|  |
| --- |
| AHA Logo.JPGOne Health Logo.JPG**Texas a&m University and One Health alliance Program in conjunction with American Humane AssociationAddressing the Cat Issue** |
|  |
| A Business Plan  **Texas A&M University Students** |
| **Daniel Brown, MBA**  Team Coordinator  DVM Candidate  **Sofia Agudelo, MS**  Wildlife Sciences  PhD Candidate  **Sammye Darling**  Psychology  BS Candidate  **Kaitlin Janning, BS**  Medicine  MD Candidate  **Lauren Pluhar, BS**  Marketing  MS Candidate  **Anne Romeo, MS**  Veterinary Medicine  DVM Candidate  **Sarah Shaffell, BS**  Business, Finance  **Texas A&M University Faculty and Staff**  **Mike Chaddock, DVM, EML**  Assistant Dean for One Health and Strategic Initiatives  **Merrideth K. Holub, MS**  One Health Program Coordinator |
| **August 2013** |

|  |
| --- |
|  |

Table of Contents

[Table of Contents 2](#_Toc365221232)

[**Executive Summary** **5**](#_Toc365221233)

[**Goals**](#_Toc365221234) 7

[Medical 7](#_Toc365221234)

[Veterinary 7](#_Toc365221235)

[Psychology 7](#_Toc365221235)

[Wildlife 7](#_Toc365221235)

[Marketing 7](#_Toc365221235)

[Business 7](#_Toc365221235)

[**Objectives** **8**](#_Toc365221235)

[Medical 8](#_Toc365221236)

[Veterinary 8](#_Toc365221236)

[Psychology 8](#_Toc365221236)

[Wildlife 8](#_Toc365221236)

[Marketing 8](#_Toc365221236)

[Business](#_Toc365221236) 9

[**Strategies and Implementation** **9**](#_Toc365221236)

[Medical](#_Toc365221237) 9

[Veterinary 11](#_Toc365221237)

[Psychology 1](#_Toc365221237)3

[Wildlife 1](#_Toc365221237)4

[**Marketing Plan** **1**](#_Toc365221237)**8**

[Marketing Objectives 1](#_Toc365221238)8

[Target Market 1](#_Toc365221239)8

[Marketing Strategies 1](#_Toc365221238)9

[Creative Execution 1](#_Toc365221239)9

[Launch 20](#_Toc365221238)

[Website 2](#_Toc365221239)1

[The Cat Collective 2](#_Toc365221238)3

[Cats Across America Tour (CAAT)](#_Toc365221239) 24

[Cat Personality](#_Toc365221238) 25

[Social Media](#_Toc365221239) 26

[**Financial** **Analysis**](#_Toc365221238) 27

[**Metrics for Success**](#_Toc365221238) 28

[**Future Financial Partners**](#_Toc365221238) 29

[**Conclusion** 30](#_Toc365221239)

[**Appendix** **3**](#_Toc365221240)**7**

[Medical Research 3](#_Toc365221238)0

[Abstract 3](#_Toc365221238)0

[Allergies 3](#_Toc365221238)1

[Health Benefits and the Animal Human Bond 3](#_Toc365221238)3

[Future Research and Recommendations 3](#_Toc365221238)5

[References 3](#_Toc365221238)6

[Veterinary Research](#_Toc365221238) 40

[Abstract](#_Toc365221238) 40

[Zoonosis](#_Toc365221238) 41

[Relinquishment 47](#_Toc365221238)

[Feline Medicine 50](#_Toc365221238)

[Future Research and Recommendations 5](#_Toc365221238)2

[References](#_Toc365221238) 53

[Psychology Research](#_Toc365221238) 56

[Abstract 5](#_Toc365221238)6

[The Question 56](#_Toc365221238)

[Cat v. Dog Owners](#_Toc365221238) 58

[Behavorial Medicine and Cats in Shelters](#_Toc365221238) 60

[Advertising and Why the Majority of People Like Dogs](#_Toc365221238) 64

[The Cat’s New Image](#_Toc365221238) 65

[Future Research and Recommendations 6](#_Toc365221238)7

[References 6](#_Toc365221238)7

[Wildlife 68](#_Toc365221238)

[Abstract 6](#_Toc365221238)8

[Prediation 69](#_Toc365221238)

[Disease Transmission](#_Toc365221238) 75

[Hybridization](#_Toc365221238) 78

[Implications 7](#_Toc365221239)9

Future Research and Recommendations 83

References 85

**Executive Summary**

In 2012, the American Veterinary Medical Association (AVMA) reported a 6.2% decrease in the number of cats in the United States between 2006 and 2011. To determine the cause for the decrease in the number of cats, the American Humane Association (AHA) employed a One Health Alliance interdisciplinary team. Each student performed research on several topics in their field of expertise, and shared the main goal of improving a cat’s chance for a loving and permanent home.

From our research, we have compiled a list of solutions. The main strategy, suggested from across all fields, is for AHA to pursue education of the public. This strategy can be broken down into short-term and long-term strategies based on needed timelines and financial requirements. The public education effort includes publicizing the ways in which cats can improve a person’s physical and mental health, as well as the importance of a yearly wellness exam. During the yearly exam, the veterinarian should build the client-patient relationship by explaining what he/she is doing during the physical exam and why these procedures are important. They should also discuss the subtle signs of illness since cats hide illness well. By involving the client more in the process, it allows them to become educated on their cat’s health, which can improve the length and quality of life for the cat.

While the cat does possess many benefits, there are some downsides. During examination, the veterinarian should educate owners on the risks, such as certain zoonotic pathogens, and provide preventative medicine when needed; thus, mitigating some of these risks. When a current or future owner is educated, he/she is less likely to abandon its pet companion. To decrease relinquishment, owners should be educated on behavioral issues; the steps before, during, and after adoption, if applicable; and responsible pet ownership, such as keeping your cat indoors.

To reach the public and educate them, we have created an extensive marketing plan that lists several options. We concluded that our primary target market is 18 to 44 year old single women who live alone. Given our primary target market and the fact that we are living in the technology age, the most significant element of the entire campaign is a dynamic, interactive website. It should encourage the responsible decision to adopt/acquire a cat, making the home a lifetime one, and inspire involvement in the movement. The website should be easy to navigate and designed to be accessible from multiple platforms, such as computers, cell phones and tablets.

In addition to the website, we suggest a physical connection to people. We suggest a Cats Across America Tour, or CAAT. A state of the art, customized bus would travel across America, making stops at partnering pet stores in major cities. The activities that the tour will encompass could be accomplished in temporary facilities that pop out from the bus, or from inside the pet store facilities. The purpose of the Cats Across America Tour is to educate and serve the needs of current and potential cat owners. The bus will be a rolling advertisement for the tour, wrapped with the Cats Across America Tour logo, images of cats, and sponsors/funders logos.

In summary, we believe that educating the public on the benefits, risks, and health of cats is crucial to increasing the cat population in American households. It also is critical in retaining the cat in households over the lifetime of the animal, as well as increasing the care it receives. Overall, we would like to aim for a 10% increase in cat adoptions at shelters. This target growth goal can then be adjusted as necessary later. Our entire research, recommendations, and extensive marketing plan are outlined in the following sections.

**Goals**

We first outlined our main goal: to provide cats with loving and permanent homes. While we did have this overarching goal to guide us, we decided to have individual goals to focus on as well. These goals covered all the fields which comprise our interdisciplinary team: medical, veterinary, wildlife, psychology, marketing and business. Listed below are each field’s main goal and why that goal is important to the project.

**Medical**

To disprove the myths surrounding cats and their effects on human health. Disproving certain myths may help to decrease the number of relinquishments due to allergies.

**Veterinary**

To validate why a cat needs regular and preventive care. Proving this aspect may help decrease the number of relinquishments and improve the public’s perception of cats, specifically any health concerns.

**Psychology**

To identify the factors which contribute to the public’s negative perception surrounding cats. Identifying these factors is the first step in helping to change the public’s view.

**Wildlife**

To understand how feral cats effect the environment. Because there is not extensive research in this area, this research will help expand our knowledge on this subject matter.

**Marketing**

To create a cat campaign that will redesign the cat’s image in a positive light. This campaign will help change the public’s negative perception on cats and hopefully increase the number of cats in US households.

**Business**

To create a business plan that details our research and strategies for moving forward. This plan will allow AHA to present our findings to major industry funders, private donors and foundations, so that funding can be sought to launch the business plan.

**Objectives**

Our main objectives throughout the entire project were to find ways to reduce the barriers to ownership, target younger and future owners, and develop strategies for pet retention.

While we did have these overall objectives to guide us, we decided to have individual objectives to focus on as well. Listed below are each field’s specific objectives as designated by the AHA.

**Medical**

The main focus of the medical student is to review research, including articles on the human-animal bond, the benefits of cats for human health and well-being, and identify opportunities for debunking any myths regarding cats and their role in human health. This includes reviewing the research of the Human Animal Bond Research Institute’s (HARBI) collection of articles on some of these topics.

**Veterinary**

The veterinary student has many objectives to focus on during the research project. These includec goals.ach field'vidual , psychology, and business. ur interdiscplinary do this, we have s studying the work of shelter veterinarians, as well as published reasons for relinquishment and barriers to ownership. The student assessed new models for providing veterinary services to cats and answered the question of how negative attitudes towards cats translates to acquiring veterinary care.

Lastly, the veterinary student brainstormed how a veterinarian could develop new strategies for serving animals that do not enjoy traveling in crates and cars to veterinary clinics. The student developed a value statement on why cats make great pets and why they require regular/preventive care.

**Psychology**

The main focus of the psychology student is to understand the psychological factors that lead to negative human attitudes about cats. The student investigates what makes some people keep a cat for 20+ years despite behavior issues, while others sometimes return them within months of adoption.

**Wildlife**

The wildlife student looks at the footprint that cats make in the environment, while also researching both the benefits and drawbacks with the Trap-Neuter-Return (TNR) program.

**Marketing**

The marketing student developed a strategy to “redesign” the cat’s image, which will make audiences love the cat once again and laugh. This recommended cat campaign draws upon the cat’s inherent qualities and celebrates the beloved feline.

**Business**

The business student developed a business plan that lists the innovative strategies to address the objectives outlined above for each field of study. The plan lists the short-term strategies to increase cat ownership; as well as long-term strategies that address the reason for cats receiving less veterinary care, having less research conducted on behalf of cats, and the negative public attitudes towards cats. Lastly, the plan has actionable, prioritized strategies, and a list of potential funders to launch the business plan could be identified.

**Strategies and Implementation**

In this section, each individual summarized their findings into an abstract, provided recommendation for the future, and listed future research possibilities. Each individual’s entire research report is listed in the appendix for further reading.

**Medical**

**Abstract**

Research on the relationship between cats and allergies was conducted. Allergies to cats have previously been indicated as a reason for either surrendering a cat to a shelter or for not keeping one in the home. In hopes of preventing or alleviating allergies, people often turn to buying a “hypoallergenic” breed of cat over adopting a shelter cat whose breed was not specified. Studies show that this measure to avoid allergies, while not only being more costly to the new pet owner, is also ineffective at preventing the cat allergen, Fel d 1, from entering the home [1, 2]. Additionally, the concept of inducing tolerance to Fel d 1though purposeful exposure was investigated. Induced tolerance was in fact found to occur in cat owning households as the level of Fel d 1 exposure was sufficient enough to trigger the resistance. Induced tolerance to this allergen as a potential incentive for the consideration of owning a cat was investigated. Though it was found that induced allergen tolerance alone is not sufficiently supported to be grounds for keeping a cat in the home, it was also found that fear of inducing allergies by keeping a cat in the home is unwarranted and should not be avoided specifically to prevent allergies. By looking deeper into the connection between cat ownership, allergen exposure and induced tolerance, the guidelines for controlling and preventing allergies could be revised in the future.

Another area of research in this study was measurable physical and mental health benefits afforded to humans through both pet ownership and interaction, especially with cats. Studies have found that interaction with cats lowers blood pressure, leads to more expedient recovery after serious illness, reduces depression symptoms and decreases anxiety. These health benefits were found to be especially prominent when the interaction was with a familiar cat [3]. This suggests that pet ownership may be the most effective way to maximize the health benefits of animal interaction. Future research into the feasibility of introducing cats as companion animals for the purpose of improving health should be undertaken.

Finally, the role of the cat in Animal Assisted Intervention (AAI) was studied. Cats have been found to be as effective as dogs at providing AAI therapy benefits, but also are able to be used in AAI for people who cannot tolerate canine AAI [4]. AAI was found to be especially beneficial to elderly dementia patients, specifically in decreasing their agitation and improving both the quality and quantity of their social interaction. Research into the benefits of feline AAI for the elderly is an important field of future study.

**Future Recommendations and Research**

Cats are attractive companion animals for many reasons. These include a more independent disposition than dogs, as well as being considered easier to care for than a dog. Cats are smaller companions and make good pets in smaller living spaces or spaces requiring less, or no, outdoor space than a dog would require. Additionally, cats can be left in the home while their owners are gone on short trips without requiring boarding or in-home pet care. Finally, cats cost less to care for on average than a dog. Though these reasons alone make cats an ideal pet for many different types of people, cats also bring additional health benefits to their owners making them an even more appealing option of companion animal. Publicizing the ways in which cats improve a person’s physical and mental health should be a highlight of the AHA’s campaign to improve the cat’s image.

The concept of induced tolerance to allergens has been the basis of treatment of many human allergies since the early 1900s. Despite this, it has only been recently that the concept of induced tolerance to the main cat allergen Fel d 1 was studied. Though it has been found that induced allergen tolerance alone is not sufficient reason enough to be grounds for keeping a cat in the home, it has been found that fear of causing allergies by keeping a cat in the home is an ungrounded fear. Further research into the connection between cat ownership and allergy immunity should be undertaken. Additionally, guidelines for controlling and preventing allergies to the Fel d 1 cat allergen could then be revised.

