Feral Cat Issues and Effects on Surrounding Ecosystems

Kristen A. Ludwick

Miami University

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Abstract

Domestic cats (*Felis catus)* are recorded as one of the 100 worst invasive species on this planet. Although hard to be accurate, estimates predict that feral cats have populations of approximately 80 million in the United States, and 160 million feral cats globally (Loss, Will, & Marra, 2013). Feral cats contribute to many issues such as the spreading of zoonotic diseases (toxoplasmosis), internal parasites (tapeworms or roundworms), problems with public nuisances (fighting, loud or frequent noises, marking of urine/spraying), as well as predation of local wildlife and disruption to surrounding ecosystems. This paper explores the options of handling the feral cat population by lethal means such as poison baiting and shooting, and more humane ways, like Trap-Neuter-Return (TNR) or Trap-Vasectomy-Hysterectomy-Return (TVHR) programs, and immunocontraception.

Keywords: Trap-Neuter-Return, Trap-Vasectomy-Hysterectomy-Return, feral cats, zoonotic diseases

Feral Cat Issues and Effects on Surrounding Ecosystems

It may be surprising that domestic cats (*Felis catus*) have been recorded as one of the 100 worst invasive species on this planet (Lowe, Browne, Boudjelas & DePoorter, 2000). Estimating feral cat populations has proven to be difficult for researchers, however estimates are approximately 80 million in the United States alone and 160 million feral cats globally (Loss, Will, & Marra, 2013). It is estimated that 80% of kittens born in the United States each year are from feral mothers (Ireland & Neilan, 2016). The overwhelming population of feral cats causes numerous issues, including the spread of zoonotic diseases (toxoplasmosis), internal parasites (hookworms or tapeworms), problems with public nuisance (fighting, loud or frequent noises, marking of urine/spraying), as well as predation of local wildlife and disruption to surrounding ecosystems (Loyd & Miller, 2010; Gosling, Stavisky, & Dean, 2013; Ireland & Neilan, 2016).

It is estimated that the life expectancy of a feral cat is no greater than five years, and this high mortality rate can be connected to poisonings, disease, environmental extremes, and motor vehicle impacts (Nutter, Levine, & Stoskopf, 2004). One study even reported a lower life expectancy, at two to three years (Normand & Urbanek, 2017), compared to the lifespan of 15 – 20 years of an owned cat (Wellock, 2013). Even with the public nuisance difficulties that arise from feral cat populations, it is estimated that up to 22% of households in the United States provide food for outdoor cats they do not own (Levy, 2003), and there is a lot of sympathy for starving, injured, or lethargic cats (Centonze & Levy, 2002).

Because of the emotions and humaneness associated with cats, especially because they are seen as companion animals, the debate on how to handle feral cats is controversial. A large percentage of people consider lethal control, or euthanizing, poisoning, or hunting feral cats to be

unethical (Chu & Anderson, 2007; Loyd & Miller, 2010). A study by Robertson (2008) even showed that the elimination of cats by lethal means from an open population created openings for new cats to fill the population, referred to as the "vacuum effect," thus not solving the feral cat issue. A more humane way that is showing promise is Trap-Neuter-Return (TNR) or Trap-Vasectomy-Hysterectomy-Return (TVHR) programs. These programs trap feral cats, surgically sterilize them, and then return the animal to their original habitat (Slater, 2007).

This paper focuses on TNR/TVHR programs by looking at cost, effectiveness, public opinions, and impacts on wildlife and surrounding ecosystems, in addition to alternatives to TNR/TVHR programs. The goal of this paper is to report data surrounding TNR/TVHR programs in hopes of being used to encourage TNR/TVHR programs and funding. Using published articles, this paper will discuss recent statistics and studies around the management of the feral cat population.

