conducted at 2 south Florida public parks with highly visible, well-fed, and well-publicized feral cat colonies. Levy et al. (2003*a*) evaluated an 11-year long TNR and adoption program on the University of Central

Florida with the following results "A comprehensive long-term program of neutering followed by adoption or return to the resident colony can result in reduction of free-roaming cat populations in urban areas." After Orange County Florida's animal control service implemented a TNR program, complaints leading to impounded cats and euthanasia of impounded cats decreased while surgeries and adoption rates increased, saving the county money (Hughes et al. 2002).

Home ranges and habitat use have been determined on a number of species (Conner et al. 1999, Hartke and Hepp 2004, Terhune et. al. 2006) including feral cats (Ash 2001, Hall et al. 2002, Izawa et al. 1982, Liberg 1980, Page et al. 1992). Liberg (1980) investigated home range patterns of a population of feral cats in Sweden using visual observations, trapping, and radio tracking. This study found a difference in home ranges as minimum convex polygons (MCP) relative to the sex and reproductive status of feral cats in Sweden (Liberg 1980). With abundant resources similar to those found on college campuses, feral cats have smaller overlapping home ranges when compared to feral cats with low food predictability (Ash, 2001; Izawa et al., 1982; Page et al., 1992).

Hartke and Hepp (2004) determined habitat use of wood ducks using radio telemetry triangulation then plotting MCPs and creating a habitat map in ARCVIEW® GIS (Environmental Systems Research Institute 2000*a*). Habitat use or compositional analysis was determined using ArcINFO® GIS (Environmental Systems Research Institute 2000*b*) and MANOVA. Terhune et al. (2006) also used radio telemetry to locate bobwhite quail. The quail locations were plotted onto aerial photographs and then digitized into ARCVIEW® GIS (Environmental Systems Research Institute 2000*a*) to create 95% MCP home ranges. Hall et al. (2000) was able to calculate home range using CALHOME, habitat analysis was determined as well as scat analysis.

The goal of this study was to examine the feral cat's home range and determine preferred habitat and use frequency for 1 year prior to TNR management and 1 year post management. We hope to achieve our objectives through a combination of methods similar to Hartke and Hepp (2004) and Terhune et al. (2006) to estimate home range and habitat use. The first goal of this study was to examine the feral cat's home range in relation to TNR management. Home range was calculated using GPS locations obtained from radio telemetry and visual identification into an individual MCP. Data were compared for all cats and then further categorized into gender one year before and one year after TNR was implemented.

The second objective was to determine which habitats were preferred by feral cats in relation to TNR management. MCPs of individual cats were determined using GPS locations obtained from radio telemetry and visual identification. Preferred habitat of individual animals was obtained and data were compared for one year before and one year after TNR was implemented. The eight habitats were pooled to determine which general habitat areas were favored by feral cats. These data were also compared for 1 year before and 1 year after TNR was implemented.

Reducing the feral cat overpopulation problem in a humane manner is the primary goal of TNR. Given the growing popularity of this method of feral cat population control, more studies are needed to understand its effects not only on the cats, but the surrounding environment as well. We hope this study will generate more information on the impacts TNR has on feral cat home ranges and habitat use.

STUDY AREA

Seven feral cat colonies located on the Auburn University campus (Figure 1) and the immediate areas surrounding campus in downtown Auburn, Alabama were selected for the 2003-2005 study. These colonies were surrounded by a relatively dense human population. On average 23,000 students are present on campus at any time with 3,680 (16%) of them residing on the 745 hectare campus (AU 2006*b*). Auburn University employs approximately 9,400 faculty and staff. At the time of this study, the combined population of Auburn and its adjoining city Opelika was approximately 66,000 (AU 2006*a*). Feral cat colonies have been documented on the campus for at least 30 years preceding the study (Griffin, B., Auburn University, personal communication).

The 7 feral colonies (Graywood, Horticulture, Ingram Hall, Jennings, Mack's, Thach Hall, and Theta Xi) chosen for this project were selected because to the authors' knowledge they had no regular caretaker or previous management efforts (Figure 1). A feeding station was installed in the area where these feral cats were known to reside. Each colony was assigned a volunteer caretaker. Caretakers were provided with basic information about feral cats and TNR as well as a description of the project. Appendix A contains the orientation materials and instructions for the caretakers. A standardized commercial dry cat food (Purina ONE Salmon and Tuna flavor, Nestlé Purina PetCare Company, St. Louis, MO) was provided as needed for the duration of the study. Caretakers were told to provide food and fresh water daily, preferably in the morning to minimize the amount of food left in the shelter during the night when wildlife species were more likely to be present. Caretakers were also asked to record descriptions of cats sited at their feeders. All 7 feeders and colonies were cared for and monitored for 1 year before and 1 year after the TNR program began. Besides designated caretakers, feeding stations were maintained and monitored by the authors and student assistants as needed.

METHODS

Feeding stations were installed and cats were entrained to a routine of feeding at a minimum of every 3 days by early March 2003. During the pre-TNR phase of the project, cats were trapped during 6 different trapping events between March and July, 2003 when the majority of the population was captured based on photographic censuses. Using the photographic censuses and visual identification, it was estimated approximately 31 cats were regularly seen at the 7 feral cat colonies. These 31 initial cats were to be monitored for 1 year before the TNR program and 1 year after initiating the TNR program. Caretakers were advised to withhold food and empty feeding stations 2 days prior to each trapping period. Cats were trapped from dusk until dawn over the course of several days according to protocol of the Auburn University feral cat program, Operation Cat Nap (Appendix B). Trapping occurred around the established feeding stations using baited Tomahawk live traps model #606 (approximately 26” long X 9” wide X 9” high) (Tomahawk Live Trap Company, Tomahawk, WI). Bait used included canned mackerel and a standardized commercial dry cat food (Purina ONE Salmon and Tuna flavor, Nestlé Purina PetCare Company, St. Louis, MO, USA) the cats were already eating. Other bait techniques such as used kitty litter were attempted with unsuccessful results.

Pre-TNR (year 1) laboratory protocol

Captured cats were transported to the multi-purpose laboratory of the College of Veterinary Medicine (an IACUC approved facility) and held in their cages for the duration of each trapping phase and data collection. In order to transport feral cats safely, personnel handling the cats were vaccinated against rabies and wore thick leather gloves. There were no scratch or bite incidents during this study. Cats were held for no longer than 4 days in their traps. Each trap was covered with a thick, waterproof pad, outfitted with a food and water bowl, and elevated off the ground for removal of waste during holding (Figure 2).

Anesthesia

Captured feral cats were anesthetized with an anesthetic cocktail called TKX (Telazol + Ketamine + Xylazine) at a dosage of 0.15 -0.25 mL per cat depending on the size of the cat (Williams et al. 2002 and Cistola et al. 2004) prior to removal from trap. Cats were handled in a humane manner and all procedures complied with the requirements of the Institutional Animal Care and Use Committee for Auburn University (IACUC # 2002-0137). Cats were injected while in the traps by using a trap divider to confine the cat to one end of the trap to allow intramuscular (IM) injection into the hind limb musculature. If additional anesthetic time was required, isoflurane and oxygen via mask or endotracheal tube were administered as needed.

Data Collection

Each cat trapped was assigned a sequential identification number (numbers 1-31 for year 1). Individual data on each cat was collected during physical examination including: cat #, date trapped, date of data collection, date released, location trapped, size of cat (small, medium, large), sex, coat color and pattern, distinguishing features, eye color, domestic short hair or domestic long hair (DSH, DLH) coat length, estimated age, body weight (lbs), general body condition, reproductive status, administration of subcutaneous (SQ) fluids, results of Feline Leukemia Virus and Feline

Immunodeficiency Virus (FeLV/FIV) testing, rabies vaccination, penicillin injection (if necessary), microchip number, radio collar, and frequency (Appendix C). Coat color and pattern were determined using the Cat Coat Color Chart developed by Operation Cat Nap (Subacz and Griffin 2002). General body condition was determined using Purina's Body Condition Chart (Purina 2002). In addition, each cat was photographed to aid in future identification. Rabies vaccinations (Imrab 3, Merial Pharmaceuticals, Duluth, GA) were administered subcutaneously in the right hind limb of each cat and blood was collected via jugular venipuncture and tested for FIV and FeLV (snap IDEXX Laboratories, Inc., Westbrook, ME).

Radio Transmitters and Microchips

Cats of varying ages (14 weeks to 9 years) were fitted with transmitters attached to adjustable collars model TS-24 (Telemetry Solutions, Concord, CA). The radio transmitter batteries were designed to last 24 months at 55 pulses/min, weighed 13 grams, and were equipped with a mortality/activity switch. Each collar had a nylon covering to protect the built in antenna (Figure 3). This nylon cover was spray painted a distinct color to help with identification of similar looking cats at the same colony site. Finally, all cats were implanted with identification microchips subcutaneously on the dorsum between the shoulder blades (Home Again, Schering-Plough Animal Health Corporation, Kenilworth, NJ).

Anesthetic Reversal and Release

Anesthetic reversal was achieved with yohimbine (2mg/ml; 0.5 ml/cat IM or IV). An additional dose of yohimbine was given after 30 minutes if reversal results were inadequate. The cat was returned to the trap immediately after reversal. Carefully monitored heat lamps were used to ensure adequate body warming during recovery. Cats were monitored overnight following anesthesia to assess any effects from sedation. Once it was determined the cats were awake, alert, and eating they were released at their individual colony location.

Post-TNR initiation (year 2) Laboratory Protocol

For the study, Trap-Neuter-Return program procedures began in April of 2004. Trapping and general laboratory procedures were repeated according to previous methods during 9 separate trapping events spanning from April 2004 until April 2005. All cats trapped during this period (11 previously radio collared cats and all new cats #32-90) were managed according to Operation Cat Nap guidelines as described above. Radio collars began to fail beginning in July and August 2003 and feral cats were unable to be monitored via radio telemetry. By the onset of 2004 TNR management, only 11 cats were able to be located via radio telemetry. The remaining 11 original cats were recaptured in April and May of 2004 and fitted with new radio collars designed by the same company. After the 11 original cats were fitted with new collars 3 surplus radio collars remained from the 14 collars purchased for post-TNR monitoring. These 3 extra radio collars were assigned to 3 new feral cats managed with TNR in 2004 and monitored via radio telemetry for the duration of the study.