Though studies have repeatedly found significant improvements of many physiological variables, including improved blood pressure and expedited recovery from illnesses, many people remain unaware of these benefits of cat ownership. To this point, promotion of cat ownership has focused mainly on the companionship the animal brings to its owner. Though cat ownership certainly decreases feelings of loneliness and can endow owners with a sense of purpose and responsibility, these are not the only health benefits of cat ownership that merit promotion. Cats have been found to improve anxiety and decrease feelings of depression. Investigation as how to best educate people on additional health benefits of cat ownership is merited. Additionally, health care providers and care givers should be educated on both the benefits of cat ownership as well as how to identify patients whose lives would be improved through cat ownership.

Finally, feline AAI with elderly dementia, Alzheimer and psychosis patients should be further researched. The optimal and most cost effective duration of feline AAI is still unknown. A better understanding of these aspects of feline AAI would allow more widespread use of feline AAI therapy, as well as allowing maximum benefit to be achieved with the therapy. Introduction of feline AAI into more elderly care facilities would be facilitated by the production of guidelines on how to implement feline AAI, ensure the space is a safe and secure environment for feline AAI to take place, and ensure the health and wellbeing of both the cat and the patient participating in the therapy.

**References**

1. Butt A, Rashid D, Lockey RF. *Do hypoallergenic cats and dogs exist?*. Ann Allergy Asthma Immunol, 2012. **108**: 74-76.
2. Hodson T, Custovic A, Simpson A, Chapman M, Woodcock A, Green R. *Washing the dog reduces dog allergen levels, but the dog needs to be washed twice a week.* J Allergy Clin Immunol, 1999. **103**(4): 581-585.
3. Schuelke ST, Trask B, Wallace C, Baun MM, Bergstrm N, McCabe B. *The physiological effects of the use of a companion dog as a cue to relation in diagnosed hypertensives.*
4. Goleman M, Drozd L, Karpinski M, Czyzowski P. *Cat therapy as an alternative form of animal assisted therapy.* Med Weter, 2012. **68**: 732-735.

**Veterinary**

**Abstract**

Though there are many benefits to owning a cat there are also potential health risks to cat ownership and these increase for an immunocompromised individual. These risks should not discourage ownership because they can be minimized with proper care of the animal. It is the job of health professionals, such as physicians and veterinarians, to work together to educate owners on these risks and provide preventative medicine when needed. The zoonotic section is a review of some the most common feline zoonotic pathogens and will explain basic pathogenesis as well as prevention of several pathogens.

Research was also conducted to examine the reasons for relinquishment of cats in the United States. Relinquishment of an animal to a shelter is a complex issue that has warranted much research. In the US alone, millions of animals are euthanized every year at shelters. In fact, studies have shown that nearly 4 million cats are euthanized in this manner making shelter euthanasia the leading cause of death in cats [[1-4](#_ENREF_1)]. Therefore, the risk factors associated with relinquishment of animals have been studied. The relinquishment section of the paper will summarize several studies pertaining to risk factors associated with relinquishment of cats. By examining these factors, the development of programs or preventive strategies can be established to decrease the number of cats relinquished at shelters.

Within the past 10 years there has been a gradual decline in feline visits to the veterinarian [[5](#_ENREF_5), [6](#_ENREF_6)]. Studies have listed several reasons for decrease in visits and they include: cats do not like to travel to the clinic, the cost of visit, the recession, internet, fragmentation of service, and the lack of client education on the importance of wellness exams. Most people in the Bayer Veterinary Care Usage Study III agreed that they would take their cat to the veterinarian more frequently if they had an understanding of the necessity of an annual exam. This is an area that veterinarians can do something about and they need to emphasize the importance of the wellness exam as well as make their clinics more appealing to the feline patient. In the “Feline Medicine” section there is a discussion on the importance of the yearly exam and suggestions on how to make a practice more feline friendly.

**Future Research and Recommendations**

As previously stated, areas of continual research pertain mainly to the subject of relinquishment. They include, but are not limited to, the effects of a behavioral consultation prior to adoption on relinquishment and in general a closer look at those cats that were relinquished due to behavioral issues. In particular was veterinary advice sought out and what were the recommendations? Also, would the establishment of a consultation prior to relinquishment in cases of behavior issues decrease relinquishment of those cats? This consultation could consist of possible causes of the behavior and the referral to a veterinarian. It would also be interesting to test the knowledge of allergies when people relinquish cats due to allergies; this could provide clinicians with the ability to know if better client education is needed. Another concerning fact is a high number of people use shelters as a means of euthanasia. Further investigation is warranted to determine why people choose a shelter for this process versus their veterinarian.

Yet another subject that this paper alludes to is the importance of regular veterinary visits. As discussed throughout the zoonotic section a healthy pet can prevent human illness. It is important to have your cat vaccinated and examined for internal and external parasites on a schedule prescribed by a veterinarian. Remember, cats age differently than humans and in one year of a cat’s life a lot can happen; on average one cat year is equal to four human years. It is important to realize that though cats are resilient and hide illness well, diseases can be prevented through annual examinations. Within the “Feline Medicine” section of the paper there are several suggestions for clinicians on how to make their practice more feline friendly. Also examined were techniques to reduce the stress of the feline patient in travel to the clinic and at the clinic. Though there have been studies that have shown that most veterinarians consider themselves to be dog people there has been little research on why. Knowing why veterinarians prefer dogs to cats may give insight on how this trend could be reversed in the future. One thing to consider as a practice owner is that even though you may not be a cat person, there are clinicians out there that are and having a member of your team that enjoys feline medicine can be an easy way to increase your feline clientele.

Cats possess qualities that set them apart from other companion animals, which make them an attractive pet. After talking to a variety of people that own just cats the following reasons were determine to be qualities that make cats great pets. Cats are considered low maintenance and require less up-keep then dogs. Just because a cat is reflected as low maintenance does not mean it is less affectionate; however, it does make it a more appealing pet to those individuals that spend less time at home. Also because they are smaller and more independent they do not always require boarding during out of town trips, making a cat a great pet for someone who has short business trips here and there.

Since cats are much smaller than your average dog they take up less space in a home and the cost of care on average is less. A cat eats less food than a large dog and generally speaking the veterinary visit for cats can be less compared to a dog - all due to size. Due to their small size cats make a wonderful addition to apartment life and do not require a large backyard in which to play. As discussed in other appendices, owning a cat has health benefits and has been shown to decrease depression and improve mental health. For some people owning a pet like a cat provides them with a sense of responsibility and companionship, all things that help improve a person’s self-worth. Perhaps the most unique quality a cat has that sets them apart from other companion animals is their ability to purr. This for many people is relaxing and comforting and is something only a cat has the capability to give. These reasons support the notion that cats make magnificent pets and are special in their own way.

**References**

1. Olson, P.N. and C. Moulton, *Pet (dog and cat) overpopulation in the United States.* J Reprod Fertil Suppl, 1993. **47**: p. 433-8.

2. Tuzio, *Feline zoonoses guidelines from the American Association of Feline Practitioners.* Journal of feline medicine and surgery, 2005. **7**(4): p. 243-274.

3. Olson, P.N., et al., *Pet overpopulation: a challenge for companion animal veterinarians in the 1990s.* J Am Vet Med Assoc, 1991. **198**(7): p. 1151-2.

4. Rollin, B.E., *Social ethics, veterinary medicine, and the pet overpopulation problem.* J Am Vet Med Assoc, 1991. **198**(7): p. 1153-6.

5. Felsted, K., DVM, CPA, CVPM,MS and John Volk, *Why cats hate your veterinary practice—and how to win back their love*, in *Veterianry Economics*2011, Advastar.

6. Felsted, K., DVM, CPA, CVPM,MS and John Volk, *Why clients are skipping your exam room.* Veterinary Economic, 2011.

**Psychology**

**Abstract**

The purpose of this research is to seek to understand why there has been a decrease in numbers of cats in households through the psychological perspective. The aspects explored and identified were the cat owners’ personalities, the differences in cat and dog people, and solutions to common behavioral problems using behavioral medicine. The findings suggest that if a cat has a similar personality to their owner, the stronger the human-animal bond will be. Also, it seems the more time the prospective adopter has spent on anticipating and preparing to adopt a cat, the less likely that cat will be relinquished. As well, if the adopter receives a class session on behavioral medicine, learns important responsibilities regarding the cat, and agrees to take the cat to the veterinarian within a short period of time before the adopter leaves the shelter with the cat, the retention rate increases. The findings will allow for reconstructing designs for advertising, cat adoption procedures, and the perception of cat ownership.

**Future Recommendations and Research**

There are numerous recommendations for future research in the field of psychology for cats. The first is actually implementing behavioral medicine, which could have a drastic effect. If adopting, adoptees should have to go through a behavioral course on cats before leaving the shelter with their cat. During this time, it should be made known that having a pet is a lifetime commitment and it should be highly recommended to visit a veterinarian in a short period of time after adopting the cat from the shelter. Both of these methods could in turn help increase the retention rate, as stated in my paper.

Next, we should start increasing the primary research on training a cat, such as trying to make cats be seen as acceptable service animals as defined in Americans with Disabilities Act. This could possibly reduce the number of cats in shelters and train them for service work. We could also look into making shelter cats a therapy animal for animal assisted therapy, which could save the lives of shelter animals and many humans’ lives, as well.

I feel that we need to advertise cats in a positive light and make these advertisements be geared towards the intelligent, yet unorthodox views of the majority of cat owners. During this advertisement campaign, we could also state and diminish untrue and stigmatized stereotypes of cat owners. Hopefully increasing the number of new cat owners.

I believe we should really work with the shelters and encourage them to start a foster-to-adopt program, where they may return the animal if they do not see that they’re a fit match. I also think that in the shelters, there should be a cat specialist to take care of any needs and answer specific questions from adoptees. In this partnership with the shelters, we could start a shelter-on-wheels campaign. This would be a mobile adopting site that tours the United States and allows cats to find their forever homes. Lastly, I feel that shelters should have more personalized advertisements for their shelter animals, such as “glamour shots”, etc. in order to increase interest in adoption.

Overall, the public should know that adopting and rescuing animals is a good thing to do and that the owners should feel good about themselves. They should know that they did their commitment is making a difference, especially with the animal.

**Wildlife**

**Abstract**

Despite being a common pet, cat ownership in the United States has decreased over the past years according to recent surveys from the AVMA. According to surveys conducted in 2007 and 2012, the percentage of households owning pet cats went from 32.4% in 2007 to 30.4% in 2012, while the total number of pet cats went down from 81,721,000 to 74,059,000 individuals (AVMA 2012).

There are several ways to classify domestic cats (*Felis catus*), based on their level of ownership and their degree of tameness, however the status of a cat can change through its lifetime and this consideration is important when describing their impacts and outlining management strategies.

There is extensive evidence on the impact of cats on wildlife populations and native species mainly through their role as introduced predators, reservoirs of human and animal diseases (with their subsequent role in zoonotic diseases), and the risk they pose to genetic pools of native species through hybridization. From a wildlife perspective, the controversy centers around the best approach to the issue of free-roaming cats, acknowledging there is a cat overpopulation problem, but disagreeing on the ethical, ecological and management implications.

Cats are innate predators and even well fed cats will have the instinct to hunt, with possible negative implications for native wildlife populations, especially rare species that occur in low densities, but even problematic for some common and widespread species in urban settings. Cat predation is an issue not only for prey but also for other native predators sharing a common prey with cats. The interaction between cats and wildlife is not static and it changes over time and space, and its implications will depend on the type of habitat, prey species, predator community, and time of the year. The best course of action is restricting cat movements and keeping them indoors highlighting the importance of responsible pet ownership and education for owners, future owners, and the general public.

Free-roaming cat interactions with wildlife and other cats increase the risk of disease and parasite transmission to humans (zoonotics), wildlife and pets. While wild populations are controlled by prey availability, predation, competition and disease, free ranging cat populations are largely protected from the above by human caretakers. Vaccination may protect cats from various diseases, but they still may act as reservoirs and vectors of several diseases and pathogens of concern to wildlife. Thus vaccination is a safe practice for cats in general (both owned and non-owned individuals), but if not accompanied by responsible ownership and management practices, such as restriction of cat movements and strict vaccination programs, it might still pose a risk to pets, humans, and wildlife.

The genetic integrity of several wild cat subspecies is considered to be seriously threatened by increased crossbreeding with free-ranging domestic cats due to human population expansion into new habitats which are close to natural and semi-natural areas. Crossbreeding can be prevented through responsible pet ownership practices, which include neutering and spaying of pet cats and restriction of outdoor movements. The problem with feral and stray cats is different, since not all individuals in a population of un-owned cats can be altered, and even a small proportion of fertile individuals from a widespread species can interbreed with wild, fragmented species, with disproportionate effects for the second one.

Cats are not bad per se. They make great pets for many households and have several advantages compared to other types of pets. However, risk factors related to poorly developed management plans and deficient pet ownership promote a negative perception of cats among specific sectors of the society. Limited and sometimes ambiguous information on the effects of cats on wildlife populations stresses even further the importance of education, responsible management and ownership practices, and interdisciplinary approaches. Education of the general public and understanding of the risks associated with poor practices are pivotal in the management of the free roaming cat overpopulation.

In this review, I intend to present available information (negative and positive) on the effects of cats on wildlife using, as far as I could, information exclusively coming from scientific articles in the peer reviewed literature for consistency. Management of cats, with its implications for wildlife welfare through responsible pet ownership is discussed at the end of the Discussion section. The final part of this review consists of recommendations for future research, highlighting areas where knowledge gaps are hindering efforts towards a holistic approach to management and responsible ownership of cats.

**Future Recommendations and Research**

Extensive evidence supports the fact that cats are effective predators, preying upon native, introduced, common, and rare species, and thus being responsible for the extinction of many populations and suspects of the decline of many others. However, in many cases evidence is indirect and until more extensive studies on the effects of cat predation on the population dynamics of the species preyed upon and the effects of competition with other predators are carried out, a definitive statement on the effects of cat predation on wildlife cannot be made; furthermore, it is highly probable that the impacts of such predation will depend on several variables that might change across time and space.