Discussion

Feral Cat Impacts on Wildlife and Surrounding Ecosystems

The presence of feral cats on an ecosystem is impactful, since cats can outcompete native predators such as foxes, which changes the composition of the ecosystem (Crooks & Soule, 1999). Some studies show that where feral cat populations are large, there are large populations of exotic rodents and native rodents are scarce (Loyd & Miller, 2010). Specifically within island habitats, feral cats are guilty of several species extinctions (Nogales et al., 2004) however there is evidence that feral cat populations have strong negative impacts on non-insular habitats as well (Crooks & Soule, 1999; Baker, Bentley, Ansell, & Harris, 2005). Feral cat populations seem to increase as habitat fragmentation increases, which impacts the fragile ecosystem of fragmented areas even more (Crooks, 2002). Feral cats live around areas populated by humans as the colony

relies on resources provided by garbage, human feeding, and other scavenging animals who are common around areas of human civilization. Since human industrialization is a large reason for habitat fragmentation (Krauss et al., 2010), feral cats are frequently found in areas of fragmentation and decrease the population of other small species in that area who are considered prey items (Uni, 2013). Dietary studies of feral cats have shown that in the northern hemisphere, feral cats derive most their nutrition from local prey, as their diet is composed of 69.6% mammals, 20.8% birds, and 1.6% reptiles. The remainder of their diet is estimated to be local vegetation, carrion, and human interference (Fitzgerald & Turner, 2000).

Disease. Disease is another issue in the feral cat population which impacts the local ecosystem. A significantly larger prevalence of infectious diseases and parasites were found in feral cats versus owned cats, most of which are zoonotic and several of which effect other species (Nutter, Levine, & Stoskopf, 2004). The feline leukemia virus, or FeLV is a disease of concern which is transmitted through the saliva or blood of an infected cat to a healthy cat. Just nose to nose contact can spread the disease between animals (Normand & Urbanek, 2017). Additionally, feline immunodeficiency virus, or FIV is another serious disease that is spread through cat populations. Although more difficult to spread, FIV is just as serious as FeLV and is typically deadly (Norris et al., 2007). The frequency of FIV was found to be double in feral cat populations when compared to owned cats (Norris et al., 2007). Epidemiologic studies suggest that the prevalence of FIV is approximately 4% and FeLV is approximately 4.5% in feral cat populations in the United States, however infection rates vary regionally (Normand & Urbanek, 2017). Articles suggest that the best TNR/TVHR program tests cats for infectious disease, euthanizes those who test positive, and vaccinates those who do not (Loyd & DeVore, 2010; Scheidegger, J. (2014).

Parasites. A disease caused by the protozoon parasite *Toxoplasma gondii*, Toxoplasmosis, is a parasite spread by feral cats but can impact humans, birds, or wild mammals. It is spread in infected water or soil, and can be transferred by skin contact with infected substrates. If an animal's immune system is weakened, toxoplasmosis can be deadly. When a cat is first infected, they shed the parasite for approximately two weeks, but during those two weeks can shed over 20 million parasites through their feces. In the right conditions, these parasites can live outside the body looking for a host for at least 18 months, making it an easily spread and easily transmitted parasite (Baithalu, Panigrahi, Maharana, Parida, & Allaie, 2010). Studies conducted by the Centers for Disease Control and Prevention have shown that in school children, there is a correlation between low academic performance and testing positive for *T.gondii*. There is also well documented evidence in humans of a correlation between mental illness, specifically Schizophrenia, and testing positive for *T. gondii* antibodies (Sommerfelt, 2006).

Additional zoonotic diseases transmitted by cats are tapeworms, roundworms, cryptosporidiosis, and fleas. Tapeworms are only spread by the ingestion of infected tissues or an infected adult flea, therefore people at the greatest risk of a tapeworm parasite are children under the age of 8. Tapeworm infection presents as abdominal pain, diarrhea, and rectal pruritus in humans (Grove, 2014). Roundworms are transmitted by the ingestion of larvated eggs in fecal-infected soil or from skin contact with infected soil, such as walking barefoot. There are many species of roundworms and their signs and symptoms of infection range from abdominal pain, to pneumonia-like symptoms, to damage to internal organs. Again, children are at the most risk for contracting this disease, but individuals with poor hygiene, landscapers, plumbers, or exterminators are all at risk (Traversa, 2012). Cryptosporidiosis is another protozoan that can be

transmitted by cats. Found in feces and unclean water, this protozoan can cause diarrhea in humans, and immunocompromised people are most susceptible to the disease (de Silveria-Neto, Inacio, Oliveira, & Bresciani, 2015).