Data Collection

The data collection in 2004 was similar to the data collection in 2003. The following information was added to the data collection sheets due to management: eartip, sterilize, FVRCP, Ivomec, Frontline, packed cell volume, and total solids. Cats were given a complete physical examination, Rabies vaccination, Feline Viral Rhinotracheitis, Calicivirus, Panleukopenia (FVRCP) vaccination, Ivomec 1% solution 0.1 ml/cat subcutaneously (to treat ear mites, round and hook worms), FeLV/FIV testing, Frontline Plus Top Spot (for flea control), Procaine Penicillin G (if needed), the distal tip of the left ear was removed, and every cat was sterilized. Cats that were pregnant or dehydrated also received 150 ml lactated ringers solution subcutaneously. Cats were monitored for 24 hours post surgery and then released at their colony locations. At the end of the study in 2005, radio collars were removed and data were collected from 5 of the 14 remaining radio collared cats. The remaining cats with radio collars were too trap savvy at this point in the study to capture a third time despite employing alternative trapping methods such as a drop traps.

Radio Tracking

Cats were released and monitored using radio telemetry after a 1-week recovery period to allow for any effects resulting from capture. Telemetry locations were determined using a collapsible Yagi antenna and RX-98E receiver (Televilt, Telemetry Solutions, Concord, CA). For 2 years each cat was located, every third day, at a randomly selected time. Time periods sampled were morning crepuscular 7-9 am, midday 3-5 pm, and evening crepuscular 7-9 pm. When a cat was located, a single point was taken using a handheld Global Positioning System or GPS unit (GARMIN eTrex Vista, GARMIN International, Inc., Olathe, KS) as close as possible to the cat. Triangulation was not necessary because close approach to the majority of cats was possible. The author could get within a few feet of all of the feral cats except when habitat prevented this i.e.: under buildings, very thick brush, or fenced in areas. Every effort was made not to disturb the cats' normal behavior. Cats were located from April 10th, 2003 to March 24th, 2005.

During radio telemetry monitoring, any cats sited visually were noted as well as any behaviors of significance i.e.: hunting, fighting, predation, etc.

DATA ANALYSIS

We used a the DNR Garmin extension 4.01© (© 2006 Minnesota Department of Natural Resources) to download GPS locations into ARCVIEW© GIS (Environmental Systems Research Institute 2000*a*) to plot the feral cat and feeding station locations with aerial photographs of the area. These data were combined using ARCINFO© (Environmental Systems Research Institute 2000*b*) and the Hawth's Analysis Tool extension (Beyer 2004) to calculate feral cat home range and a habitat map for 2003-2005. Feral cat home ranges were estimated with the 95% minimum convex polygon method. Differences between pre-TNR and post-TNR as well as male and female home ranges were conducted using proc_glm ANOVA with Tukey's multiple comparison test in SAS ® version 8.2 (SAS Institute Inc. Cary, NC, USA). Differences were considered significant when $P<0.05$.

Using aerial photos from 1997 of the colony locations, the author was able to break down the study area into the following habitat types: structures, lawn, hardscapes, scrub, woods, landscaping, roadways, and water (Table 1). These habitat types were delineated in ARCINFO© (Environmental Systems Research Institute 2000*b*) as a habitat map which was combined with the feral cat home ranges (Figure 4).

We used compositional analysis to determine whether habitat use varied with TNR treatment (Aebischer et al. 1993). Compositional analysis was determined using Compos Analysis (Smith 2004). Second and third order habitat analysis were compared for pre-TNR and post-TNR management. Utilized habitat types were then pooled into 3 catagories: natural areas (scrub and woods), man-made areas (structures, hardscape and roads), and a combined category (lawn and landscaping). Second order analysis describes the type of habitats found in the feral cat home ranges or MCP (use) within the total study area (availability). Third order analysis uses the feral cat GPS locations (use) to determine which habitat types are most used within the MCP (availability).

RESULTS

Thirty four cats were captured and monitored via radio telemetry collars and visual observations producing 2173 GPS locations (1674 pre-TNR and 499 post-TNR initiation). Cats were monitored at three different times of the day (7-9 am, 3-5 pm, and 7-9 pm). We hoped to be able to analyze GPS locations to determine if there was a difference in feral cat activity at different times of day. This was not possible due to failure of handheld GPS to log date and time with each location. Based on visual observations and radio telemetry surveys, the author did not observe a significant difference in activity level between diurnal periods and the midday period as seen in other works (Haspel and Calhoon 1993 and Conner et al. 1999). Captures of non-target species during trapping events included raccoons (*Procyon lotor*) and opossums (*Didelphis virginiana*). Unfortunately 1 male kitten died in 2003 shortly after release due to radio collar strangulation.

Pre-TNR MCPs (Figure 5) and post-TNR initiation MCPs were determined for 24 of the 34 cats (10 females and 14 males) monitored with radio collars. Ten cats were excluded from calculations due to insufficient numbers of locations (<30). Overall the model was not significant ($F=2.67$) with $p=0.0668$. There were differences among male pre-TNR ($\bar{X}$ =8.5, SD=8.2, n=14) and post-TNR ($\bar{X}$ =3.6, SD=2.1, n=3) as well as female pre-TNR ($\overline{X}$ =2.5, SD=2.5, n=9) and post-TNR initiation ($\overline{X}$ =2.2, SD=2.1, n=6) home ranges (Figure 6). Due to small sample size and high variability the results were not significant. Although average home ranges for males did not differ significantly it is worth noting that older (>1 year) pre-TNR males had a much larger home ranges ($\overline{X}$ =9.4, n=9) when compared to the older (>1 year) post-TNR initiation males home ranges ($\overline{X}$ =3.6, n=3).

Habitat use was analyzed using the same 24 individual cats catagorized into pre-TNR (N=23) and post-TNR (N=9). The habitat in the study was composed of hardscape (22.8%), landscaping (9.6%), lawn (27.3%), roadway (11%), structures (15.6%), water (0.3%), woods (10.9%) and scrub (2.5%) (Table 1). The simplified ranking matrix of pre-TNR cats (Table 2a) ordered the preferred habitat types within the study area as hardscape > structures > landscaping > roadway > lawn > scrub > woods with water not utilized at all. Hardscape, structures and landscaping composed significantly more in the MCP within the study area than lawn, roadway, water and woods habitat types. Pre-TNR cats prefered woods > scrub > hardscape > landscaping > structures > lawn with roadway not used at all within the MCP (Table 2b). Woods habitat was significantly preferred by the cats over lawn and roadway within the pre-TNR cats' home range.

The simplified ranking matrix of post-TNR initiation cats (Table 3a) ordered the preferred habitat types within the study area as landscaping > hardscape > structures > roadway > lawn > scrub > woods with water not utilized at all. Landscaping, hardscape, and structures composed significantly more in the MCP within the study area than lawn, roadway, water and woods habitat types. Post-TNR initiation cats preferred woods > hardscape > structures > scrub > landscaping > lawn with roadway not used at all within the MCP (Table 3b). Woods habitat was significantly preferred by the cats over lawn within the post-TNR initiation cats' home range.

Second order analysis of pooled habitat use within the study area for pre-TNR cats were ranked the same as those for post-TNR initiation cats (Table 4a – 5a). Man-made habitats (hardscape, roads, and structures) were significantly preferred habitats over natural habitat (scrub and woods) and combination habitat (landscaping and lawn). Third order analysis of pooled habitat use within the MCP demonstrates pre-TNR cats preferred natural habitats (scrub and woods) over man-made and combination habitat types (Table 4b). This is slightly different among post-TNR initiation cats as they seem to prefer man-made habitats (hardscape, roads, and structures) over other habitat types (Table 5b). The difference in pre-TNR and post-TNR initiation pooled habitat preference is not significant.

DISCUSSION

Mean home range size post-TNR initiation was comparable, although somewhat smaller than those estimated by Ash (2001). The smaller home range size might be due to the different habitats and feeding circumstances between the two different studies. In this study, three feeding stations are positioned within 0.5 miles (0.8 km) of each other. These feeding stations are supplemented by dumpsters located at the many apartment complexes within the study area. Feral cats were frequently observed feeding in dumpsters. The 24 cats monitored had a high level of food predictability. Turner and Bateson (2000) hypothesized that female home ranges are determined by food abundance and distribution. Our results support this theory since the home ranges of females (pre-TNR and post-TNR initiation) were smaller than those of males (pre-TNR and post-TNR initiation) and condensed around the areas of the multiple feeding stations and apartment dumpsters. According to Turner and Bateson (2000) and similar studies (Ash 2001, Liberg 1980) male home ranges are three times larger than those of females. This was also reflected in our results and suggests breeding is a key factor in territory size as found by Liberg (1980), and Turner and Bateson (2000). There are 3 times the number of locations pre-TNR as those of post-TNR initiation and this must be taken into consideration as a possible bias.

Lawn, hardscape and structures composed over 65% of the study area with roadway, landscaping, woods, scrub, and water composing the other portion of study area. The most common habitats in the pre-TNR and post-TNR initiation MCP were hardscape, structures, and landscaping. Within the MCP both pre-TNR and post-TNR initiation feral cats significantly preferred woods over other habitat types.

Kittens were seen in feeders at approximately 4-6 weeks of age during peak kitten season in March and April of 2003 and 2004. No kittens were observed in March 2005. The most probable reason for this is a majority of the feral cats were participating in TNR, and therefore did not reproduce. Queens preferred to nest in areas inaccessible to the author (under buildings, deep in thick woods, in abandoned houses). Pregnant queens were noted in visual monitoring, but only 2 litters were found by the author. One litter was in a row of bushes between apartments and the other was under a set of concrete stairs surrounded by overgrown vegetation. The litter in the bushes had 4 kittens: 1 died at 2 days old, 1 was adopted by the author, 1 was found dead in the parking lot and the other kitten went missing around the same time frame of 3 months of age. Following the initial siting by the author, the mother moved the litter under the staircase after the nearby vegetation was cleared by the property manager. The mother was sited for another 2 months before her disappearance and the kittens were never seen after the initial siting. Often times queens in the same colony were pregnant at the same time and multiple kittens would emerge at 12-14 weeks of age. It would be very difficult to quantify the rate of kitten mortality in this study, but the author believes it to be similar to those found by Nutter et al (2004) of 75%. Therefore, the author recommends spaying all pregnant queens and taming and adopting all small kittens during TNR management. The author also believes mortality of all feral cats can vary depending on certain factors such as: diligence of the caretaker, location of colony, TNR status, etc. Male cats were the first and most numerous cats to disappear from colonies before TNR was implemented. Of the original 20 male cats, 30% of them were still sited by the end of the study as compared to 55% of the original 11 females.