Public attitudes toward control measures play an important role on the implementation and feasibility of such management strategies, and education of several sectors of the society following a multi-disciplinary approach is necessary in order to reconcile public preferences for free-ranging domestic cat management and the implications associated with such strategies.

Several tactics such as anti-predatory devises, partial restriction of cats’ movements, TNR programs, and lethal methods have been proposed to reduce the predation, disease transmission and hybridization impacts of cats on wildlife populations, but evidence suggests no single alternative is applicable or effective in all cases. It is imperative to recognize that management strategies will have to be applied on a one-to-one basis and that in many cases a combination of strategies will be the best approach.

Restriction of movement is not a popular practice among cat owners, and special efforts have to be made in order to make current and prospective owners aware of the benefits of keeping cats indoors, not only for wildlife and the environment, but also for the cats themselves and their human caretakers. Understanding of the implications of keeping a pet exclusively indoors is fundamental to avoid posterior abandonment or relinquishment, since this practice requires the willingness to spend time educating your pet, providing it with the proper space and accommodations for daily activities, and the time to be able to deal with any changes or behavioral issues: an educated current or future pet owner will be less likely to abandon its pet companion.

Independently of the ownership status, vaccination rates have to increase in order to minimize the health risks to both humans and wildlife. The benefits of vaccination for owned cats is evident, but for stray and feral cats, further research is needed in order to better estimate the efficacy of TNR programs on disease transmission dynamics and health risks. The best course of action so far is responsible pet ownership, where owners keep their cats exclusively indoors and restrain from abandoning their pets.

Un-owned and free roaming cats are an issue of special interest from a wildlife perspective because of the controversy involved with their management. Within this context, the subject of community cats needs further study to really understand and evaluate the effectiveness of this approach on population growth, disease transmission, and hybridization rates.

Both lethal and non-lethal methods will find obstacles as long as there is a favorable, artificial environment that promotes immigration and supports a high density of cats, since intact individuals will continue to breed and the surplus of resources will promote addition of new individuals coming from within the population (reproduction), from immigration (other populations) or from abandonment (pet relinquishment).

Despite acknowledging the uncertainty inherent to the study and research of cats’ impact on wildlife, it is not wise to wait for all the data to be available before implementing management strategies, since several studies, using different methods and approaches, have concluded that cat predation is one of the main factors contributing to the decline of several species of wildlife and have already caused the extinction of many others.

The fact that the status of cats (from feral to stray to owned) can change over time, and that gender and age specific traits seem to influence predatory and behavior and use of space, makes it especially difficult to assess their impact, but stresses the importance of studies pertaining to population structure and demographic metrics.

Responsible pet ownership will have a positive impact on public attitudes toward owned cats, but un-owned cats might still be perceived as a nuisance factor, and efforts have to be made in order to make people aware of the societal implications of pet abandonment and the negative implications it has on prospective pet ownership. Education of the general public is also pivotal in the management of cat overpopulation: avoiding contact with feral and stray cats, restricting artificial feeding of free-roaming cats, and understanding the human and wildlife health risks associated with poor management practices. Fulfilling these educational needs is central in achieving the goals of controlling free-roaming cats populations and improving public attitudes toward cat ownership.

To achieve the goal of shrinking free-roaming cat populations and reducing their impacts on wildlife through predation, disease transmission, and hybridization, pet adoption rates have to increase and pet relinquishment and abandonment rates have to decrease. Vaccination and neutering have to be promoted and owner education programs have to be implemented such as pet owners and the general public becoming aware of the impacts and consequences of the current free-roaming cat overpopulation.

**Marketing Plan**

**Marketing Objectives**

* Redesign the cats image to eliminate negative stereotypes and advance positive qualities
* Increase awareness of the cat being a premier pet
* Increase cat adoption numbers by 10% at shelters; if necessary, this number can be adjusted

**Target Market**

We identified our target markets by first considering the broad characteristics that would combine to personify the ideal cat owner. We then researched current cat owner statistics, in addition to a study that accessed future cat ownership, to predict who would be most likely consider owning a cat or adding an additional cat to their household. From this research, we developed a primary and secondary target segment.

**Broad Characteristics**

* **Interest** in owning and caring for a cat companion
* **Time** to provide adequate physical and emotional care and companionship
* **Money** to provide a basic level of physical and emotional care
* The ability to provide **lifelong care** to a cat, and ideally, multiple cats throughout the owner’s lifetime

**Primary Target Segment**

* Age: 18-44
* Gender: Female
* Marital Status: Single
* Lifestyle: Lives alone

The primary target market is the single woman, aged 18-44 who lives alone. Phase I of a retention study conducted by the AHA in 2012 found that, of non-pet owners, those most likely to consider owning a cat are aged 18-44. [1] The age range was narrower for those who were previous pet owners (18-34). A 2013 study by Mintel of US pet ownership [2] confirmed that generationally, those most likely to own a cat are Millennial and Gen X. The AVMA Demographics study [3] found that younger cat owners are more likely to have a closer bond with their cat, and therefore we can conclude that they will be more likely to provide a higher level of care.

The AVMA Demographics study indicated that women are the primary caretakers for the household pet. A study conducted by Stanley Coren [4] revealed that a single woman was the most likely individual to own a cat, that cat owners are a third more likely to live alone than dog owners, and cat owners are twice as likely to live in an apartment or flat.

Although we are targeting single women, it is important to note that if a single woman adopts a cat and is satisfied/pleased with the cat as a pet, she will likely retain the cat throughout future life stages (getting married/having children). There are conflicting findings regarding the influence of cat ownership as a child resulting in increasing the likelihood of cat ownership as an adult, but it can be generally accepted that owning a cat as a child will not make an individual less likely to own a cat as an adult, and could potentially be a motivator. Therefore, a cat being present in a young parents’ household could potentially motivate that child to adopt a cat later in life.

**Secondary Target Segment**

* Age: 49+
* Gender: Any
* Marital Status: Any
* Lifestyle: Any

Although there is a significant amount of research that indicates that the Baby Boomer and WWII generations are not likely to own a cat, we believe that this segment should not be ignored. As a whole, they have the finances to properly care for a cat and with retirement/decreasing work schedules/children moving away from home, they potentially have the time to invest in a companion.

**Marketing Strategies**

*Branding*

Rebrand the cat as a fun, hip, and flexible pet.

*Message Development*

Shape and deliver messages that will clarify for, connect with, and engage our audiences. Delivering consistent, memorable messaging helps our base keep the movement in mind, recognize its relevance to them, and spread the word about it.

**Primary message:** The cat is a fun, hip, and flexible pet - consider adopting!

*Content Creation*

Create dynamic and interactive content that engages our audience. The material should always be beneficial and presented in a variety of formats. Ultimately, the educational content should be effortless to learn because of the engaging delivery methods.

*Community Building and Organizing*

Establish relationships on the local level to create supporters of the movement and encourage grassroots/word of mouth promotion.

**Creative Execution**

To achieve our marketing objectives through the strategies outlined above, we have developed an execution plan that includes the elements listed below.

**Primary Elements**

* Website
* The Cat Collective
* Cats Across America Tour

**Secondary Elements**

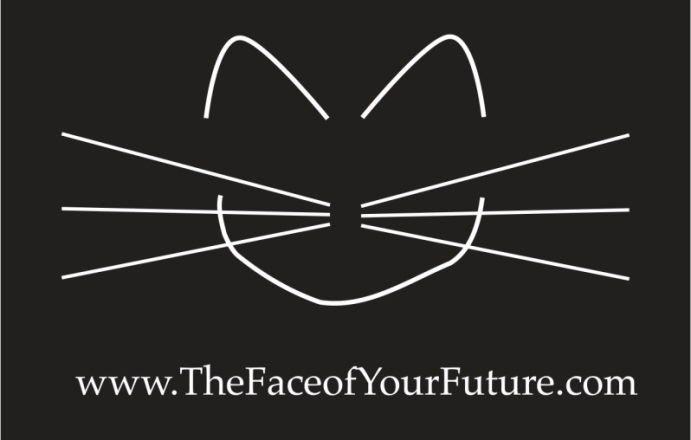
* Cat Personality
* Social Media
* Viral YouTube Campaign
* Celebrity Endorsements

Although all of these elements can be considered independently, the primary elements are designed to integrate with one another to form a strong, cohesive master campaign.

**Launch**

A strong launch will position the overall campaign for success. The launch should contain elements that intrigue, provoke, and inspire the audience. The following advertisement should be positioned in print and electronic form in media that will best reach the target audience (women’s magazines, YouTube ads, etc.) and also on billboards in cities that will be visited by the Cats Across America Tour (see Cats Across America Tour).

Option 1



Option 2



The image of a sleek cat face outline in white on a black background coupled with a domain name that piques interest fits the voice of our campaign. The domain name suggestions above are both currently available. When an individual navigates to the website, they would be greeted with a visual of the ad and an invitation to enter the main website. Clicking to enter will redirect to the main website, which is the focal point of our master campaign.

**Website**

The most significant element to our master campaign is a dynamic website. This site will serve as a central hub for the entire campaign and will be the primary source of engagement for our audience. The domain name should be descriptive and memorable (e.g. TheCatResource.com or ThePurrfectCompanion.com). The appearance should be visually stimulating, interactive, and include a variety of engaging content delivery techniques. The site should be easy to navigate and designed to be accessed from multiple platforms (PCs, Macs, iPhones, iPads, Androids, etc.).

The site will serve as a go-to resource for both current and potential owners. The three focuses of the website should be as follows:

* Encourage the responsible decision to adopt/acquire a cat
* Make the home a lifetime one
* Inspire involvement/personally promote the movement

**Encourage the Responsible Decision to Adopt/Acquire a Cat**

Encouraging the responsible decision to adopt is largely using messaging and content that makes cat ownership appealing and attractive. The following recommendations are a sampling of the elements that could be developed for the website:

*Testimonials from Current Cat Owners*

These testimonials should be primarily from owners in the target market. They should include excellent photos that are a focal point of the testimonial. The length should be short to encourage engagement by the audience and the content should highlight the positive and quirky/lovable qualities of the cat, subtly differentiated from the dog.

*Is a Cat the Right Pet for Me?*

A cat is not the pet for everyone. An important factor to reducing relinquishment and therefore creating a sustained ownership model is placing a cat in the right home from the start. That being said, a cat is a flexible pet that could integrate into a broad range of homes and lifestyles. We recommend developing an interactive tool, possibly a series of questions using Flash technology, which will help people determine if a cat is the right pet for them. While this tool may indicate that a cat is the best pet for the individual, most likely it will demonstrate the flexibility of the cat and the individual will have evidence that a cat may be a good pet for them.

*Cat Search Tool*

A pet search tool, such as PetFinder.com, could be imbedded into the website. Once an individual has made the decision to adopt, it is important to give them the resources to convert the decision into an action (adoption).

**Make the Home a Lifetime One**

Making the home a lifetime one can be accomplished by promoting excellent care and reducing relinquishment. The primary means to this end is education. As mentioned previously, it is imperative to deliver educational content in a form that is stimulating and attractive, causing the audience to absorb the information with minimal effort. Many of the findings in our research can be incorporated into content that is developed within this area of focus. The following recommendations are a sampling of the elements that could be developed for the website:

*Feline Health & Care*

This section should be a primary resource within the website. The content should be organized well and developed by a licensed veterinarian. The number of topics should be exhaustive, but each article/content section should be concise and a quick read for the audience. Suggested overarching topics include veterinary care, normal behavior, behavioral abnormalities, etc.

*Human Health*

The human health component is a barrier to adoption and is often cause for relinquishment. A licensed medical doctor should develop the content in this section. The topics should be specific to human health as it relates to cats. Each article/content section should be concise and a quick read for the audience. Suggested overarching topics include zoonosis, allergies, asthma, etc.

*Children and Cats*

Because our target market will likely be having children soon, it is important to address issues relating to children and cats. If a cat and a child do not cohabitate well, most likely the cat will be relinquished. This can be combatted by providing resources that will encourage the audience to appropriately manage the relationship between the cat and the child. Suggested overarching topics include introducing a cat to your child, introducing a child to your cat, how to promote gentle play interactions, how to build responsibility, etc.

*Video Series*

Developing a series of educational videos can augment written copy and provide an additional learning tool. The videos can be housed in a corresponding YouTube channel and imbedded in the website for ease of access. They should be professionally produced and have an engaging personality narrating/starring. This individual could provide a comedic perspective or be a notable actor or actress. The cat that stars in the videos could be the cat personality (“Tux”) that maintains the Twitter presence (see Cat Personality). Suggested topics include how to… introduce a cat into the home, travel with a cat, groom a cat, train a cat, discourage undesirable behaviors, etc.

**Inspire involvement/personally promote the movement**

A tab on the main website will redirect to a microsite for “The Cat Collective”, which is a hub for the network of individuals who are involved on the local level and who personally encourage the ownership of cats. This concept is discussed in detail in the following section, The Cat Collective.

**Blog**

A blog is an excellent way to generate new content on your website and encourage your audience to visit frequently. The blog content could be created by the entity who owns the main website, and also by guest bloggers. These guest bloggers could be veterinarians, other feline health professionals, or cat enthusiasts who have an established following of individuals who are interested in cats. This will bring more traffic to the main website and encourage people to become personally involved in the movement by joining “The Cat Collective.”

**Future Web Possibility - Portal**

We identified the opportunity to have a portal on the main website for use by veterinarians, shelters, and other cat professionals. Suggested content includes:

* Approved continuing education for veterinarians/shelter employees
* Electronic downloads of print media for clinics/shelters
  + Promote ownership and care
    - E.g. Health benefits of cat ownership, preventative medicine

More research will need to be conducted to determine the potential for a portal and the content that should be provided to each group.