Costs of TNR/TVHR Programs

An economic study performed by the Best Friends Animal Society in 2010 showed the pricing differences between trap-and-euthanize and TNR/TVHR programs using a Feral Fiscal Impact Calculator (Nolen, 2010). The authors estimate that eliminating all feral cats in the United States by means of euthanasia would cost $15.74 billion. However, if all the feral cats in the United States in 2010 were trapped, sterilized, and released, the estimated cost would be $14 billion, which is approximately $1.7 billion less than the euthanizing method. The study then looked at funding if veterinarians and community members volunteered time, as well as discounted services, and estimated it would cost $7 billion dollars to sterilize all the feral cats in the United States alive in 2010 (Nolen, 2010).

However, a study published in 2013 stated that in Hawaii, trap-and-euthanize was the most cost effective way to decrease the population of feral cats (Lohr, Cox, & Lepczyk, 2013). The cost difference between trap-and-euthanize programs compared to TNR programs was $4.06 million dollars. However, as the article states, there is a "social cost" accompanying euthanasia which is difficult to price (Lohr, Cox, & Lepczyk, 2013).

If veterinary services are provided at low cost, and volunteers donate time to set and monitor traps, then TNR/TVHR is extremely cost effective. The most expensive part of TNR/TVHR programs is the purchase of traps, which can range from approximately $60 – $85 dollars each. It takes one person about an hour and fifteen minutes to set out 15 traps and around 45 minutes the next morning to check and/or collect the traps. If minimum wage is factored in at

$7.25/hour, it would cost a program $14.50 for labor and $900 - $1,275 for traps. Once the traps are purchased, it costs approximately $1.00 per trap to pay someone minimum wage to prepare, set, and collect the traps (Nutter, Stoskopf, & Levine, 2004). In an interview with a veterinarian in Cincinnati, OH, the approximate overhead for a clinic in consumables to spay a cat in 2017 is $19.00 and is $15.00 for male cats. This is with all volunteer hours of the surgeon and staff, and only utilizing anesthetic drugs, suture, and pain medication (K. Mohlmann, personal communication, April 13, 2017).

Effectiveness – TNR versus TVHR

The main finding from the research is that in controlled settings, TNR/TVHR programs are successful, and even more so when applied in conjunction with effective educational programs for citizens. An important piece of having these programs work is educating residents of the risks associated with abandoning a cat or feeding feral cat colonies.

For only TNR programs, there is less effectiveness in nuisance control when compared to TNR/TVHR programs. TVHR programs that preserve hormone production in male cats do not reduce the vocalization or fighting, and raise nuisance factors as cats are nocturnal and therefore are loud when fighting or copulating. Therefore, the ideal program uses hormone control TNR and TVHR programs in addition to citizen education (Mendes-de-Almeida et al., 2011).

Additional studies shows that TNR and TVHR are suitable programs for decreasing feral cat numbers when executed with high capture rates timed appropriately with the beginning of mating season, which is dependent on the environment of the colony (Ireland & Neilan, 2016). One study discovered that 6 years after a colony of 50 feral cats were all 100% sterilized, the colony was reduced to an estimated 9 – 11 cats (Ireland & Neilan, 2016). Not all of this decrease is due to sterilization programs, as the life expectancy and other environmental issues cause a

loss of life, however these findings are consistent with other literature on successful TNR or TVHR programs (Ireland & Neilan, 2016; Levy, Gale, & Gale, 2003).

One of the most difficult things to regulate with feral cat colonies is the migration of external cats into a population. TRN and TVHR are most effective in closed populations where the sterilization of cats can be monitored and addressed. In populations where there is not funding or personnel able to monitor for unsterilized cats who enter the population, TRN and TVHR programs are not as successful (Ireland & Neilan, 2016).