Over the 2 year study aggressive behavior among feral cats was witnessed only 2 times by the author and no predation was witnessed. Occasionally cats were observed stalking prey, but no successful capture of prey was ever witnessed by the author. Most cats observed were consistently non-aggressive and seemed to have a social hierarchy when feeding and resting.

MANAGEMENT IMPLICATIONS

This method of analysis yielded successful results. Radio transmitter failure was the most limiting factor of this study since some failed after only 3 months and a full 2 years of data could not be used in the analysis. Only 12 collars remained functioning in the field by the end of the first year. Feral cat mortality was also a factor. Out of the original 31 cats, 14 or 74 % of males and 5 or 42% of females did not complete the 2-

year study. Some cats were known to have been killed while others went missing from the colonies and could not be tracked due to collar failure or loss. The author recommends radio collars with adjustable bands for a secure fit to prevent cats from getting their lower jaw caught in the collar. No difference in habitat use was observed by the author during the different times of day and is therefore probably not necessary in obtaining unbiased results. TNR significantly decreased the feral cats' home ranges, but did not significantly alter their habitat preferences. One could theorize that if TNR reduced feral cat home range size, then they are roaming less, have a somewhat smaller risk of trauma (such as being struck by a car), and have much fewer nuisance behaviors associated with breeding. In the author's opinion, when TNR was performed on younger cats (approximately 3-4 months old) the cats grew up to have a smaller home range and a smaller "touch barrier" making them seem less feral when compared to cats enrolled in the TNR program as adults. Some cats (mostly kittens and 1 adult) became tame after TNR and were adopted. The author also recommends trapping out an entire colony site at once when implementing TNR so it does not result in intact, trap savvy cats being left behind in the colony.

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Associate editor:

Table 1. Habitat Type. Description and percentage of available habitat within the study area in Auburn, Alabama 2003-2005.

Habitat Type	**Description**	**% of Study Area**
Hardscape	Parking lots, sidewalks, driveways, tennis courts, etc.	22.8
Landscaping	Landscaped flower beds, lone trees & shrubs that were in maintained areas, sandboxes and playgrounds	9.6
Lawn	Maintained open grass.	27.3
Roadway	Paved, dirt, or rail roads.	11
Structures	Buildings, fencing, feeding structures, ditches & bridge supports, power transformers, water cooling towers, AC units, walls, and bike racks.	15.6
Water	Creeks, fountains and swimming pools.	0.3
Woods	Heavily treed areas not otherwise maintained.	10.9
Scrub	Overgrown areas of tall grass and/or light bushes.	2.5

Table 2. Simplified ranking matrices of pre-TNR cats. Habitat ranking based on (a) comparing proportional habitat use within MCP home ranges with proportions of available habitat types in the study area, and (b) comparing the proportion of GPS locations for each animal in each habitat type with the proportion of each habitat type within the animal's MCP range during 2003-2005 in Auburn, Alabama. Each mean element in the matrix was replaced by its sign, a triple sign represents significant deviation from random at P < 0.05, n=23.

a. 2nd Order Analysis - pre-TNR MCP home ranges vs. total study area

Habitat Type	hardscape	Landscaping	Lawn	Roadway	Structures	water	Woods	Scrub	Rank
hardscape		+	+++	+++	+	+++	+++	+	7
Landscaping	-		+++	+++	-	+++	+	+	5
Lawn	---	---		-	---	+++	+	+	3
Roadway	---	---	+		---	+++	+	+	4
Structures	-	+	+++	+++		+++	+	+	6
water	---	---	---	---	---		---	---	0
Woods	---	-	-	-	-	+++		-	1
Scrub	-	-	-	-	-	+++	+		2

b. 3rd Order Analysis - pre-TNR cat GPS locations vs. MCP home ranges

Habitat Type	hardscape	Landscaping	Lawn	Roadway	Structures	Woods	Scrub	Rank
hardscape		+	+	+++	+	-	-	4
Landscaping	-		+	+++	+	-	-	3
Lawn	-	-		+++	-	---	-	1
Roadway	---	---	---		-	---	---	0
Structures	-	-	+	+		-	-	2
Woods	+	+	+++	+++	+		+	6
Scrub	+	+	+	+++	+	-		5

Table 3. Simplified ranking matrices of post-TNR initiation cats. Habitat ranking based on (a) comparing proportional habitat use within MCP home ranges with proportions of available habitat types in the study area, and (b) comparing the proportion of GPS locations for each animal in each habitat type with the proportion of each habitat type within the animal's MCP range during 2003-2005 in Auburn, Alabama. Each mean element in the matrix was replaced by its sign, a triple sign represents significant deviation from random at $P < 0.05$, n=9. Parentheses indicate where significance levels from standard t-tests of observed data differ.

a. 2nd Order Analysis - post-TNR initiation cat MCP home ranges vs. total study area

	hardscape	Landscaping	Lawn	Roadway	Scrub	Structures	Woods	water	Rank
hardscape		-	+++	+++	+	+	+++	+++	6
Landscaping	+		+++	+ (+++)	+	+	+ (+++)	+++	7
Lawn	---	---		-	+	---	+	+++	3
Roadway	---	- (---)	+		+	-	+	+++	4
Scrub	-	-	-	-		-	+	+	2
Structures	-	-	+++	+	+		+ (+++)	+++	5
Woods	---	- (---)	-	-	-	- (---)		+	1
water	---	---	---	---	-	---	-		0

b. 3rd Order Analysis - post-TNR initiation cat GPS locations vs. MCP home ranges

	hardscape	Landscaping	Lawn	Roadway	Scrub	Structures	Woods	Rank
hardscape		+	+	+++	+	+	-	5
Landscaping	-		+	+++	-	-	-	2
Lawn	-	-		+	-	-	--- (-)	1
Roadway	---	---	-		-	---	-	0
Scrub	-	+	+	+		-	-	3
Structures	-	+	+	+++	+		-	4
Woods	+	+	+++ (+)	+	+	+		6

Table 4. Simplified ranking matrices of pooled pre-TNR cats. Habitat ranking based on (a) comparing proportional habitat use within MCP home ranges with proportions of available habitat types in the study area, and (b) comparing the proportion of GPS locations for each animal in each habitat type with the proportion of each habitat type within the animal's MCP range during 2003-2005 in Auburn, Alabama. Each mean element in the matrix was replaced by its sign; a triple sign represents significant deviation from random at P < 0.05. n=23.

a. 2nd Order Analysis - pooled pre-TNR MCP home ranges vs. total study area

	Hard_Rd_Struc	Land_Lawn	Scrub_Woods	Rank
Hard_Rd_Struc		+++	+	2
Land_Lawn	---		+	1
Scrub_Woods	-	-		0

b. 3rd Order Analysis - pooled pre-TNR cat GPS locations vs. MCP home ranges

	Hard_Rd_Struc	Land_Lawn	Scrub_Woods	Rank
Hard_Rd_Struc		+	-	1
Land_Lawn	-		-	0
Scrub_Woods	+	+		2

Table 5. Simplified ranking matrices of pooled post-TNR initiation cats. Habitat ranking based on (a) comparing proportional habitat use within MCP home ranges with proportions of available habitat types in the study area, and (b) comparing the proportion of GPS locations for each animal in each habitat type with the proportion of each habitat type within the animal's MCP range during 2003-2005 in Auburn, Alabama. Each mean element in the matrix was replaced by its sign, a triple sign represents significant deviation from random at P < 0.05, n=11.

a. 2nd Order Analysis - pooled post-TNR initiation cat MCP home ranges vs. total study area

	Hard_Rd_Struc	Land_Lawn	Scrub_Woods	Rank
Hard_Rd_Struc		+++	+	2
Land_Lawn	---		+	1
Scrub_Woods	-	-		0

b. 3rd Order Analysis-pooled post-TNR initiation cat GPS locations vs. MCP home ranges

	Hard_Rd_Struc	Land_Lawn	Scrub_Woods	Rank
Hard_Rd_Struc		+	+	2
Land_Lawn	-		+	1
Scrub_Woods	-	-		0