**Merchandise**

Merchandise can be a dynamic way to spread the message and get people thinking about cats. We recommend developing a line of branded merchandise that features the cat face outline that is seen in the advertisements. The color theme should be black and white, with the cat face graphic identity appearing in the contrasting color. The graphic identity could be placed on clothing, accessories, and also a line of cat-specific products. It is important that the merchandise be high quality and appeal to the needs and desires of the target market (young females). While the color theme is black and white, different textures can be explored to add visual interest to the apparel (e.g. sequins/glitter). The merchandise can be sold both online and on the Cats Across America Tour.

**The Cat Collective**

The Cat Collective is a body of people who promote the movement on a local and, because of the reach of the Internet, national scale. The microsite (TheCatCollective.com), which redirects from a tab on the main website, is a hub for this body and provides a vibrant place for people to interact. The following recommendations are a sampling of the elements that could be developed for the website:

**Share Ideas**

Individuals could share creative ideas for increasing cat adoptions. Others could implement these ideas at the local level, or the organization that is funding the movement could build a national campaign. (This concept warrants the investigation of intellectual property rights.)

**Submit Artwork**

Individuals could submit cat artwork that could be featured online and also on the Cats Across America Bus (see Cats Across America Tour).

**Tell Your Story**

Individuals could write their own testimonials/anecdotal stories about their cats and/or themselves.

**Join the Movement**

Individuals could sign up to become an active participant in the cat movement. The registration process should be very simple and each registrant will receive a black t-shirt that contains the cat face outline in white on the front and “The Cat Collective” lettering on the back. Members can have the option of starting or joining a local chapter of “The Cat Collective” and provide ideas, resources, and incentives for becoming involved locally. Suggested resources for local involvement include access to electronic downloads of talking points regarding the benefits of cat ownership and brochures/pamphlets/posters that encourage ownership and care. In addition, members who are located in a city on the Cats Across America Tour could help promote the stop locally. Suggested incentives for becoming involved locally include developing a rewards program that could include merchandise (tanks, polos, fleeces, waterbottles, etc.) that features the cat face outline with the exclusive “The Cat Collective” lettering and also opportunities to be featured on the website or in advertising.

**Cats Across America Tour**

The Cats Across America Tour (CAAT) is the crown jewel of the campaign and is a vehicle for physically connecting people. The heart of the Cats Across America Tour is a state-of-the-art bus that travels across the nation making stops at partnering pet stores in major cities. The bus will be a rolling advertisement for the tour and wrapped with the Cats Across America Tour logo and images of cats. The activities that the tour will encompass could be accomplished in temporary facilities that pop out from the bus, or from inside the pet store facilities. At least two veterinarians and several other team members will staff the tour. “Tux”, the cat personality of the campaign, will also travel with the tour (see Cat Personality). The purpose of the Cats Across America Tour is to educate and serve the needs of current and potential cat owners.

**Educational**

The tour could provide educational workshops on a variety of topics relating to cats. With two veterinarians on staff, workshops regarding cat health and care could be especially popular. It is vital that the educational materials be presented with a variety of interactive and fun methods, so that people will be eager to attend and learn.

**Service**

Following the educational component, the tour could provide services that reduce relinquishment, such as one-on-one counseling for behavioral issues. Although these services can prove helpful for the tour visitors, it is important to encourage cat owners to develop a working relationship with their regular veterinarian. There could be some opportunities to engage local veterinarians in each tour stop to promote their practices and meet potential clients. Prior to the tour stop, these veterinarians could help build excitement about the event locally. An additional service that could be offered is working with local or national pet adoption groups to host a large cat adoption event concurrently with the tour.

**Entertainment**

Drawing the public to the tour event is vital to its success. In addition to the engaging educational and service components discussed previously, we recommend the use of incentives to encourage attendance. Giveaways of branded merchandise (see Merchandise) and electronics, such as iPods and iPads, can be a crowd builder. We recommend giving everyone who attends a small item that can be displayed on his or her person (e.g. a button) or vehicle (e.g. a magnetic bumper sticker) to increase the reach of the campaign. An additional entertainment component could be to display the artwork that individuals submitted thorough The Cat Collective website.

**Cat Personality**

An effortless method for building empathy and garnering followers for this movement is having an actual cat “spokesperson.” This cat could appear in several places across the main campaign, perhaps most prominently in social media (See Social Media) and the Cats Across America Tour.

We recommend that the cat come from a shelter/rescue. He/she could be a black and white tuxedo, a coat color that fits our campaign theme and also translates well in all forms of advertising. His/her name could reflect his coat color and be recognizable as a cat name, such as “Tux”. Most notably, his/her temperament would need to be relaxed so that he/she could do personal appearances and promote the campaign well. His/her online personality should be playful, engaging, and above all, reflect the positive qualities that make a cat a unique and lovable pet.

**Social Media**

The campaign should have a presence in several social media platforms including Twitter, Facebook, and Instagram. The Twitter profile should be maintained by “Tux” and the tweets are from his/her perspective and in his/her voice. His/her posts should be humorous and educational. Suggested post topics include tweets that are about typical funny occurrences in his/her day, redirect to content on the main website, encourage people to interact with/join The Cat Collective, and updates on the Cats Across America Tour. Facebook and Instagram should have active profiles for both The Cat Collective and the Cats Across America Tour.

**References**

1. "Keeping Pets (Dogs and Cats) in Homes: A Three-Phase Retention Study." *Www.americanhumane.org*. American Humane Association, n.d. Web. <http://www.americanhumane.org/aha-petsmart-retention-study-phase-1.pdf>.
2. *America's Pet Owners - US - March 2013 Pet Ownership*. Rep. N.p.: Mintel, n.d. *America's Pet Owners - US - March 2013 Pet Ownership*. Mintel Group Ltd. Web. 6 Aug. 2013.
3. Section 1: Total Pet Ownership and Pet Population." *U.S. Pet Ownership & Demographics Sourcebook.* Schaumburg, IL: American Veterinary Medical Association, 2012. 1-171. Print.
4. Coren, Stanley, Ph.D. "Personality Differences Between Dog and Cat Owners." *Www.psychologytoday.com*. Sussex Publishers, Inc., 17 Feb. 2010. Web. <http://www.psychologytoday.com/blog/canine-corner/201002/personality-differences-between-dog-and-cat-owners>.

**Financial Analysis**

Because there are too many variables when executing the marketing plan, such as number of posters printed or shirts made, listed below are the large item costs for critical or primary elements. These costs are basic estimates based off of historical prices and it should be noted that these prices will most likely change. As noted in the chart, some prices will depend on the features or amount of customization wanted. Professional estimates will be needed for a more accurate cost.

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Largest Marketing Item Costs** | | | | |
| **Category** | **Item** | **Expected Cost** | **Priority** | **Description** |
| **Launch** |  |  |  |  |
|  | Advertisement/Branding Creation | $10,000 | Critical | 1This will be used in print and electronic forms to best reach target audiences |
| **Website** |  |  | Primary Element |  |
|  | Content Management System | $100-$1,000 per month |  | To control your website content |
|  | Website Maintenance | $100-$1,000 per month |  | Both website items depend on the features & size of the website selected |
| **Cat Across America Tour** |  |  | Primary Element |  |
|  | Tour Bus | $ 75,000.00 |  | 2Based off the ESPN NBA RV used |
|  | Customization and Outfitting | > $10,000.00 |  | Too many variables; minimum price of $10,000 |

**References:**

1. <http://www.logolance.com/average-logo-spend>
2. <http://promo.espn.go.com/espn/specialsection/yournbadestination/#/rvtour/rvtour/>

**Metrics for Success**

The marketing plan offers an extensive list of options to promote a new and fun cat image. Many of these options have metrics that can be used to measure the performance or success rate.

The first type of metric that can be utilized is an electronic data tracker. This can be used to track the number of people who visit the campaign website, individual pages, or educational videos on the website. From this, AHA will be able to see which pages are most/least popular and then assess where more emphasis may be needed. The data tracker can also keep updated list of number of Facebook “Likes” if a page is created, YouTube views if a channel is created, Twitter and/or Instagram followers, and trending hashtags with key phrases geared towards the campaign. The information and numbers gathered from these areas can then be used on a dashboard for a more visual display.

Surveys are a great way to get a customer’s opinion and not just numbers; therefore, it is another key metric to measure the success of the campaign. The surveys could be at partnering shelters or pet stores, as well as on the main campaign website. It can pose questions such as, “How did you hear about us?”, “If you’re adopting, why did you decide to?”, “What level of cat education do you feel you have?” and other questions along these lines. Over time, AHA can track how account users’ or owners’ education has grown and if the educational tips/lessons have been helpful. They can also be used to obtain feedback and cater towards the customer’s needs and wants.

Next, AHA can measure the performance of the campaign through tracking the number of people who attend the Cats Across America Tour. During the tour, surveys could be passed out where attendees state which areas they participated in, their rating for each area, and then any feedback. This will help AHA to improve any area that may be rated consistently low and possibly add new ideas as the tour goes along. Lastly, tracking the number of merchandise sold as well as the frequency of each sold item will help AHA understand the trends of the customers.

**Future Financial Partners**

**Human Healthcare**

Elderly:

****

Autism Organization such as:



**Veterinary Medicine**



****

****

****

**Other Pet Companies:**

****

**Conclusion**

Starting in 2006, the cat population in United States household began to decline. From 2006 to 2011, the population decreased by 5.5 million cats, which is almost a one million cat decline per year. Some of these cats end up being relinquished, while others are sadly euthanized. Our goal during this research project was to creatively think of ways to improve a cat’s chance for a loving and permanent home through research and a marketing campaign.

After extensive research, we concluded that education was the key to reversing the cat population trend in households. Education involves not only the medical and veterinary medicine aspects, but also the psychological and wildlife sides such as behavioral medicine and responsible pet ownership of keeping your cat indoors. When owners became educated and involved in their pet’s health, they were less likely to relinquish their animal and increased the bond between them and their pet companion.

Another major aspect we found important was increasing research in certain unknown areas. These areas include: cats in AAI for the elderly, connection between cat ownership and allergy immunity, why many veterinarians consider themselves dog people, making shelter cats a therapy animal for animal assisted therapy, and the effects of cats on wildlife populations. As it can be seen, these areas are not very commonly thought of in connection with cats. However, they are the front of the next line of research needed. Breakthrough research in the assisted and therapy areas alone would allow the cat to become almost as versatile as the dog.

Until this research can be conducted, there are several options outlined in the marketing plan that promote the current suggestion on increasing public education. These include and are not limited to a campaign advertisement; website with educational videos, testimonials from current owners, and more; a cat personality, who will be the physical face of the campaign; and lastly, a tour across America to increase interaction. While the website and tour will require the most financial support, we believe these will be very effective strategies that will reach a vast number of people.

With this campaign, we hope to increase the adoption rate at shelters by 10%. By using numerous metrics such as data tracking and surveying, the AHA will be able to see if the campaign efforts have reached the 10% target growth goal as well as others. Overall, we believe the solutions listed in the research and marketing plan will give AHA the ability to improve the cat’s image and a chance at a loving and permanent home.

**Appendix**

**Medical Research**

**Abstract**

As reported by the AVMA, between 2006 and 2011 there was a 6.2% decrease in the number of households owning cats in the United States. To determine the cause of this decrease in cat ownership, the AHA assembled an One Health team and tasked them with not only discerning the possible causes of this decline but also to devise a plan to improve the image of the domestic cat. The following sections – Allergies and Health Benefit and the Animal Human Bond were written based on research gathered by the medical student of this research team, Kaitlin Janning.

Research on the relationship between cats and allergies was conducted. Allergies to cats have previously been indicated as a reason for either surrendering a cat to a shelter or for not keeping one in the home. In hopes of preventing or alleviating allergies, people often turn to buying a “hypoallergenic” breed of cat over adopting a shelter cat whose breed was not specified. Studies show that this measure to avoid allergies, while not only being more costly to the new pet owner, is also ineffective at preventing the cat allergen, Fel d 1, from entering the home [1, 2]. Additionally, the concept of inducing tolerance to Fel d 1through purposeful exposure was investigated. Induced tolerance was in fact found to occur in cat owning households as the level of Fel d 1 exposure was sufficient enough to trigger the resistance. Induced tolerance to this allergen as a potential incentive for the consideration of owning a cat was investigated. Though it was found that induced allergen tolerance alone is not sufficiently supported to be grounds for keeping a cat in the home, it was also found that fear of inducing allergies by keeping a cat in the home is unwarranted and should not be avoided specifically to prevent allergies. By looking deeper into the connection between cat ownership, allergen exposure and induced tolerance, the guidelines for controlling and preventing allergies could be revised in the future.

Another area of research in this study was measurable physical and mental health benefits afforded to humans through both pet ownership and interaction, especially with cats. Studies have found that interaction with cats lowers blood pressure, leads to more expedient recovery after serious illness, reduces depression symptoms and decreases anxiety. These health benefits were found to be especially prominent when the interaction was with a familiar cat [3]. This suggests that pet ownership may be the most effective way to maximize the health benefits of animal interaction. Future research into the feasibility of introducing cats as companion animals for the purpose of improving health should be undertaken.

Finally, the role of the cat in AAI was studied. Cats have been found to be as effective as dogs at providing AAI therapy benefits, but also are able to be used in AAI for people who cannot tolerate canine AAI [4]. AAI was found to be especially beneficial to elderly dementia patients, specifically in decreasing their agitation and improving both the quality and quantity of their social interaction. Research into the benefits of feline AAI for the elderly is an important field of future study.

**Discussion**

**Allergies**

Cats are one of the most popular companion animals worldwide. As previously discussed, many of the health concerns associated with cats can be minimized through proper veterinary care of these companion animals. While maintaining the health of your cat minimizes the human health issues related to owning a cat, it does not always completely address the occurrence of allergies in humans who come in contact with cats. This section will address the connection between cats and human allergies.