In situations where the feral cat population needs to be decreased quickly, for instance in case of feral cats threatening local endangered wildlife, TNR/TVHR programs are not recommended (Denny & Dickman, 2010). TNR/TVHR programs are not a quick fix and require at least two breeding cycles to show a decrease in the feral cat population (Levy, Gale, Gale, 2003). Kittens reach puberty around six to nine months of age, and the average cat pregnancy is 63 days. Therefore, to see any effects from a TNR/TVHR program, it will be a minimum of four to five months (Wellock, 2013).

Ear tipping. Ear tipping is a key component to any TNR/TVHR program. Ear tipping, as explained by the World Society for the Protection of Animals, is a method of identification used to determine if a cat has been surgically sterilized. While the animal is under anesthesia for sterilization, approximately 10 mm of the tip of the left ear is removed. If ear tipping is completed under anesthesia with adequate analgesia, it is a humane way to recognize individuals who have been sterilized without invasive measures (Gosling, Starvisky, & Dean, 2013).

Alternatives to TNR/TVHR programs

Poison baiting. Poison baiting is used frequently to control mammalian invasive species populations. Although cheaper than other methods, poison baiting can be difficult to administer,

since there is no guarantee that the targeted species will ingest the poison (Doherty & Algar, 2015). A study in Australia showed that 5.8% of vertebrate species, including carnivorous marsupials, birds, and reptiles, all consumed poison bait sausages that were intended to bait the feral cat population. This quickly became an issue when it was discovered that the threatened Tasmanian devil (*Sarcophilus harrisil*), five types of threatened birds, and 21 species of endangered mammals had access to the poison baits (Buckmaster, Dickman, & Johnston, 2014). A separate study in Western Australia showed that poison baits were ineffective in regulating feral cat colonies and left other species to inadvertently consume the poison bait (Doherty & Algar, 2015).

Shooting. A time and labor-intensive method of feral cat population control with controversial humaneness (Doherty & Algar, 2015). Although frequently used in wildlife management protocols, the efficiency and reduction of suffering is solely reliant on the skill of the hunter. Shooting is most ideal in low populations of feral cats with limited space, such as a small island (Denny & Dickman, 2010).

Trap-and-euthanize. Trap-and-euthanize programs are most successful over relatively small areas or in conjunction with additional lethal means. Most traps either capture the animal in a cage by encouraging entry using bait, or a padded leg-hold strap which secures the cat in one location by its leg. There is debate on the humaneness of either of these traps, since the animal could be in the trap for an extended period, based on the frequency by which the traps are checked. With the end goal being euthanasia, there is less emphasis to check the traps regularly unlike in a TNR/TVHR program. Kill traps are legal in New Zealand and render the animal unconscious in less than three minutes. Potential issues with kill traps are the capturing of other animals not intended for euthanasia (Fisher, Algar, Murphy, Johnston, & Eason, 2015).

Exclusion fencing. Several types of fences have shown to be adequate for maintaining a feral cat free zone. Floppy-top fences are ideal for this situation, as most cats can jump a 1.5m barrier or climb wooden structures such as wood fences. A combination of a floppy-top, electric wire, and wire netting fencing was tested in Australia and proven effective of keeping feral cats out of a specific area. Exclusion fencing is ideal in terms of humaneness, but is not ideal when it comes to cost. Fencing is also not ideal for large areas of feral cat populations and is mainly used in urgent situations of feral cat prey species endangerment (Denny & Dickman, 2010).

Immunocontraception. A humane way of administering a virus to sterilize female feral cats by preventing fertilization of the ovum is immunocontraception (Gorman et al., 2002). A study in 2000 showed that viral-vectored immunocontraception (VVIC) was more efficient in reducing feral cat populations than poison baiting (Courchamp & Cornell, 2000). The downside to VVIC is the route of administration. Trap and release is time and resource consuming, and there are arguments that VVIC could change the immune function of adult cats, making VVIC a less than ideal strategy. Baiting prey with VVIC is another option, although few studies have been conducted on the impacts of other local mammals and birds who may consume the baited prey (Denny & Dickman, 2010).