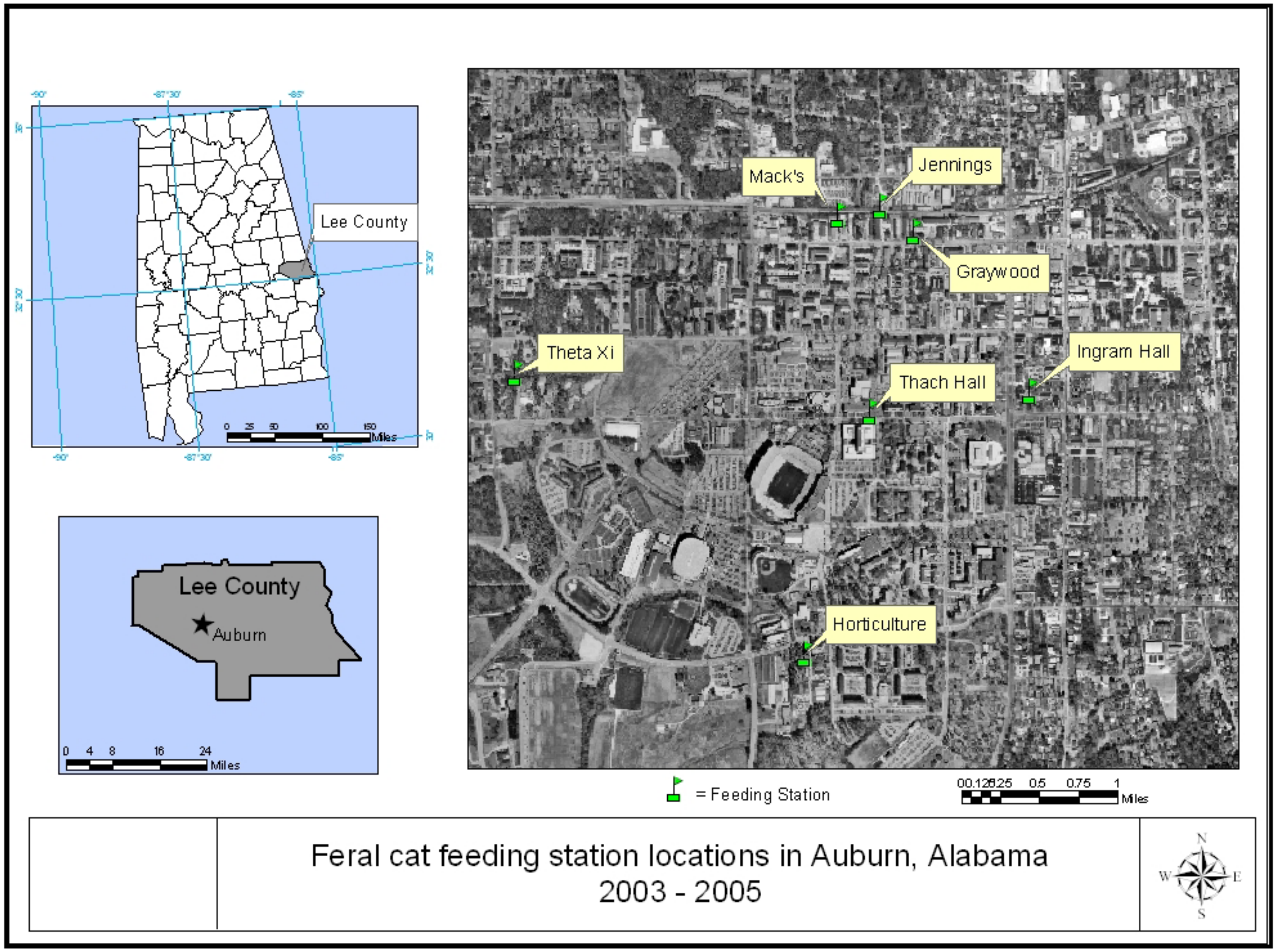


Figure 1. Feeding Station Map. Feral cat feeding station locations in Auburn, Alabama 2003-2005.

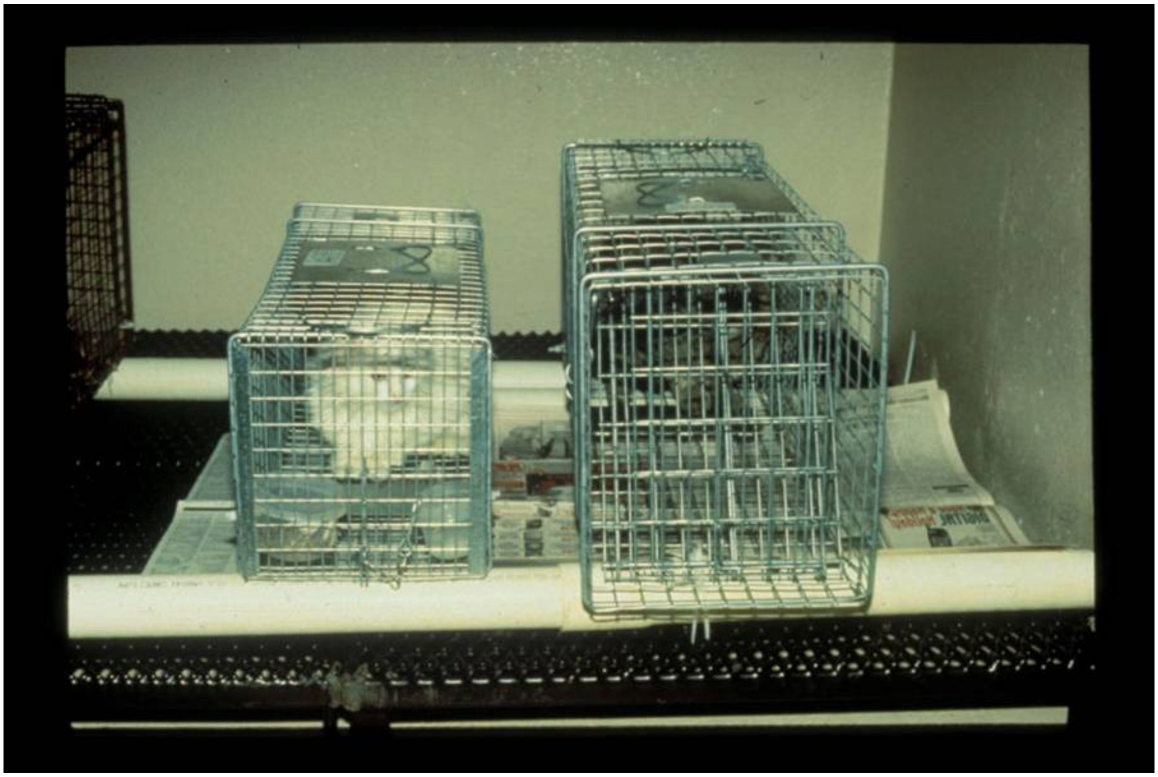


Figure 2. Holding Procedures for Feral Cats. Feral cats inside Tomahawk traps (model #606 and #608) fitted with food and water bowls (waterproof pads to cover traps not shown) during holding for study in Auburn, Alabama 2003-2005. Note elevation of traps above floor for sanitary purposes.

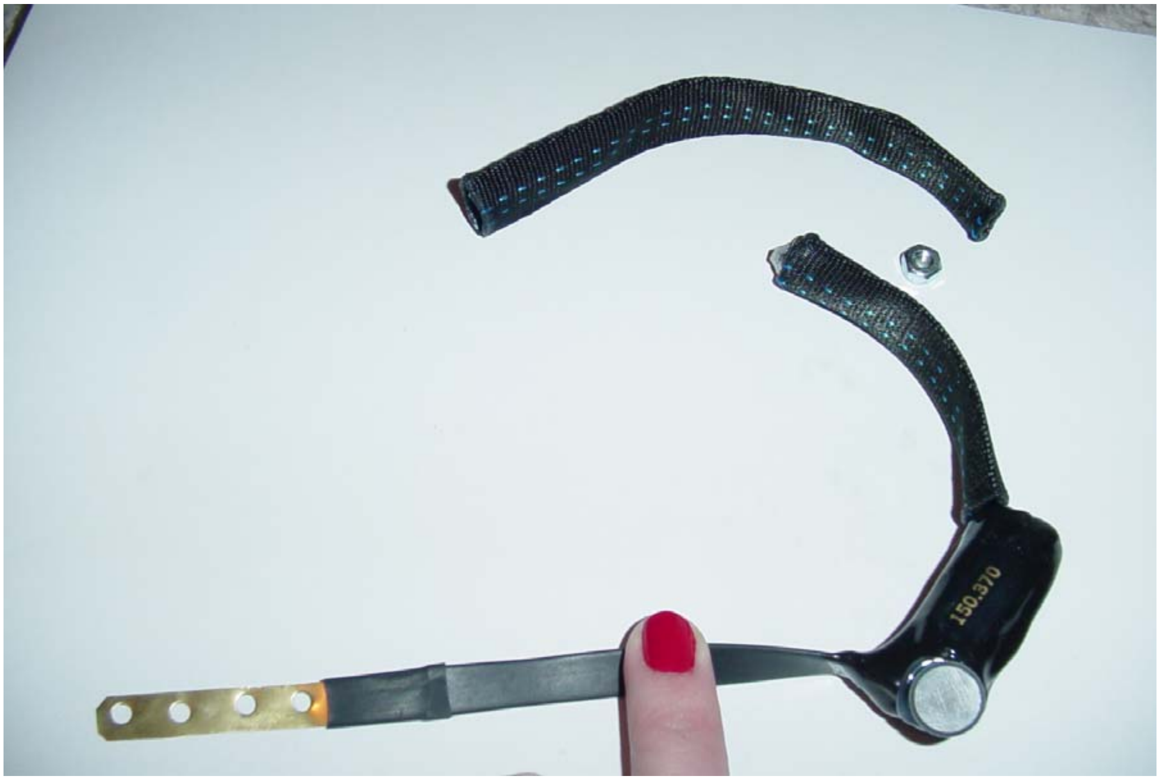


Figure 3. Feral Cat Radio Collar. Radio transmitter and adjustable metal collar with loop antenna used in feral cat home range and habitat use study in Auburn, Alabama 2003-2005.