As related to human health, the most significant cat allergen is Fel d 1. This protein becomes airborne at high levels in homes that keep cats [5]. The Fel d 1 protein is found mainly in the sebaceous glands of felines’ skin but also in their salivary glands. The protein is carried in different sized particles with a diameter less that 5um, with some less than 2.5um. Because of their small size, these particles can remain suspended in the air for long periods of time [6], can become re-airborne very easily [7] and are easily inhaled [5]. In humans, cat allergens induce primarily an immunoglobulin E (IgE) response, as well as an IgG, IgA, and IgG4 response [8]. These immune responses lead to the induction of a T helper 2 (Th2) response that promotes allergic disease. The strength of the immunologic response depends on the individual’s degree of susceptibility to allergen and the level of allergen exposure.

As the prevalence of fur-bearing animals in homes has increased in the Unites States of the last 60 years, so has the incidence of allergic disease to these animals [9]. In the past, animals, including cats, were kept outdoors for a variety of reasons ranging from the concept of them being “dirty” to their causing human disease. These diseases include allergies and zoonotic diseases such cat scratch disease and toxoplasmosis. Though these same risks exist today, there has been a shift in the way in which companion animals are viewed by the people that care for them. Today, companion animals are often considered part of the family and occupy the same space in homes as the humans that care for them. This shared space includes couches, beds and other allergen holding surfaces and are examples of additional sources of animal allergens besides the animal itself. Studies have shown that it is near impossible to eliminate companion animals from homes, even when humans are allergic to their companion animal [10]. Though in the past doctors were able to suggest pet elimination from the home as treatment for allergies, today these suggestions are met with almost immediate resistance and patient preference of medication prescription or allergen immunotherapy to control and alleviate symptoms [10].

The most recent attempt by many allergic individuals to maintain a cat in their home, despite being allergic to the cat, has been to turn to hypoallergenic breeds as a solution. For previously non-cat owning individuals, the concern for becoming allergic to their cat can be so great that they will only own ”hypoallergenic” breeds of cats. Because pets are known to aggravate asthma, allergic rhinitis, and eczema in sensitized individuals [11], in situations where a person is historically allergic to cats and have a positive prick puncture skin test to cat extract, hypoallergenic pets are also often opted for so as to still be able to keep a cat in the home. Though both of these groups adopt hypoallergenic cats with the best of intentions, multiple studies have shown that these so called hypoallergenic cats still produce the protein that is involved with causing allergies to the animal [8]. One study conducted in 2012, conducted with both cats and dogs, found that there was no evidence for differential shedding of allergens by the hypoallergenic pet group versus the non-hypoallergenic pets [12]. The same study also found that the main cat allergen, Fel d 1, was widely dispersed in indoor environments irrespective of what breed of cat lived in that space [1]. Though the washing a pet dog twice a week has been found to reduce the levels of allergen put into the environment by the dog, the same preventative measure is not effective at lowering the amount of allergen shed by cats [2]. The concept of hypoallergenic pets, in particular hypoallergenic cats, is not supported by scientific evidence [1] and these breeds should not be preferentially adopted as a means to control allergic disease.

Many studies exist concerning the best method of managing allergic disease. These findings are summarized in the World Health Organization book on allergy prevention [13]. Based on these guidelines, unfortunately, for adults who are already proven allergic to cats, the best option for minimizing and preventing exacerbations of their allergic disease is to not keep cats in their home. This avoidance strategy is not necessary for individuals who do not already have allergies to cats. For people with no allergic history or positive prick-puncture skin test, their preference for adopting “hypoallergenic” cats in place of a rescue cat can often be attributed to their desire to eliminate the possibility of developing allergies. For this population, adoption of a hypoallergenic cat breed in place of a non-hypoallergenic breed is an unnecessary and more expensive measure. In this group, after adopting any breed of cat, regular cleaning of the home, especially vacuuming of upholstered or soft surfaces, and scheduled changing of home air filters can help eliminate much of the circulating cat allergen and reduce their allergen exposure.

More often than being concerned about their own development of allergies, adults worry about children developing allergies. Though cats are most commonly implicated as the cause of asthma and allergic disease in children, systematic reviews have concluded that there is a lack of evidence to support the claim that cat exposure early in life increases the risk of allergic disease [14]. In direct opposition to the commonly held belief that exposure to cats increases the risk of allergies, exposure to cat allergens at an early age is likely to be protective against developing allergic disease. Studies have shown that living with a cat, especially in the first year of life, could be protective against the development of allergies [15, 16]. Results of multiple investigations have found a U-shaped relationship between cat allergens and cat sensitization leading to allergic disease, with very high and very low levels of exposure protecting individuals from sensitization to the cat allergen [17]. In these individuals who develop tolerance after high levels of exposure, a variant response called a modified Th2 response is observed [18]. In these individuals a high prevalence of IgG and IgG4 antibodies to the Fel d 1 protein can be detected and have led to the development of tolerance to the protein. Studies looking into this phenomenon of post exposure developed tolerance have proposed that there are important windows of time, including 20 weeks prior to birth until 4 weeks after birth, in which immune development is influenced by environmental exposures that can increase or decrease the risk of developing subsequent allergic disease [19,20]. Though evidence of the development of cat allergen tolerance is strong, health care providers should not advise the acquisition of a cat specifically for the primary prevention of asthma or allergic disease [21]. Though the specific advice of keeping a cat to prevent allergic disease cannot be advised, there is also no reason to advise avoidance of cats as pets in homes to prevent the development of allergic disease.

**Health Benefits and the Animal Human Bond**

As previously discussed, cats are one of the most popular companion animals kept in homes. While cats effectively provide companionship to humans, this is not the only benefit to keeping them as pets. The concept of “pets are good for us” is not new. Though many throughout time have believed this, it has only been recently that studies on human-animal bond and their effects on human health and wellbeing have been conducted. Beyond the companionship and enjoyment of the animal itself, it has been found that cats provide many other measureable health benefits to their owners. These studies have shown both short- and long-term benefits to human health. Cats have also been found to be effective in pet assisted therapy settings, especially when interacting with the elderly. This section will discuss the various health benefits of human- cat interaction and cat ownership.

In the short term, companion animals such as cats decrease stress and improve blood pressure in healthy individuals [22]. Simply petting an animal has been shown to transiently decrease blood pressure and heart rate [23, 24]. These beneficial physiological drops have also been shown to occur to a greater extent when the human-animal interaction occurs with a familiar animal, such as a family pet, than with an unfamiliar animal, such as a neighbor’s pet [3]. Decreases in stress and blood pressure after human-animal interactions have been attributed to decreased sympathetic nervous system stimulation in these individuals [22].

Cat ownership has also been found to have similar health benefits in patients with cardiovascular conditions. Cat ownership was found to be significantly associated with 1-year survival in patients after suffering myocardial infarction or angina pectoris [25]. Additionally, pet ownership tended to predict human survival independently of the physiologic severity of the patient’s heart disease [25]. Another major study found that pet owners risk for cardiovascular disease was greatly reduced as they had both lower systolic blood pressure and lower triglyceride levels [26]. Both of these studies also suggest that pets decrease stress, anxiety and blood pressure in this patient population by decreasing sympathetic nervous system stimulation [25, 26].

Though the long term benefits of pet ownership have less evidentiary support, there are studies to support that in the long term pets both prevent illness and facilitate recovery from serious physical ailments [22]. Pet owners have been found to visit the doctor significantly less than individuals who do not own companion animals [27]. The ability of pets to prevent their owners from developing chronic conditions has also been documented [26]. One main source of this ability is that pet ownership leads to increased exercise in the owner [28].

It has been well documented that a lack of physical exercise is correlated with many disease processes. Chronic conditions correlated with sedentary lifestyle that can be prevented or controlled by physical activity include heart disease; hypertension; stroke; cancers of breast, lung, and colon; type II diabetes mellitus; obesity; depression and anxiety [29]. It has been found that pet ownership, including cat ownership, increases the amount of exercise the owner gets daily [28]. This could be attributed to the sense of purpose and responsibility felt by pet owners to their pet as well as their increased sense of well-being and need to care for themselves so as to be able to care for their pet. This important result of pet ownership increases human physical wellbeing, improves existing conditions, and even prevents the developing chronic illness.

Cats not only provide measureable physical health benefits, they also increase psychological wellbeing in their owners. Cat owners were found to better negotiate daily life and social challenges, experienced less emotional, cognitive and behavioral dysfunction and felt less symptoms of depression throughout their daily lives [30, 31]. These findings suggest that cat ownership alone can improve psychological health. Another study found increase feeling of constancy, decrease in social isolation and decrease stressed because of nonjudgmental companionship provided by cats [32]. Animals, unlike people, are perceived as completely nonjudgmental and may thus be able to serve as social facilitators to decrease stress and improve human performance.

Owning pets such as cats can help diminish feelings of loneliness and partially compensate for the absence of human companionship in people living alone [33]. In households with multiple people, especially in single-family homes, pet ownership correlated with family cohesion and adaptability suggesting that a cat can serve to ease tension between family members and facilitate conflict resolution [34]. Irrespective of living alone or with other, pet ownership was found to be correlated with increased social support and successful coping strategies [31]. Pets have been found to facilitate social interactions between people irrespective of what type of pet it is. One study found that people are significantly more likely to be approached socially in public parks when accompanied by a companion animal than when engaging in an activity [35]. All of these studies support the concept of companion animals playing an important role in supporting human socialization and interaction.

The supportive function of a human-pet relationship has also been suggested as a source of the health benefits afforded to pet owners [36]. High levels of social support have been shown to predict emotional and physical wellbeing after bone marrow transplants, reduce risk for myocardial infarction and strokes in women, and facilitate recovery from coronary heart disease [37, 38, 39] Even in less serious circumstances, the support lent to owners by their pets leads them to report in increased feeling of being loved, esteemed, and needed by another [40]. This improved mental and emotional wellbeing provided by companion animals plays a vital role in maintaining and improving physical health.

It is important to mention that though cat ownership confers both physical and mental health benefits upon the owner, the extent to which these benefits are seen depends upon the level of attachment demonstrated by the owner for their pet [41]. Attachment Theory was first suggested by John Bowlby as an explanation of the bonds that develop between a parent and child [42]. Just as they form between people, these strong emotional ties are formed between humans and their pets. Many pet owners consider their pet as part of the family and treat them as they would a child [43]. The emotional bond between humans and animals is a key factor that leads to improved psychological and, in turn, physiological, health. Facilitating the attachment of a person to their pet can be a simple way to increase the physical and mental benefits the owner receives from their relationship.

The health benefits brought about through animal human interaction are not only afforded to pet owners. Recently, the animal human bond has been used in therapy settings to bring health benefits to people. AAI, including animal assisted activities (AAA), are being increasingly used in conjunction with traditional medical therapies with excellent results. Animals have been found to sever as “emotional mediators” as well as facilitators for social interactions [44]. In this capacity they are able to facilitate interaction between people that would not have otherwise happened as well as make these interactions enjoyable to the involved parties. This facilitation can be especially beneficial to people suffering from social anxiety. Additionally, animals provide sensory stimulation, emotional support and a sense of well-being to those who interact with them [45]. Traditionally, AAI has been conducted with dogs; However, AAI conducted with cats has been found equally effective and has become common. Feline AAI therapy is a good alternative to canine AAI therapy in situations such as hospitals, hospices, nursing homes, and therapy for elderly patients where canine AAI is not possible, as it obtains the same therapeutic results [4].

The benefits of AAI feline therapy have been found to be especially significant in elderly patients with dementia or psychiatric disorders [46]. AAI have positive influence on dementia patients by decreasing their levels of agitation and improving their amount and quality of social interaction [46]. Studies have found that after AAI, elderly psychosis patients have improved Geriatric Depression Scale scores as well as improved Mini Mental Status Exam scores [47]. Additionally, feline AAI decreases aggressiveness, anxiety and phobias in elderly Alzheimer’s patients [48]. Though feline AAI is beneficial in this patient population, it has been found that its positive effect on agitation dissipates when therapy is discontinued [49]. With this in mind, studies have concluded that the optimal and most cost-effective AAI duration and frequency of session is still unclear [46, 50].

Despite the unanswered questions concerning how to optimize the benefits of feline AAI, many physicians and care givers recognize the particular benefit of cats as both companion animals and therapy animals to the elderly and are searching for ways to better incorporate it into their care. Recently the International Federation for Animal Health – Europe launched a new campaign to highlight the benefits of cats as companion animals to the elderly [51]. Similar campaigns in the United States would be beneficial in improving understanding by the public of these benefits as well as generating discussion on how to most effectively implement programs to bring these benefits to the elderly.

Despite the many benefits they bring to our lives, it must be remembered that companion animals, including cats, can potentially impair human health by spreading zoonotic diseases, causing allergies, and biting. These risks aside, pets carry clear therapeutic and life enhancing value for their owners and can significantly improve human quality of life. Companion animals are a valuable and underutilized means of treating human illness and maintaining health.

**Future Research and Recommendations**

Cats are attractive companion animals for many reasons. These include a more independent disposition than dogs, as well as being considered easier to care for than a dog. Cats are smaller companions and make good pets in smaller living spaces or spaces requiring less, or no, outdoor space than a dog would require. Additionally, cats can be left in the home while their owners are gone on short trips without requiring boarding or in-home pet care. Finally, cats cost less to care for on average than a dog. Though these reasons alone make cats an ideal pet for many different types of people, cats also bring additional health benefits to their owners making them an even more appealing option of companion animal. Publicizing the ways in which cats improve a person’s physical and mental health should be a highlight of the AHA’s campaign to improve the cat’s image.

The concept of induced tolerance to allergens has been the basis of treatment of many human allergies since the early 1900s. Despite this, it has only been recently that the concept of induced tolerance to the main cat allergen Fel d 1 was studied. Though it has been found that induced allergen tolerance alone is not sufficient reason enough to be grounds for keeping a cat in the home, it has been found that fear of causing allergies by keeping a cat in the home is an ungrounded fear. Further research into the connection between cat ownership and allergy immunity should be undertaken. Additionally, guidelines for controlling and preventing allergies to the Fel d 1 cat allergen could then be revised.