Gaps in Knowledge, Inconsistencies in the Literature

There is a lack of information around tracking feral cats, as no telemetry study has been conducted anywhere in the world. The lack of telemetry studies also leaves life spans only an estimate. Most feral cat research has been conducted in locations of rural, urban, or suburban areas, and does not include information on exurban (between areas of urban and rural areas) feral cat populations (Normand & Urbanek, 2017).

Depending on the research, there are discrepancies into which program yields the best

results. Several articles recommend a TNR and TVHR program in addition to citizen education (Mendes-de-Almeida et al., 2011; Levy, Gale, & Gale, 2003). Other articles state that a TVHR program is best, especially with colonies who are not checked regularly for new, unsterilized cats (Ireland & Neilan, 2016). The program of choice seems to depend on what issue is trying to be eradicated. If it is the reduction of population, TNR /TVHR programs in conjunction seem to be the best approach. If the main issues are nuisance control, TNR is the most effective solution, not TVHR (Ireland & Neilan, 2016). When the main problem is feral cats killing endangered indigenous wildlife, TNR/TVHR programs are not recommended (Denny & Dickman, 2010).

An article by Denny and Dickman (2010) states that one major issue is the lack of standardization to feral cat programs around the United States, the absence of a centralized database to report inadvertent poisonings of non-target animals, and irregularities in regard to animal welfare policies.

Successful TNR/TVHR Studies

A study from 2006 to 2008 evaluated the feral cat population in the Rio de Janeiro Zoological Park in Brazil. Over the course of two years, 27 feral cats were captured. Seventeen cats were captured in 2006 and 10 were captured in 2008. Of these 27 individuals caught, only seven were spayed, as the others were either males, kittens, or previously spayed individuals. The results showed that a biannual program of hysterectomy only trap and return programs could be an effective and feasible control method. Two years before the study began in 2004, it was estimated that there were 28 female and 14 male cats living in the Zoo. After the study, with two years of biannual spaying, the population was estimated at 12 female and five male cats in the zoo at the close of 2008 (Mendes-de-Almeida et al., 2011).

A two-year study conducted by the University of Florida neutered 2,366 feral cats which

was assessed to be approximately 54% of the colony in the region of Alachua County, Florida. At the end of the study, there was a 70% decrease in animal control feral cat intake, however outside of the community only saw a decrease of 13%. Euthanasia rates declined an incredible 95% in the targeted area and 30% in the surrounding areas. As cats and kittens were taken in to be sterilized, several were also adopted out if their temperaments were a good fit to be a family pet. Of the 2,366 cats sterilized, 1,169 cats were released, 61 cats were relocated to other colonies outside of the targeted area, 308 cats were adopted, and 805 cats were sent to rescue organizations for adoption. This was all done with a $250,000 grant from a foundation hoping to research and educate no-kill solutions for feral cats (Scheidegger, 2014).

The veterinary school at Texas A&M in the United States has a team of feral cat trappers who trap feral cats. The feral cats are then brought into the school and the fourth-year veterinary students surgically sterilize the cats (Slater, 2003). This is an excellent utilization of resources, as the students need practice and the cats need sterilized. It is a low-cost option that other veterinary schools should consider.

Conclusion

The overwhelming population of feral cats around the world causes several issues. From the spread of disease, public nuisance issues, predation and impacts on local wildlife, and disruption to surrounding ecosystems, the feral cat issue needs a solution. There are multiple suggestions on how to take care of the issue, from lethal control means (poisoning, shooting, trap-and-euthanize) or more humane ways, such as exclusion fencing, TNR, TVHR, or immunocontraception. While the only true way to eradicate feral cat populations is by lethal control, the majority of the public has concerns around animal welfare practices using lethal control on a species seen as companion animals.

Additional research must be completed to provide more data on the best practices for reducing feral cat populations. The method of choice is often determined by the reason for the issue. If there is an immediate threat to local wildlife, eradication by lethal means may be the correct solution. However, if the issue is reduction to the ever-growing population without a strong sense of urgency, TNR/TVHR programs alongside of citizen education seem like the most humane and appropriate action.

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