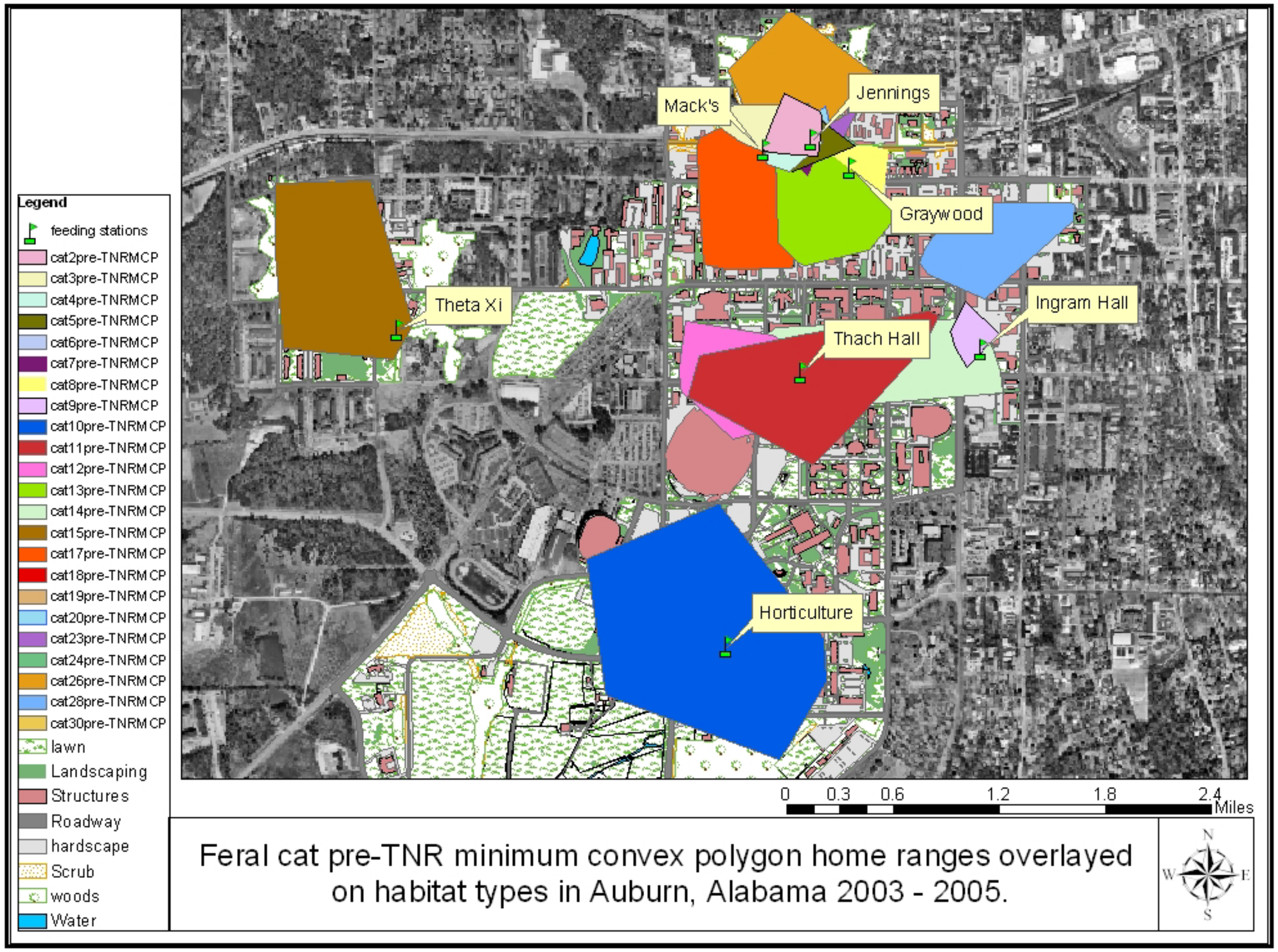


Figure 4. Feral Cat Habitat with pre-TNR Home Ranges Overlay. Aerial photographs of Auburn, Alabama with habitat map and pre-TNR MCP overlay 2003-2005.

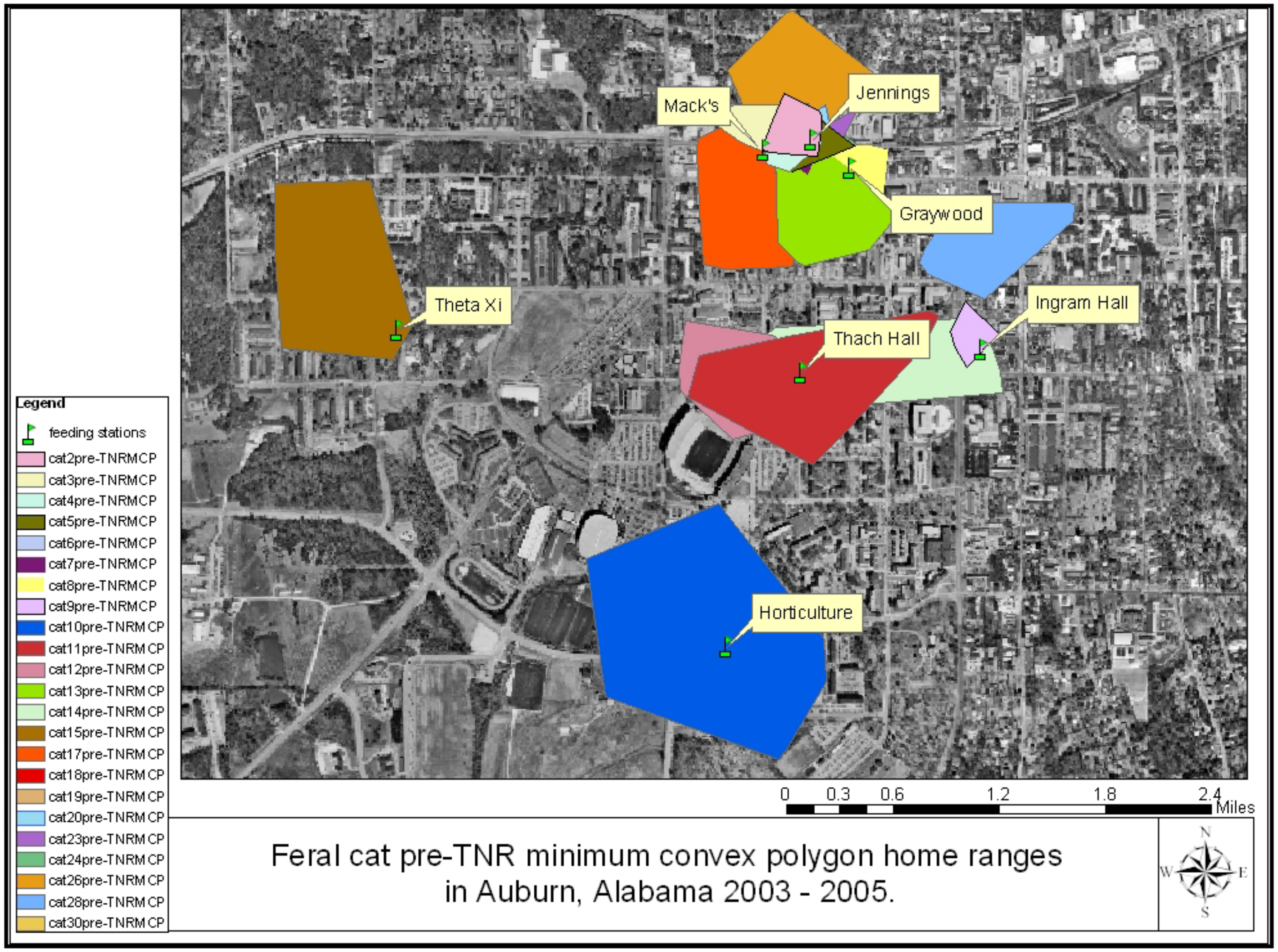


Figure 5. Feral Cat Pre-TNR Home Ranges. Feral cat pre-TNR minimum convex polygon home ranges in Auburn, Alabama 2003-2005.

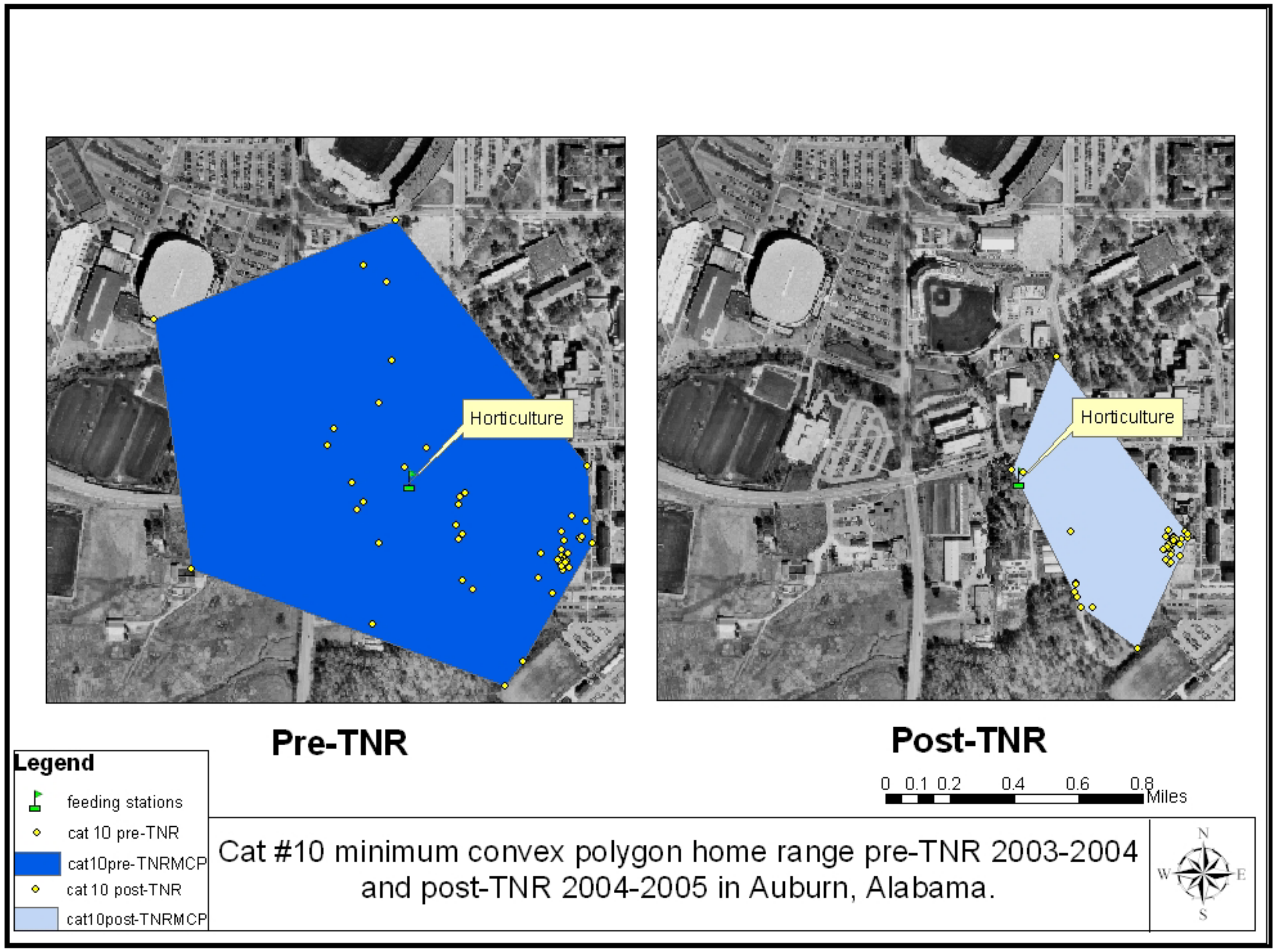


Figure 6. Cat #10 MCP pre-TNR and post-TNR initiation. Cat #10 (approximately 2 year old male DSH) minimum convex polygon home range pre-TNR 2003-2004 and post-TNR 2004-2005 in Auburn, Alabama.