Though studies have repeatedly found significant improvements of many physiological variables, including improved blood pressure and expedited recovery from illnesses, many people remain unaware of these benefits of cat ownership. To this point, promotion of cat ownership has focused mainly on the companionship the animal brings to its owner. Though cat ownership certainly decreases feelings of loneliness and can endow owners with a sense of purpose and responsibility, these are not the only health benefits of cat ownership that merit promotion. Cats have been found to improve anxiety and decrease feelings of depression. Investigation as how to best educate people on additional health benefits of cat ownership is merited. Additionally, health care providers and care givers should be educated on both the benefits of cat ownership as well as how to identify patients whose lives would be improved through cat ownership.

Finally, feline AAI with elderly dementia, Alzheimer and psychosis patients should be further researched. The optimal and most cost effective duration of feline AAI is still unknown. A better understanding of these aspects of feline AAI would allow more widespread use of feline AAI therapy, as well as allowing maximum benefit to be achieved with the therapy. Introduction of feline AAI into more elderly care facilities would be facilitated by the production of guidelines on how to implement feline AAI, ensure the space is a safe and secure environment for feline AAI to take place, and ensure the health and wellbeing of both the cat and the patient participating in the therapy.

**References:**

1. Butt A, Rashid D, Lockey RF. *Do hypoallergenic cats and dogs exist?* Ann Allergy Asthma Immunol, 2012. **108**: 74-76.
2. Hodson T, Custovic A, Simpson A, Chapman M, Woodcock A, Green R. *Washing the dog reduces dog allergen levels, but the dog needs to be washed twice a week.* J Allergy Clin Immunol, 1999. **103**(4): 581-585.
3. Schuelke ST, Trask B, Wallace C, Baun MM, Bergstrm N, McCabe B. *The physiological effects of the use of a companion dog as a cue to relation in diagnosed hypertensives.*
4. Goleman M, Drozd L, Karpinski M, Czyzowski P. *Cat therapy as an alternative form of animal assisted therapy.* Med Weter, 2012. **68**: 732-735.
5. Thein FCK, Leung RCK, Czarny D, Walters EH. *Indoor allergens and IgE mediated respiratory illness.* Immunol Allergy Clin N Am, 1994. **14**(3): 567-590.
6. Luczynska Cm, Li Y, Chapman MD. *Airborne concentrations and particle size distibution of allergen derived from domestic cats (Feliz domesticus). Measurements using a cascade impactor, liquid iminger and two site monoclonal antibody assay for Fel d 1*. Am Rev Respir Dis, 1990. **141**: 361.
7. Bateman BJ, Dean TP. *The Cheshire cat’s grin – is cat allergy here to stay?* Clin Exp Allergy, 1999. **29**: 725-728.
8. Platts-Mills TA, Woodfold JA. *Allergens and their role in the allergic immune response.* Immunol Rev, 2011. **242**(1): 51-68.
9. Morris, DO. *Human allergy to environmental pet danders: a public health perspective.* Vet Dermatol, 2010. **21**: 441-449.
10. Bertelsen RJ, Carlsen KCL, Granum B, Carlse K-H, Haland G, Devulapalli CS, et al. *Do allergic families avoid keeping furry pets?* Indoor Air, 2010. **20**: 187-195.
11. TePas EC, Litonjua AA, Celedon JC, Sredl D, and Gold DR. *Sensitization to aeroallergens and airway hyperresponsiveness at 7 years of age.* Chest, 2006. **129** (6): 1500-1508.
12. Lockey RF. *They myth of hypoallergenic dogs (and cats)*. J Allergy Clin Immunol, 2012. **130**: 910-911.
13. Host A, Boner A, Odhiambo J. Contributors: Custovic A, Lockey R. *Preventative measures. section 1: early interventions*. In: Johansson SGO, Haahtela T, editors. *Prevention of allergy and allergic asthma.* World Health Organization project report and guidelines. Basel: Karger, 2004. 135-51.
14. Charmage SC, Lodge CL, Matheson MC, Campell B and Lowe AJ. *Exposure to cats: update on risks for sensitization and allergic diseases*. Curr Allergy Asthma Rep, 2012. **12**: 413-423.
15. Hesselmar B, Aberg N, Aberg B, Eriksson B, Bjorksten B. *Does early exposure to cat or dog protect against later allergy development?* Clin Exp Allergy, 1999. **29**(5): 611-617.
16. Popp W, Rauscher H, Sertl K, Wanke T, Zwick H. *Risk factors for sensitization to furred pets*. Allergy, 1990. **45**(1): 75-79.
17. Custovic A, Hallam CL, Simpson BM, Craven M, Simpson A, Woodcock A. *Decreased prevalence of sensitization to cats with high exsposure to cat allergen*. J allergy Clin Immunol, 2001. **108**(4): 537-539.
18. Platts-Mills TA, Vaughan J, Squillace S, Woodfole JA, Sporik R. *Sensitization, asthma, and modified Th2 response in children exposed to cat allergen: a population based cross sectional study.* Lancet, 2001. **357**(9258): 752-756.
19. Prescott SL, Smith P, Tang M, et. all.  *The importance of early complementary feeding in the development of oral tolerance: concerns and controversies.* Pediatr Allergy Immu, 2008. **19**(5): 375-380.
20. Holt PG, Sly PD. *Non-atopic intrinsic asthma and the ‘family tree’ of chronic respiratory disease syndromes*. Clin Exp Allergy, 2009. **39**(6): 807-811.
21. Lodrup-Carlsen KC, Roll S, Carlsen KH, Mowinckel P, Wijga AH, Brunekreef B, et al. *Does pet ownership in infancy lead to asthma or allergy at school age? Pooled analysis of individual participant data from 11 European birth cohorts*. PLoS ONE, 2012. **7**(8): e45214.
22. Wells DL. *The effects of animals on human health and well-being*. J Soc Issue, 2009. **65**(3): 523-543.
23. Shiloh S, Sorek G, Terkel J. *Reduction of state-anxiety by petting animals in a controlled laboratory experiment*. Anxiety Stress Copin, 2003. **16**: 387-395.
24. Eddy TJ. *Reductions in cardiac activity in response to a pet snake*. J Nerv Ment Dis, 1996. **184**: 573-575.
25. Friedmann E, Thomas SA. *Pet ownership, social support, and one-year survival after acute myocardial infarction in the cardiac arrhythmia suppression trial (CAST)*. Am J Cardiol, 1995. **76**: 1213-1217.
26. Anderson WP, Reid CM, Jennings GL. *Pet ownership and risk factors for cardiovascular disease.* Me J Australia, 1992. **157**(5): 298-301.
27. Headey B. *Health benefits and health cost savings due to pets: preliminary estimates from an Australian national survey.* Social Indicators Research, 1998. **47**: 233-243.
28. Jennings LB. *Potential benefits of pet ownership in health promotion*. J Holis Nurs, 1997. **15** (4): 358-372.
29. Powell KE, Caspersen CJ, Koplan JP, Ford ES. *Physical activity and chronic diseases.* Am J Clin Nutr, 1989. **49**: 999-1006.
30. Straede CM, Gates GR. *Psychological health in a population of Australian cat owners*. Anthrozoos, 1993. **6** (1): 30-42.
31. Friedmann E. *The value of pets for health and recovery*. Proceedings of the Waltham Symposium 1990. **20**: 9-17.
32. Patronek GJ, Gilckman LT. *Pet ownership protects against the risks and consequences of coronary heart disease.* Medical Hypothesis, 1993. **40**: 245-249.
33. Zasloff RL, Kidd AH. *Loneliness and pet ownership among single women*. Psychological Reports, 1994. **75**(2): 747-752.
34. Cox RP. *The human/animal bond as a correlate of family functioning*. Clinical Nursing Research, 1993. **2**(2): 224-231.
35. Hunt SJ, Hart LA, Gomulkiewicz R. *Role of small animals in social interactions between strangers*. J Soc Psych, 1992. **132**: 245-256.
36. Collis GM, McNicholas J. *A theoretical basis for health benefits of pet ownership*. Companion Animals in Human Health. CC Wilson & DC Turner Eds. 1998. London: Sage. 105-122.
37. Hochhausen N, Altmaier EM, McQuellon R, Favies SM, Papadopolous E, Carter S, et al. *Social support, optimism, and self efficacy predict physical and emotional well being after bone marrow transplantation.* J Psychosoc Oncol, 2007. **25**: 87-101.
38. Anderson D, Deshaies G, Jobin J. *Social support, social networks and coronary artery disease rehabilitation: a review*. Can J Cardiol, 1996. **157**: 298-301.
39. Andrew-Petersson L, Engstrom G, Hedblad B, Janzon L, Rosvall M. *Social support at work and the risk of myocardial infarction and stroke in women and men*. Soc Sci Med, 2007. **64**: 830-841.
40. Cobb S. *Social support as a moderator of life stress.* Psychosomatic Medicine, 1976. **38**: 300-314.
41. Barker SB, Wolen AR. *The benefits of human-companion animal interaction: a review*. J Vet Med Educ, 2008. **35**(4): 487-495.
42. Bowlby J. *Attachment*. 1969. Harmondsworth, UK: Penguin.
43. Archer J. *Why do people love their pets?*. Evolution of Human Behavior, 1997. **18**: 237-239.
44. Wilson CC, Netting FE. *Companion animals and the elderly: a state-of-the-art summary*. J Amer Vet Med Assoc, 1983. **20**(8): 31-35.
45. Jofre ML. *Animal assisted therapy in health care facilities*. Revista Chilena de iInfectiologia,
46. Bernabei V, De Ronchi D, La Ferla T, Moretti F, Tonelli L, Ferrari B, Forlani M, Atti AR. *Animal assisted interventions for elderly patients affected by dementia or psychiatric disorders: a review*. J Psychiatric Res, 2013. **47**:762-773.
47. Moretti F, De Rochi D, Bernabei V, Marchetti L, Ferrari B, Forlani C, et al. *Fet therapy in elderly patients with mental illness*. Phsychogeriatrics, 2010. **11**(2): 125-129.
48. Kanamori M, Suzuki M, Yamamoto K, Kanda M, matusi Y, Kojima E, Fukawa H, Sugita T, Oshiro H. *A day care program and evaluation of animal assisted therapy (AAT) for the elderly with senile dementia*. Am J Alzheimer’s Dis Other Demen, 2001. **16**: 234-239.
49. Richeson B, Ferris S, Franssen E. *An ordinal functional assessment tool for Alzheimer’s type dementia*. Am J Alzheimer’s Dis, 2003. **18**(6): 353-358.
50. Filan SL, Llewellyn-Jones RH. *Animal assisted therapy for dementia: a review of the literature*. Int Psychogeriatr, 2006. **18**(4): 597-611.
51. *European campaign to promote the benefits of pets to the elderly*. Vet Record, 2013. **172**: 257.

**Veterinary Research**

**Abstract**

In 2012 the AVMA reported a 6.2% decrease in the number of cats in the United States between 2006 and 2011. To determine the cause for the decrease in the number of cats the AHA employed a One Health interdisciplinary team. Each student performed research on several topics in their field of expertise and shared the main goal of improving the cat's image through innovative marketing ideas and research. The following sections – zoonosis, relinquishment, and feline medicine were written based upon research gathered by the veterinary student, Anne Romeo, who in collaboration with the medical student, Kaitlin Janning, developed the zoonotic section.

Though there are many benefits to owning a cat there are also potential health risks to cat ownership and these increase for an immunocompromised individual. These risks should not discourage ownership because they can be minimized with proper care of the animal. It is the job of health professionals such as physicians and veterinarians to work together to educate owners on these risks and provide preventative medicine when needed. The zoonotic section is a review of some the most common feline zoonotic pathogens and will explain basic pathogenesis as well as prevention of several pathogens.

Research was also conducted to examine the reasons for relinquishment of cats in the United States. Relinquishment of an animal to a shelter is a complex issue that has warranted much research. In the US alone millions of animals are euthanized every year at shelters. In fact studies have shown that nearly 4 million cats are euthanized in this manner making shelter euthanasia the leading cause of death in cats [[1-4](#_ENREF_1)]. Therefore the risk factors associated with relinquishment of animals have been studied. The relinquishment section of the paper will summarize several studies pertaining to risk factors associated with relinquishment of cats. By examining these factors the development of programs or preventive strategies can be established to decrease the number of cats relinquished at shelters.

Within the past 10 years there has been a gradual decline in feline visits to the veterinarian [[5](#_ENREF_5), [6](#_ENREF_6)]. Studies have listed several reasons for decrease in visits and they include: cats do not like to travel to the clinic, the cost of visit, the recession, internet, fragmentation of service, and the lack of client education on the importance of wellness exams. Most people in the Bayer Veterinary Care Usage Study III agreed that they would take their cat to the veterinarian more frequently if they had an understanding of the necessity of an annual exam. This is an area that veterinarians can do something about and they need to emphasize the importance of the wellness exam as well as make their clinics more appealing to the feline patient. In the “Feline Medicine” section there is a discussion on the importance of the yearly exam and suggestions on how to make a practice more feline friendly.

**Discussion**

**Zoonosis**

One worldwide zoonotic pathogen is the obligate intracellular protozoan *Toxoplasma gondii.* Cats have an important role in the life cycle of *T. gondii* because they are the only definitive host for this parasite. Cats become infected either directly through ingestion of sporulated oocysts or indirectly via consumption of tissues cysts from other intermediate hosts such as rodents or poorly cooked meat. The life cycle of *T. gondii* starts with ingestion of sporulated oocysts that contain infectious sporozoites. Sporulation of the oocysts occurs in the environment usually within 1-5 days [[7](#_ENREF_7)]. Therefore when the oocysts are first released into the environment within feces they are not infectious. Sporulated oocysts are very resilient once in the environment and can thrive for years within a moist cool area. With entrance into the stomach the sporulated oocysts release sporozoites which then enter the intestine. These sporozoites enter the intestinal epithelium and begin asexual reproduction followed by sexual reproduction [[7](#_ENREF_7)]. The end result is the release of unsporulated oocysts from the hosts cell into feces then out to the environment. Cats only shed these oocysts for a couple of weeks and most cast only shed this organism once in a lifetime [[8](#_ENREF_8), [9](#_ENREF_9)].

Intermediate hosts such as rodents, swine, sheep and man become infected with *T. gondii* by ingestion of sporulated oocysts, ingestion of tissue cysts from another intermediate host, or transplancentally [[10](#_ENREF_10)]. The life cycle within intermediate hosts differ from that in cats. Within immunocompetent intermediate hosts the normal life cycle of *T. gondii* stops at the bradyzoite stage. Bradyzoites are slow multiplying organism that resides in the host’s tissue and are the main player in latent infections [[11](#_ENREF_11)]. In an immunocompetent host the body walls off these bradyzoites forming a tissue cyst and producing no clinical signs of infection. Humans can become infective by ingestion of sporulated oocysts via the fecal-oral route due to direct exposure of oocysts within cat feces. People can also consume sporulated oocysts due to contaminated water or food products [[12](#_ENREF_12), [13](#_ENREF_13)]. Ingestion of infective tissue from livestock species that contain tissue cysts with bradyzoites is yet another potential source for *T. gondii* exposure in people [[14](#_ENREF_14)].

There have also been reports of transmission of *T. gondii* via organ transplantation; due to the tissues transplanted containing cysts. Approximately one third of the U.S. population is seropositive for *T. gondii* indicating exposure during their lifetime [[15](#_ENREF_15), [16](#_ENREF_16)]. In most immunocompetent people symptoms of infection are unapparent however a small percentage may experience flu-like symptoms [[17](#_ENREF_17)]. In contrast, in immunocompromised individuals clinical signs will appear most likely due to reactivation of latent infect. Reactivation occurs when tissue cysts rupture and release the once walled off bradyzoites into the host environment. These bradyzoites then form tachyzoites which are able to invade cells within the body and quickly multiple thus causing clinical manifestations [[11](#_ENREF_11)]. Infection in immunocompromised people can be life threatening. For example it has been shown that 10-50% of those individuals with AIDS are likely to develop toxoplasmosis from a latent infection and 10% of those people will die from toxoplasmosis encephalitis [[17](#_ENREF_17), [18](#_ENREF_18)]. Therefore, preventative strategies should be used in situations where immunocompromised individuals are at risk for toxoplasmosis exposure.

Another group of individuals that should be aware of toxoplasmosis is pregnant women. Though T. gondii infections in immunocompetent humans are typically asymptomatic and self-limited, T. gondii infections acquired during pregnancy can have serious potential side effects [[19](#_ENREF_19)]. Within intermediate hosts *T.gondii* can be transmitted transplacentally. It has been reported that there are an estimated 400-4000 cases of congenital toxoplasmosis in the U.S. each year [[11](#_ENREF_11)]. If a woman that has never been exposed to *T. gondii* becomes infected during pregnancy there is about a 20-50% chance that the fetus will be infected [[11](#_ENREF_11), [20](#_ENREF_20)]. The probability of fetal infection increases throughout pregnancy from 5% to 80%, with the greatest risk occurring during the third trimester. This phenomenon is due to the fact that the placenta is more difficult for the parasite to cross during the first half of gestation. Interestingly, late term *T. gondii* infections are associated with less severe side effects and early term infections associated with the greatest risk of major clinical effects [[10](#_ENREF_10), [19](#_ENREF_19), [21](#_ENREF_21)]. Toxoplasmosis can induce abortion, stillbirth or preterm delivery and can generate health problems for the fetus such as mental retardation, malformations, deafness, blindness and seizures [[11](#_ENREF_11)]. It should be noted that just cat ownership in general has not been shown to be a risk factor for toxoplasmosis infection rather it was the exposure to sporulated oocysts which pose the greatest risk [[22](#_ENREF_22)].

The most frequent consequence of congenital toxoplasmosis is retinochoroiditis. Ocular lesions occur in up to 80% of untreated, congenitally infected individuals with 50% of these being unilaterally or bilaterally blind [[21](#_ENREF_21)]. Primary prevention of congenital toxoplasmosis infections involves prenatal education for pregnant women of reproductive age and physician counseling, especially by obstetricians, of pregnant women. It is standard of care to provide pregnant women with avoidance counseling during early prenatal care visits [[23](#_ENREF_23)]. Avoidance counseling should include information on fecal contamination from cats and consumption of undercooked meat. Though prenatal serologic screening and treatment has been standard practice in Europe for many years, currently well-designed randomized control trials have not been conducted to evaluate the effectiveness and safety of these prenatal screening [[24](#_ENREF_24)]. Because prevention of congenital toxoplasmosis relies primarily on maternal education and avoidance of risk factors for *T. gondii* during pregnancy, pre-conception and antenatal education on these risk factors is vital [[19](#_ENREF_19)]. Studies have shown that the majority of women are uneducated regarding toxoplasmosis risk and of necessary preventative measures, some reporting up to 73% of participating women lacking adequate education [[25](#_ENREF_25)].

Cats have long been synonymous with toxoplasmosis infections and have previously been considered the main source of these infections [[25](#_ENREF_25)]. However, studies have shown that ingestion of undercooked meat or contaminated food and water instead of cat exposure is the main risk associated with toxoplasmosis infections acquired during pregnancy [[22](#_ENREF_22), [26](#_ENREF_26)]. It should also be noted that alone, cat ownership in general has not been shown to be a risk factor for toxoplasmosis infection rather it was the exposure to sporulated oocysts which pose the greatest risk [[22](#_ENREF_22)].

Though toxoplasmosis is a common zoonotic pathogen in which cats are the definitive hosts there are several preventative measures that immunocompromised or pregnant cat owners can take to ensure their safety. Transmission of *T. gondii* by direct contact with cats is not likely and studies have shown that cats do not have oocysts attached to their fur normally or even when the cat is experiencing diarrhea [[27](#_ENREF_27)]. Furthermore, another study showed that even in cats induced to shed oocysts no oocysts were found on the cat thus supporting the notion that transmission via direct contact with cats in not likely [[9](#_ENREF_9)]. One way to avoid a cat’s exposure to *T. gondii* is by keeping pets inside and avoiding raw food diets since these diets can contain meat with tissue cysts. Cats that are kept inside will not hunt prey that is potential intermediate hosts thereby decreasing their risk to *T. gondii* infection. Cleaning the litter box daily prevents exposure to sporulated oocysts since it takes 1-5 days for the oocysts to become infectious once shed. Immunocompromised or pregnant individuals should attempt to find someone else to clean the litter box. However, if this cannot be achieved they can clean the box themselves but should wear protective equipment such as gloves and mask followed by hand washing. Pregnant women should also take precautions when gardening by wearing gloves and implementing hand washing. The most common route for infection is ingestion of tissue cysts in undercooked meat therefore do not eat raw or under cooked meats [[13](#_ENREF_13)]. The USDA recommends cooking pork, lamb and beef to 145°F; however, studies have shown that cysts can remain viable up to temperature of 147.2°F. Therefore it is recommend to cook meat to 160°F [[13](#_ENREF_13)].

Another zoonotic pathogen of concern is *Bartonella henselae*. *B. henselae* is a curved pleomorphic gram negative bacterium associated with Cat-Scratch Disease (CSD) in people. Roughly 40% of cats have be exposed or are infected with *B. henselae* in their life time [[28](#_ENREF_28)]. Cats infected with *B. henselae* are classically asymptomatic but can remain bacteremic for extended periods of time. It has been shown that *Bartonella spp*. infection is more common in flea-infested cats most likely due to the fleas’ role in *Bartonella spp*. life cycle [[29](#_ENREF_29)]. *B. henselae* is ingested by fleas when having a blood meal on an infected cat. The bacterium replicates within the gut of the flea and then is excreted out within the fleas’ feces. Research has shown that the bacteria can live in flea feces for up to nine days [[30](#_ENREF_30), [31](#_ENREF_31)]. The flea is thought to be responsible for transmission of *Bartonella* from cat to cat however there is no real evidence that the flea can transmit *Bartonella* to people. *Bartonella* infections in people are mainly cause by inoculation of the bacteria into the skin by a cat scratch. Flea excrement containing the bacteria can contaminate the claw during normal grooming. This contamination leads to the ability of the cat to transmit the bacteria via scratching [[32](#_ENREF_32)]. It is unclear on whether or not *Bartonella* can be transmitted through inoculation of saliva from bacteremic cats.

*Bartonella spp*. infection is the most common direct zoonotic pathogen associated with cats [[2](#_ENREF_2)]. It is estimated that up to 80% of cats worldwide, depending on geographic location, have serologic evidence of exposure to *Bartonella* [[30](#_ENREF_30)]. One study indicated that there are approximately 25,000 cases of CSD diagnosed per year in the USA [[2](#_ENREF_2)]. There are several *Bartonella spp*. However cats are the only known reservoir for *B. henselae*, *B. clarridgeiae* and *B. korhlerae* [[33](#_ENREF_33)]. Of these Bartonella spp. *B. henselae* has caused the majority of CSD cases in immunocompetent individuals and bacillary peliosis, or bacillary angiomatosis in immunocompromised people [[34](#_ENREF_34)]. *B. henselae* is transmitted to humans most commonly through contamination of scratches or skin abrasions with flea excrement from infected cats [[30](#_ENREF_30)]. People with CSD present with a variety of clinical signs such as lymphadenopathy, malaise, fever, weight loss, primary skin lesion at the site of inoculation, and conjunctivitis. The disease in immunocompetent people is usually self-limiting however it can take several months for all symptoms to completely resolve [[2](#_ENREF_2)].

Since the primary route of transmission is inoculation of flea dirt via scratches there are several potential precautions that could be taken to decrease the risk of bartonellosis. Since the flea has been shown to be responsible for transmission from cat to cat establishing a good flea control program is vital. If a new cat enters the household with multiple cats all cats should be on a flea prevention program. It is highly recommended that continual flea control be used on all cats including those housed indoors to decrease risk of exposure [[33](#_ENREF_33)]. Kittens pose the highest risk potential and should be treated with a flea control product and flea feces should be removed. Those kittens that are too young for flea products should be bathed and flea dirt removed. In general kittens should be avoided by immunocompromised individuals [[33](#_ENREF_33)]. People should also avoid playing rough with cats and use cat toys to play with their cats versus their hands.

Protocol for preventing *B. henseale* transmission to humans has recently been reviewed. Ongoing vector control is key, as well as avoiding interactions with cats that could result in bite or scratch wounds [[30](#_ENREF_30)]. If this does occur, vigorously wash cat bites and scratches immediately with soap and hot water.  Since it is unknown if *Bartonella* can be spread via saliva, it is not recommended to let your cat lick open wounds.  Keeping cats’ nails trimmed and the use of nail covers are recommended and decrease the potential risk of infection. When acquiring a new pet, be sure that they are in good health and have been ectoparasite-free [[30](#_ENREF_30)].

Yet other potential zoonotic pathogens are several types of Nematodes or round worms. The common nematodes found to be zoonotic and associated with cats are *Toxocara cati*, *Ancylostoma braziliense*, *Ancylostoma tubaeforme* and *Unicinaria stenocephala*. *Toxocara cati* has been associated with human visceral larva migrans (VLM) and ocular larva migrans (OLM) however most cases of VLM and OLM are more commonly associated with its canine counterpart *Toxocara canis* [[35](#_ENREF_35), [36](#_ENREF_36)]. VLM has been shown to be more common in young children and OLM is seen in older kids to young adults [[2](#_ENREF_2)].

Cats, both wild and domestic, are the main host for *Toxocara cati* and are found commonly in kittens and moderately in adult cats. Single cell eggs are passed into the environment from infected hosts. In suitable warm climate conditions the egg will develop to its infectious larval state in about 4 weeks[[2](#_ENREF_2)]. The infectious eggs are environmentally hardy and can live outside the host for months to years[[2](#_ENREF_2)]. There are two main ways which cats become infected with this parasite. They can ingest the larvated egg from the environment or it can be transmitted transmammary from queen to kittens. People become infected by ingestion of the larvated egg. Once the egg is ingested in cats the infectious larvae are released in the gastrointestinal tract where it penetrates the intestinal epithelium and it can either migrate to stomatic tissue or lungs. Within the lungs the larvae is then coughed up and swallowed again and completes its development within the intestine and produces eggs which are passed through feces into the environment. In abnormal hosts such as people *T. cati* migrates to other organs such as the liver, heart, muscle, eyes, lungs and occasionally the brain. The larva stop development within in these tissues; therefore, it does not produce a mature stage and eggs but it can cause a severe local reaction.

Cats can be the definitive hosts for *A. braziliense*, *A. tubaeforme*, and *Uncinaria stenocephala*. These are commonly called hookworms and have been associated with cutaneous larval migrans (CLM). Canines may also be a definitive host for *A. braziliense* and *U. stenocephala* but they have their own hookworm, *A. caninum*. Hookworm infection starts with the passage of segmented oval eggs into the environment within feces of infected hosts. Once in the environment the egg develops over a week into the infectious larval stage. Skin penetration of the infectious larval stage is the most common route of infection. Once in the host migration is dependent upon exposure. If the host has not been exposed to the parasite previously it undergoes skin tracheal migration. In previously exposed hosts it undergoes skin-aortic migration. People can become infected by direct skin contact to the infectious larvae. The infectious larvae can penetrate human skin and cause creeping eruption, the migration of larvae throughout a localized piece of skin. CLM can be painful and extremely pruritic.