IV. CONCLUSIONS

The main focus of this investigation was to determine what effects, if any, feral cat management using TNR has on feral cats located on Auburn University's campus by specifically examining its influence on population size, home range size and habitat use. Population parameters were measured for 1 year before and 1 year after initiating treatment to determine the effects of TNR on feral cat colonies. Seven feeding stations were established at pre-existing unmanaged feral cat colonies.

Identifying feral cats using photographic surveys was a viable method to supplement visual identification and trapping events. There was variability found among all 3 methods used to estimate feral cat populations. The Chapman model was successful in estimating 4 of the 7 colony populations at 3-month intervals. Graywood's significant population growth after TNR initiation was contrary to management outcome. Graywood's colony had a continual (although decreasing) immigration of feral cats into the area after TNR management had begun. Since this colony was never completely trapped out during TNR management, the author recommends a longer study period to assess the "after" effect of TNR on this colony. Two colonies had larger post-TNR initiation population averages while the remaining 2 post-TNR initiation populations decreased. Photographic sampling was an accurate and reliable way to census these colonies of feral cats, but the Chapman model must have a larger population to yield significant results. Longer study duration is needed to determine possible impact of TNR on feral cat colonies. A combination of methods similar to this study (using a dedicated daily caretaker, photographic sampling, and trapping events) could be the most accurate means to estimate feral cat colony populations Initial trapping events were valuable in estimating feral cat populations, but subsequent trapping events created trap savvy cats. The author recommends trapping out an entire feral cat colony at once to implement TNR so it does not result in intact, trap savvy cats being left behind in the colony.

The mean home ranges (MCP) for pre-TNR and post-TNR cats were determined with pre-TNR significantly greater than post-TNR. Pre-TNR male home ranges were significantly greater than those of pre-TNR females. Lawn, hardscape and structures composed over 65% of the study area with roadway, landscaping, woods, scrub, and water composed the other portion of study area. The most common habitats in the MCP were hardscape, structures, and landscaping. Within the MCP the feral cats preferred woods and scrub over other habitat types.

TNR management during 2004 and 2005 included 33 spays, 32 neuters, 1 euthanasia, and 9 adoptions. By the end of the study the author estimates over 90% of the cats in the area were successfully managed using TNR. Continued management using TNR must be maintained in order for population control to be effective, but this holds true for any form of population management. Kitten mortality appeared to be similar to the high rates (75%) found in previous studies, therefore the author recommends spaying all pregnant queens and taming and adopting all small kittens during TNR management.

Overall it was determined that TNR does affect feral cat home ranges. More long term studies are needed in order to determine TNR’s effect on population size over time.

Censusing feral cat colonies over a period of years pre-TNR and post-TNR would prove provide additional insight into the long-term effect on population size. Censusing feral cats using 35 mm. cameras proved costly. The author recommends digital cameras for future studies.

APPENDIX A.

Dear Jane Smith,

Thank you for agreeing to be a caretaker for the feral cats residing at Theta Xi. You are helping to us to better understand feral cat populations and Trap-Neuter-Return (TNR). Your help as a caretaker for this feral cat colony is greatly appreciated. In this package you will find:

1. An overview of Operation Cat Nap
2. Commonly Asked Questions and Answers about Feral Cats
3. Summary of Graduate Project
4. Caretaker Instruction Sheet
5. Caretaker Cat Description Form
6. Cat Coat Color Chart

If you have any questions please feel free to contact me at the information below. Once again, thank you for your willingness to participate in this study and to care for the cats. I am looking forward to working with you.

Sincerely,

Kimberly B. Subacz

OPERATION CAT NAP

In January, 2000, Auburn University's College of Veterinary Medicine, with the support of the Scott-Ritchey Research Center, implemented a feral cat trap-neuter-return (TNR) program to control the cat population on campus. This program (called Operation Cat Nap) is under the direction of Dr. Brenda Griffin and has been approved by the Dean of the College of Veterinary Medicine and the University Provost. This program represents a collaborative effort among faculty, staff and students to take responsibility for the cats residing on the Auburn University campus.

The specific goals of Operation Cat Nap include the following:

1. To humanely control the campus population of cats

2. To raise awareness regarding the awesome importance of responsible cat ownership and spay/neuter

3. To contribute descriptive scientific information to the pool of knowledge concerning feral cats and the effects of TNR

4. To provide veterinary students and veterinarians with the knowledge required to implement a successful TNR program in practice.

Commonly Asked Questions and Answers About Feral Cats

Kimberly Subacz and Brenda Griffin, DVM
School of Forestry & Wildlife Sciences
College of Veterinary Medicine
Auburn University

Q: What exactly is a feral cat?

A: Feral cats are'wild' offspring of domestic cats and result from pet owners abandoning and/or failing to sterilize their pets, allowing them to breed uncontrollably. Feral cats are unsocialized, unowned free-roaming cats. They generally do not allow handling by humans and must be trapped in order to be presented for veterinary care. They, however, are NOT a wildlife species and can not fully fend for themselves. Unattended, they survive, but do not thrive, breed prolifically, and lead meager lives shortened by malnutrition, disease, trauma, and high kitten mortality. They can become public nuisances and make up a large portion of the cats euthanized at animal shelters. Just one pair of breeding cats can produce two or more litters per year can exponentially produce **420,000 offspring** over a seven year period.

Q: What can be done to prevent more feral cats?

A: First and foremost, responsible cat ownership must be promoted, focusing on sterilization, the wearing of identification, preventative health care and keeping cats safe at home.

Q: Is there a safe, humane and effective method of controlling existing populations of feral cats?

A: Yes, it is called Trap-Neuter-Return (TNR). Cats are trapped by caretakers, neutered and then returned to their "home" for release. Caretakers feed and monitor the health and reproductive status of the colony. Millions of cat-lovers in the United States feed and care for feral cats. The American Veterinary Medical Association supports the use of Trap-Neuter-Return to control existing colonies of carefully supervised feral cats, provided they are located in safe areas away from wildlife refuges and bird sanctuaries.

Q: How does TNR compare to other methods of controlling feral cats?

A: Substantial debate surrounds the appropriate response to the presence of feral and free-roaming cats. The traditional approach to controlling them has been extermination by trapping and euthanasia. However, large scale trap and kill programs have not been widely implemented or successful and frequently result in public outcry. TNR has become an increasingly popular method of managing existing colonies of feral cats. Neutered cats display fewer "nuisance" behaviors such as spraying and fighting and can not reproduce. Over time, colony size should decrease due to attrition. In addition, TNR has been shown to be more cost effective than trapping and euthanizing feral cats since most states require impoundment and holding prior to euthanasia and since private volunteers are more likely to trap cats for surgery than for euthanasia.

Q: What about the wildlife?

A: TNR programs have been the focus of great criticism and controversy concerning the impact of feline predation on wildlife species, in particular song birds. Although it is a widely held belief that free-roaming cats are detrimental to bird populations, scientific studies that support this belief do not exist with the exception of isolated island habitats where cats have contributed significantly to bird mortality. Studies to determine the magnitude of feline predation on wildlife in relation to population dynamics and size are needed. When considering this controversial issue, it is important to keep in mind that the goal of TNR is to control the free-roaming cat population.

Q: What if I need to pursue other methods?

A: TNR however beneficial is not always the best option in every circumstance. If you need to purse other methods of feral cat management you should contact your local animal control. Our local Animal Control agencies can be reached at: Auburn Animal Control 501-3091; Opelika Animal Control 705-5400; Lee County Animal Control 745-9835. You can also contact your local animal shelter. You can reach Lee County Humane Society at 821-3222.

Q: How can graduates of a TNR program be identified?

A: The tip of the left ear is removed. Ears are tipped, rather than notched since notching may occur as the result of fighting, especially in tom cats and may be mistaken as a sign of previous TNR.

Q: What about small kittens?

A: Because the mortality rate of feral kittens is 50% on average, kittens should be tamed and kept as pets or humanely euthanized. Kittens older than 3 months of age are difficult to tame. Information on taming feral kittens is available at www.feralcat.com or by ordering a video tape entitled *Socializing Feral Cats* (9-Lives video series) from the San Francisco SPCA by calling 1-800-211-SPCA. More information on raising very young kittens can be found in the kitten care handbook at www.kittenrescue.org.

Q: What about sick or injured cats?

A: Unless treatment can be entirely performed at the time of neutering (ex: cleaning a wound), humane euthanasia should be performed. Ongoing treatment cannot usually be safely and reliably administered to a feral cat.

Q: What about relocating feral cats to a new site?

A: Relocation of feral cat colonies is frequently unsuccessful and is not advised since cats possess strong homing instincts and will try to return to their original home base or colony site. If relocation is necessary, cats must be confined for several weeks at their new “home” location prior to release.

Q: Is there a national resource for information concerning feral cats and TNR?

A: Yes, Alley Cat Allies is a national nonprofit organization that actively promotes TNR as the accepted method of feral cat population control throughout North America. They serve as a national resource and authority on all aspects of feral cat management using TNR. To learn more, visit their website at www.alleycat.org.

Summary of Graduate Project

The general goal of this study is to determine the impact that management using TNR has on the population of feral cats here at Auburn University. It specifically examines the population size and density, home range size, habitat use and physical health for one year before and one year after TNR.

We have 7 colonies that will be the focus of this study. Each colony has a caretaker and a feeding station with an infrared-triggered camera that takes pictures inside the station. The stations are actually modeled after ACA's cat shelters.

We will be capturing cats and collecting individual data, giving each cat a physical exam, testing them for Felv and FIV, microchipping, vaccinating for rabies, and then fitting them with radio collars so that I can track their movements. I will be using GIS to analyze their home ranges and habitat use over the 2 year study. After one year the cats will be captured and go through the full TNR treatment with the tests, all vaccinations, eartipping and of course sterilization. Monitoring will begin again for a full year after the TNR treatment.

We are also conducting surveys of both established campus caretakers and my project caretakers every 4 months for the duration of the study. We hope the survey will provide additional population information as well as assess the general attentiveness of each caretaker.

Caretaker Instruction Sheet

Location: Horticulture & Thach Hall Feeders

Caretaker: Jane Smith

1. Feeding instructions:

- Feed and check water daily if possible, preferably at the same time in the morning so the cats are accustomed to a routine. This also prevents wildlife from eating any leftover food.

- Empty food and water bowl of any dirt, debris or old cat food.

- Fill feeder with food and water as needed.

- If there are ants at the feeding station contact Kim Subacz to treat the area.

2. Monitoring instructions:

- Use Caretaker Cat Description Form to describe each cat seen on site and keep form updated with date, time, location, and any observed behavior if possible.

- Note: Some cats will only be in your area for a short period of time. Please take note of any newcomers to the colony.

Caretaker Cat Description Form

Please fill out a description form for every cat you have seen at your location.

Caretaker Name: ___________________________

Location: _________________________________

Cat Name (if applicable): _____________________

Please circle one answer for each of the following categories:
(Refer to Cat Coat Color Chart if needed)

Coat Length:

Short Hair Long Hair

Coat Color:

Red Cream Chocolate Black Smoke Blue

White Fawn Cinnamon Lilac

Coat pattern:

Mackeral Tabby Classic Tabby Spotted Tabby Ticked Tabby

Tortie Calico Torbie Tuxedo Van Bicolor

Solid Harlequin Locket Mitted Pointed

Please fill in any sightings to the best of your ability:

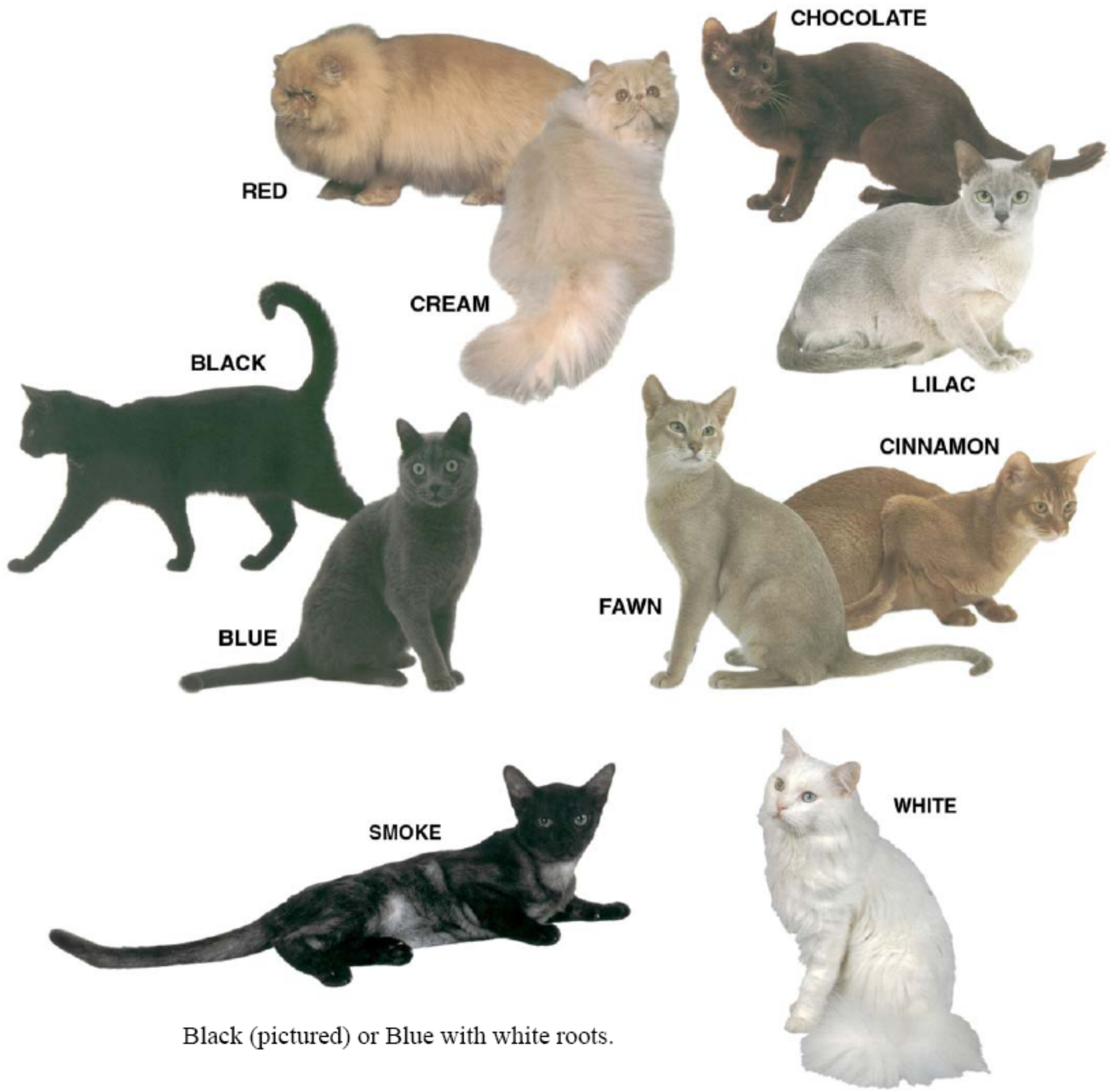
Date	**Time**	**Location:**	**Behavior witnessed:**

Feeding/ Drinking
Sleeping/Resting - laying down on ground or under bush for a long period of time.
Fighting - two or more cats participating in growling/howling/biting one another
Spraying - tail in air with back feet on toes while urinating on object.
Rubbing - rubbing head or jowls on objects or other cats
Other – Please describe

Cat Coat Color Chart

CAT IDENTIFICATION

Solid Coat Colors



Eye Coloration

Brown **Hazel** **Gold** **Green** **Blue**

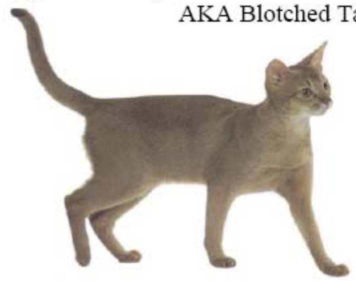
Tabby Coat Markings

Tabby M
All tabbies have distinctive
M on forehead.

Mackeral Tabby
(Red Mackeral Tabby)

Classic Tabby
(Chocolate Classic Tabby)
AKA Blotched Tabby

Spotted Tabby
(Chocolate Spotted Tabby)



Ticked Tabby
(Cinnamon Ticked Tabby)

Tabby Coat Colors

Distinct color patterns with one color predominating.
Black stripes ranging from coal black to brownish on a background of brown to gray.
Brown mackeral tabbies are the most common.

Brown Mackeral Tabby with Brown Field
Black stripes with brown background.

Brown Mackeral Tabby with Gray-Brown Field
Black stripes with gray-brown background.

Brown Mackeral Tabby with Gray Field
Black stripes with gray background.

Blue
(Blue Classic Tabby)
Gray stripes with gray roots.

Silver
(Silver Classic Tabby)
Black stripes with white roots.

Red
(Red Classic Tabby)
Red stripes with red roots.

Chocolate
(Chocolate Classic Tabby)

Red Silver
(Red Silver Classic Tabby)
Red stripes with white roots.

Cream
(Cream Ticked Tabby)
AKA Cameo Tabby

Tortoise Shell Colorations

Random color distribution among varying shades of red, black, and cream. Patches may be mingled or distinct.

Tortie
Randomly patched all over with red, black and cream.

Dilute Tortie
"Blue Cream Tortie"
Dilute version of Black and Red.

Lilac Tortie
Randomly patched all over with lilac and cream.

Tortie and White
Small white areas with mingled red, black and cream colors.

Dilute Tortie and White
Small white areas with mingled blue, and cream colors.

Chocolate Tortie
Chocolate mingled with red and cream.

Calico
Tortoiseshell with large patches of white. Red tabby and solid black patches more distinct.

Dilute Calico
Same amount of white as calico with distinct patches of solid blue and cream tabby.

Torbies

Tortoiseshell cats with tabby patterns.
Torties because of random *color variation*, but tabbies due to the *patterns* in the coloration.
Torbies are also called patched tabbies.

Brown Torby
(Brown Spotted Torby)
Patches of brown tabby and red tabby.

Brown Torby and White
(Brown Spotted Torby and White)

Dilute Torby
(Blue Classic Torby)
Patches of blue tabby and cream tabby.

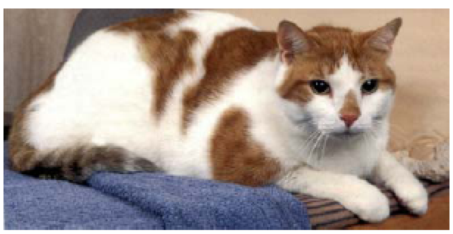
Dilute Torby and White
(Blue Mackeral Torby and White)

Other Coat Patterns

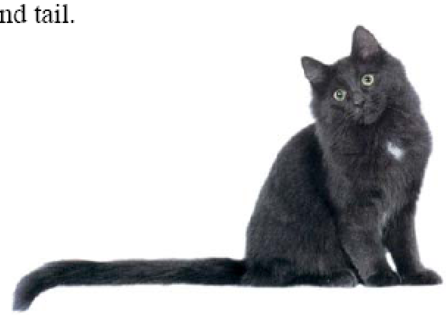
Snowshoe

Van
(Red Mackeral Tabby Van)
Mostly white, color mainly on head and tail.

Bicolor
(Black and White Bicolor)
~1/2 white, color on head and torso.



Harlequin
(Red Mackeral Tabby Harlequin)
Mostly white with several large patches of color.



Locket
(Blue Locket)
White spot on chest.

Mitted
(Black Mitted)
Just white paws.

Tuxedo Cats

Coloration with white paws, chest, and belly, with optional white on face.

Smoke Tuxedo
(Blue Smoke Tuxedo)
Blue smoke with tuxedo markings.

Tuxedo
(Black Tuxedo)
Black with tuxedo markings.

Tuxedo Tabby
(Brown Mackeral with Brown Field Tuxedo Tabby)
Tabby with tuxedo markings.

Points: Color Points



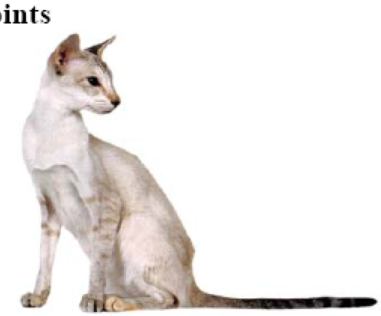
Seal Point **Blue Point** **Lilac Point**


Cream Point

Red Point
AKA Flame Point

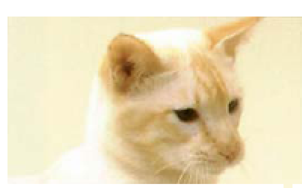
Pattern Points

Tortie Point
Tortoiseshell pattern on points.



Torbie Point
Both striped and tortoiseshell patterns on points.

Tabby Point
(Lilac Tabby Point)
AKA Lynx Point
Striped pattern on the points.



Tabby Point
(Red Tabby Point)

Tabby Point
(Seal Tabby Point)

APPENDIX B.

Operation Cat Nap

Caretaker Trapping and Release Instructions

Before you trap

It is easier to trap a cat that is used to coming to a certain site for food at a regular time. If the cats are not used to a routine, it will be much harder to trap them. Try to feed the cats according to a routine as far in advance of trapping as possible.

Prepare a warm, sheltered area for holding the cats before surgery. Garages or well-ventilated sheds work well. Place newspapers on the floor to catch urine, stool, and food that will fall from the trap. Bricks or other convenient items can be used to elevate the traps off the ground so that the cats are not sitting in their waste. It may be necessary to spray the area with cat-safe flea or ant spray to keep insects away from the cats. Also, you should place a plastic liner in your vehicle for the cages to sit on. This will keep urine from damaging your car while traveling to and from the trap site and clinic.

Be sure to contact other people around the area where you intend to trap so that everyone in the area understands what you are trying to do and neighbors can keep their pets confined. Stop feeding the cats two nights before you begin trapping so that the cats will be hungry. Inform anyone else that might be feeding the cats to stop feeding too.

Setting the traps

Begin trapping up to two nights before the surgery clinic at your established feeding area. Open the traps at dusk then close them at dawn. Traps should never remain open during the day due to the heat. Also, do not trap in the rain. Find a good location to put the trap. It should be hidden from view so that it will not be noticed by a passerby who might disturb the trapping. Bushes are often places where cats hide and provide good camouflage for the trap. The trap should be placed on level ground. Cats are unlikely to enter a trap if it wobbles. Check to make sure the back door of the trap is correctly latched. Open the front door of the trap by pushing the top of the door in and pulling the bottom of the door out. Latch the hook on the top of the trap to the small metal cylinder on the door. This will keep the door open and raise the trip plate. The trap should be baited with smelly food such as canned mackerel or the dry cat food they are used to eating. Place a small trail of food leading from the opening of the trap to the back. Then put a larger amount of food in one of the bowls tied to the back of the trap. Make sure the Catnappers sign is easily seen on the trap to deter anyone from disturbing the trap. Cover the trap with a large towel such that the sides and back are covered but not the front or the Catnappers sign. The cover helps to keep the cat calm in the trap and provides camouflage. Any trapped cat must remain covered throughout all trapping, transporting, and holding. Always wear leather or thick gloves when handling or transporting any animal in the trap. **Be sure the trap is covered with a towel when you bring the cat to the Operation Cat Nap surgery clinic!**

Picking up the traps

Don't wait around to see if a cat enters the trap. Your presence will make the cats wary and scare them off. Check the traps once every few hours during the evening and again very early in the morning. Be sure to close the traps during the day for the safety of the animal and reopen them at night**. Never reach into the trap with any caged animal or you risk serious injury.** Cover the trap completely, make sure the back door is secure, and carry the trap to your holding location. If you capture a pet cat wearing a collar, a previously neutered cat (ear-tipped) or a wild animal (such as an opossum), wearing thick gloves (heavy leather gloves work best), carefully open the back door of the trap, stand back at a safe distance, and allow the animal to leave. If you note that you have captured a nursing mother cat, check the area for kittens and remember this female should be released as soon as possible after surgery so she can care for and nurse her kittens if necessary.

Holding procedures

Place the traps in the prepared area. Keep them covered. If it is more than 1 day before the surgery clinic, sprinkle dry food from the top of the cage into the food bowl and pour a small amount of water into the other bowl. If less than 1 day, just give water. Check the cats periodically and change dirty newspaper as needed. The cats will likely stay calm and quiet as long as the traps are covered. Be sure they do not get overheated or too cold and that they have adequate air ventilation. After transfer of cats to surgery clinic, change all newspaper in the holding area before cats are returned so they have a clean area to recover from their surgery.

Recovery

The cats will be picked up the same day as their surgery. They may still be recovering from anesthesia. Normal behaviors include head bobbing, wobbly movements, fast breathing, shivering, and deep sleep. Keep the cats warm and covered. Monitor them periodically. They should not be bleeding from the surgery area. Bleeding from the left ear crop is expected but should stop before release the next day.

Release

If the cats are fully awake the next day, they can be released in the same location from which they were trapped. Relocating cats is rarely successful. They will either be driven off by territorial cats or other animals or follow their natural instinct to return home. To release the cat, point the back of the trap away from danger, such as a busy street. Take off the cover, safely unlock the back door, and lift the door away from the trap. Stand back and patiently allow the cat to leave at its own pace. Usually it will run away immediately.

Helpful Hints

- Never put your hands near the trap without wearing gloves. Never reach inside the trap with a caged animal. If you are bitten or scratched, contact your doctor immediately. If your doctor is unavailable, contact your local law enforcement agency. All cat bites and scratches must be reported to the Public Health Department as soon as possible. **Do not release the cat!**
- Bring a flashlight and a friend to check the traps at night.
- Bring a spoon for your bait. The smell of fish doesn't wash off your hands easily.
- Lactating queens should be spayed and released as soon as possible after surgery.
- Females with kittens are attracted to the sound of their kittens. Placing a trap next to the trapped kittens will encourage the mother to enter. Likewise, kittens will be attracted to a trap set next to their trapped mother.

- Feeding schedule for trapping:
  - Wednesday and Thursday – don't feed cats you are going to trap
  - Friday and Saturday – set traps according to instructions. Be sure to check every few hours during the night.
  - Saturday morning – Take trapped cats to holding location. Give small amount of food and water to trapped cats. Close empty traps for the day.
  - Saturday evening – Open/reset traps according to instructions. Previously trapped cats should not be fed, but can receive a small amount of water.
  - Sunday morning – Check traps a final time, close and pick up all empty traps; bring all trapped cats to Operation Cat Nap surgery clinic at the time specified. ***Be sure to leave food out at usual locations when you pick up your traps on Sunday morning. ***

Special Precautions

Because feral cats are in contact with wildlife, and because they will readily bite and scratch, feral cat caretakers and volunteers should consider receiving a 3-shot series of rabies vaccinations from the Public Health Department or a physician for their own protection. All cat bites and scratches are serious and should receive medical attention.

ALWAYS wear thick protective gloves when carrying a trap with a cat inside and always keep the trap covered with a towel or blanket during transport. This will serve to protect you and to calm the cat. Never open a trap containing a cat or put your exposed hands near the trap.

ALL ANIMAL BITES ARE SERIOUS! IF YOU ARE BITTEN, SEEK MEDICAL ATTENTION, AND DO NOT RELEASE THE CAT. The cat must be quarantined. Contact your veterinarian for quarantine advice. Cat bites and scratches are extremely painful and dangerous, and may require hospitalization to treat serious infection.

The rabies virus has reached epidemic proportions in the southeastern United States. Humans acquire the virus through contact with virus-laden saliva of an infected animal (dog, cat, raccoon, bat, skunk, etc.). Blood and other body fluids are a much less common source of infection. Bites and scratches are the most common routes of infection from animals to humans. The rabies virus is 100% FATAL once a person starts showing infection. There is no known treatment for rabies, either in humans or in animals. The only course of action is to give a series of post-exposure vaccinations to a person suspected of having been exposed to a rabid animal. The only definitive test to detect rabies in an animal is to euthanize the animal, remove the head, and inspect the brain tissue for identification of the virus. Human rabies vaccines are recommended for anyone who works with stray animals.

APPENDIX C.

Subacz Feral Cat Study Paw Tag

Cat # ______________
Trap Color and # ___________________
Location Trapped:__________________
______ Anesthesia (0.25 mL TKX adult cat)
______ Eye Lube
Sex ______________
DSH/DLH
Coat Coloration and Pattern:
____
Distinguishable Features:
____
Eye Color: ________________
Body Weight: ______________
Estimated Age:
4-6 mo >6mo-<1 yr 1yr-<2yr ≥2yr
Physical Exam (0 = normal, + = abnormal)

_____GEN	_____EYES	_____EARS	_____ORAL
_____NT	_____PLN	______HL	_____ABD
_____UG	_____MS	_____INTEG	_____NEURO

______ General Body Condition
______ Eartip
Physical Exam Findings:
Normal/Unremarkable
Already Spayed or Neutered
Already eartipped
Abscesses/Wounds (Location)
Other _____________________
Spay/Neuter Status: Pregnant (#feti ____) Lactating Neither Both
Special Instructions: SQ Fluids Other (Findings)
______ FeLV/FIV tests Results __________
______ FVRCP
______ Rabies vaccination (lot # ______________)
______ Ivomec (0.1 cc)
______ Penicillin (0.5 cc)
______ Frontline
Microchip # _______________________
Radio Collar Color:____________
Radio Collar Frequency _______________
______ Photograph cat PCV (30-45% normal) ________
______ Reversal Total Solids (5.7 – 7.6 g/dl normal) _______