For both roundworms and hookworms there are measures that can be taken to prevent accidental infection in humans. Frequent deworming of kittens and routine fecal exams can help reduce the risk of infection [[2](#_ENREF_2)]. Cleaning of the litter box frequently prevents development of infectious larvae. People should practice good hand washing technique after touching contaminated areas or playing with potentially exposed animals. It is important for parents to educate their children about hand washing and the dangers of eating dirt. Another recommendation is to cover children’s sandboxes when not in use and remove any noticeable feces immediately [[2](#_ENREF_2)].

Briefly, cats and people can also be infected by *Dipylidium caninum*, a tapeworm found in both species; however, people do not acquire the infection from the cat but rather from ingestion of a flea which harbors the infectious cysticeroid [[2](#_ENREF_2)]. The cat can be a mechanism in which the infected flea is bought into the human environment and supports the implementation of a continual flea control program.

One viral zoonotic pathogen that can be controlled through proper care and vaccination of animals is rabies. Rabies is a zoonotic disease caused by virus in the genus Lyssavirus [[37](#_ENREF_37)]. Rabies is a progressive fatal neurologic disease and in people may manifest as general weakness, discomfort, headache, and fever. As the disease progresses, cerebral dysfunction, anxiety, confusion and agitation has been seen. In the end stages of rabies infection people have had delusions, insomnia and hallucinations. Throughout 2010 there was 40 cases of human rabies suspected and tested at the Center for Disease Control and Prevention here in US [[37](#_ENREF_37)]. Rabies is a widespread zoonotic disease within the United States and control programs have been established since the 1950s [[38](#_ENREF_38)]. According to a study in 2010, 7.9% of rabid cases were seen in domestic animals, a decrease from the previous year [[37](#_ENREF_37)]. The majority of these cases, 62.2% were rabid cats [[37](#_ENREF_37)]. Cats are highly susceptible to rabies and are commonly infected with the enzootic strain that is generally found in wildlife such as raccoons, skunk, bats, and foxes. The common strains of rabies which infect cats vary depending upon the region of the US. For example, raccoon rabies is more prevalent on the Atlantic Coast whereas in the Midwest skunk rabies is the most common form [[2](#_ENREF_2)]. Of importance there is no feline specific strain of rabies and cats get rabies from other infected wildlife animals [[37](#_ENREF_37)]. Cats can present with the classical furious or dumb rabies but other general clinical signs include: paralysis, lethargy, anorexia, trembling, behavioral changes, and vomiting [[2](#_ENREF_2)]. There is not an effective treatment for rabies in cats [[39](#_ENREF_39)].

Rabies virus is typically found within saliva, central nervous system tissues, and cerebral spinal fluid. It is transmitted via inoculation into wounds or direct contact with mucus membranes. Cats transmit rabies to people mainly by bites. However, there is some speculation that in theory rabies could be transmitted via scratches since cats lick their paws [[2](#_ENREF_2)]. There are strict regulations pertaining to rabies and cat bites. For example, if a cat bites a person, this cat should then be quarantined for 10 days (240 hours) regardless of vaccination status [[2](#_ENREF_2)]. If a pet cat is exposed to a potential rabid animal the number of days in confinement depends on vaccination status.

In humans, rabies is a progressive fatal neurologic disease. The virus has an incubation period of several weeks to months [[40](#_ENREF_40)]. It manifests as general weakness, discomfort, headache, and fever.  As the disease progresses cerebral dysfunction, anxiety, confusion, and agitation are seen.  In its end stages, a rabies infection manifests in an infected individual as delusions, insomnia and hallucinations.  In developing countries, rabies still poses a significant threat to humans [[40](#_ENREF_40)]. Humans bitten by any animal who’s rabies status is unknown should be treated with local wound care and postexposure prophylaxis consisting of vaccination and rabies immunoglobulin [[40](#_ENREF_40)].

Vaccinations can be first administered to cats at 12-16 weeks of age according to the vaccines instructions and then a second vaccination a year later [[39](#_ENREF_39)]. After the second vaccination, annual or tri-annual vaccinations are given based upon the veterinarian’s procedure as well as state and local policies. Though the vaccinations have a high efficacy there has been reports of rabies appearing in vaccinated animals, perhaps due to the incorrect handling of the administered vaccination [[2](#_ENREF_2)]. Rabies vaccinations are considered a core vaccination for cats [[39](#_ENREF_39)]. Cats should be vaccinated regardless if they are indoor only pets since there could be an incident that the cat gets outside or raccoons, bats or other potential rabid animals come inside. There has been reported adverse reactions associated with vaccination such as local pain or swelling, fever, or lethargy as well as granuloma formation [[39](#_ENREF_39)]. One adverse reaction of concern is vaccine-associated sarcomas in cats. Though these sarcomas are rare (l-2/10,000 in vaccinated animals) they are very serious and are of great public concern [[39](#_ENREF_39), [41](#_ENREF_41), [42](#_ENREF_42)]. The exact mechanism that causes these sarcomas is still an area of great debate. One speculation is that vaccine adjuvant-induce inflammation is responsible for the sarcomas development [[43](#_ENREF_43), [44](#_ENREF_44)]. Though there has been other studies showing that there was not an association between adjuvant vaccination and sarcomas it is still recommended that veterinarians use products that are less inflammatory when obtainable [[39](#_ENREF_39)]. Nonetheless, even with these unfavorable reactions rabies vaccination is recommended for all cats due to rabies public health risk.

Additional common zoonotic pathogens are dermatophytes, commonly referred to as “ring worm.” Dermatophytes are fungal pathogens that generally infect non-dividing skin or keratinized tissue. Transmission occurs through direct contact either with a symptomatic or asymptomatic hosts or contact with infected hairs or skin. There are different types of dermatophytes and are categorized based on their reservoirs – animal, humans or soil. All types can live in the environment and are present worldwide. Several dermatophytes are shared between animals and people and the most common one in cats is *Microsporum canis*. Typical clinical signs in animals include pruritus, hair loss, scaling, and crusting [[2](#_ENREF_2)]. Infections are usually self-limiting lasting only a few weeks to months in short-haired cats and conversely in long-haired cats the infection may last longer. Many cats present as asymptomatic carriers [[45](#_ENREF_45)].

In people, *M. canis* infections present with the development of red, raised, pruritic, ring-like lesions are common [[2](#_ENREF_2)]. In immunocompetent individuals this infection is limited to the keratinized part of the skin and is easily treated. However, with immunocompromised people an invasive system infection is plausible [[46](#_ENREF_46)].

Diagnosis in animals can be made using fungal culture, cytology, fluorescence, and dermatophyte test medium (DTM). Only 80% of *M. canis* will fluoresce using a woods lamp and if dermatophytosis is suspected a DTM should be performed [[2](#_ENREF_2)]. Dermatophytosis is treatable in cats using either or both a topical product and systemic drug. Kittens pose the greatest risk to dermatophytosis in people especially if they come from a shelter with an unknown history and have been exposed to multiple cats [[2](#_ENREF_2)]. Since ringworm is found persistently in the environment and is resistant to many everyday disinfectants precautions should be taken to ensure it does not enter a contained environment. For example, a thorough physical exam should be performed when bringing a new cat home or when one enters a shelter. All suspicious lesions should be cultured and the cat should be isolated away from other animals and handled using protective clothing – long sleeves, long pants, and gloves. Surfaces should be cleaned using a diluted bleach mixture (1:10) and contaminated toys and blankets should be discarded [[2](#_ENREF_2)].

There are potential zoonotic diseases to be aware of when owning a pet but with proper knowledge and medical care these diseases can be prevented. Ownership of pets provides many positive benefits to one’s health both mentally and physically and should not be avoided due to the fear of zoonoses. Of importance is the ability of veterinarians and physicians to work together to educate the public of these diseases as well as provide suggestions of preventive measures.

**Relinquishment**

One study in the early 1990s stated that the number one reason for relinquishment in cats was behavioral issues such as inappropriate elimination, aggression and destructive behavior [[47](#_ENREF_47)]. However in a more recent study the number one reason for relinquishment of cats was found to be due to health and personal issues (HPI) [[48](#_ENREF_48)]. A reason for the switch from behavioral to HPI could be due to the advancement in the treatment and understanding of behavioral issues of cats in veterinary medicine. Since the study in the 1990s, there has been much research relating to behavioral issues in cats. For example, in 2005 the American Association of Feline Practitioners (AAFP) published behavioral guideline for practitioners, which had summaries of normal cat behavior and suggestions on treatment of common behavioral problems [[49](#_ENREF_49)]. Though behavioral issues have declined in the reason for relinquishment it has not been eradicated. Another study showed that 28% of animals relinquished were due to behavioral issues and the most common where as follows: inappropriate elimination, aggression towards other pets and people, and destructive behavior [[50](#_ENREF_50)]. Thus, there is still a need for improvement in the field of behavioral medicine. Establishment of a behavioral consultation prior to adoption could be beneficial in reducing future relinquishments. This consultation could be given by a trained individual and would educate new owners on what to expect when taking on the responsibility of owning a cat. This consultation would cover possible behavioral issue that could occur in the following months at home and contact information for a veterinarian could be given for further information. Not only would this help with educating the new owners on what to expect but would also encourage establishing a relationship with a veterinarian.

Currently the number one reason for relinquishment of cats in the United States is HPI, more specifically allergies followed by owner personal problems and lastly a new baby [[48](#_ENREF_48)]. This studied was conducted through surveys and people were allowed to list multiple reasons for relinquishment; however, 48% of the people surveyed listed one reason - allergies. The results of this study support the need for better education concerning animal allergies and pet ownership. People who have never owned a pet should exposed themselves to cats prior to adoption to see if there is an issue of allergies. People should also be informed of strategies that can be taken to lessen exposure to allergens [[51](#_ENREF_51)]. One disturbing finding in this study was that 10% of those that relinquished one cat for allergies had others at home [[48](#_ENREF_48)]. This fact was disturbing because how did owners determine which cat was producing the allergen. In reality all the cats in household could have the potential to produce the allergen. This circumstance leads to the suspicion of bias in the survey. This would be an interesting area of research and a survey could be conducted after relinquishment of an animal occurred due to allergies. This survey would test the owners’ knowledge of allergies and show clinicians areas of education in which they can improve.

An interesting finding is that the majority of the animals surrendered were not neutered and this has been shown to be associated with behavioral problems that lead to relinquishment [[48](#_ENREF_48), [50](#_ENREF_50)]. The point that the majority of animals relinquished were not neutered in combination with HPI ranking the number one reason for relinquishment shows a need for proper education on pet ownership [[48](#_ENREF_48), [50](#_ENREF_50), [52](#_ENREF_52)]. To further support the need for public education studies have been done to test the public’s knowledge on husbandry of cats. Results of such surveys showed significant deficiencies in knowledge regarding normal breeding and behavioral activities of cats [[52](#_ENREF_52)]. This void of knowledge could be the cause of unrealistic expectations of cat ownership and thereby contributes to unsatisfied owners and ultimately relinquishment. One way to improve this lack of knowledge would be for the shelters to partner up with a veterinarian and encourage a visit to the clinic within the first couple of months of new ownership. At this time the veterinarian could neuter the animal and educate the owner on husbandry. In general having this initial contact with the veterinarian could decrease relinquishment by helping prepare owners for the responsibilities of owning a healthy cat and determine realistic expectations.

Several studies have shown that age and length of ownership are risk factors in relinquishment. A large percentage of cats surrendered where acquired at no cost and were given up within 6 months to a year of acquisition at an average age of 1 to 2 years [[48-50](#_ENREF_48), [52](#_ENREF_52)]. Being that the majority of those relinquished were acquired for little to no cost could lead to ease of relinquishment due to no monetary investment. The fact that most relinquishment occurs within 6 months to a year of ownership may show that the human-animal bound plays a role in relinquishment [[53](#_ENREF_53)]. For example giving up an animal early on in the relationship may be due to the fact that there is not an emotional connect between owner and pet thus making relinquishment an easier task. Research has been performed to look for an association between relinquishment and lack of bonding and it was found that almost half the animals relinquished had bonded with their previous owner [[53](#_ENREF_53)]. However this number may vary depending on the cohort used in the study. In the previous study the sample used was taken from those people who listed moving as the reason for relinquishment. The results of such a study may be different if the sample was derived from those relinquishing animals due to a behavioral issues or HPI. Furthermore, even with some degree of bonding the animal was still relinquished due to moving, suggesting that the bond between the owner and pet was not as important as seeking a residence that could accommodate the animal. This evidence demonstrates that the emotional bond that owners have with their animal plays an important role in relinquishment.

Another article examined companion animals who were relinquished by their owner for adoption versus those relinquished for euthanasia [[54](#_ENREF_54)]. There were few differences between owners of the two groups and when looking at the animals the main significant difference was age. For example the average age for cats relinquished for euthanasia was 10 whereas for adoption it was 2 years of age [[54](#_ENREF_54)]. Of those cats being relinquished only 17% were relinquished for euthanasia and of this group 82% were euthanized for either old age and/or illness [[54](#_ENREF_54)]. The other 18% relinquished for euthanasia were due to behavioral issues with inappropriate elimination being the number behavioral cause [[54](#_ENREF_54)]. This advocates the need of better client education and improvement in veterinary medicine pertaining to behavioral issues in cats and supports the need for behavioral consultations at adoption time. Also since older animals were relinquished for euthanasia this may imply that people are using shelters as a low cost alternative to veterinary hospitals when it comes to euthanasia. Research needs to be done to determine why people would choose a shelter versus their veterinarian for euthanasia of their pets; however, some speculations are that veterinary hospitals may not provide a non-judging environment or lower cost options for clients like shelters do.

Some may believe that one cause for cat relinquishments could be due to the economic recession that began in December 2007 in the U.S. The findings of one study out of Chicago showed that the recession had little to no impact on cat relinquishment and relinquishment of cats in 2010 has decreased [[55](#_ENREF_55)]. This study also exhibited that, though relinquishment numbers of cats were not affected by the recession, adoption numbers have decreased and are slow to rise back to the original starting point [[55](#_ENREF_55)]. Intuitively, the decrease in adoptions makes sense because during the recession finances were not optimal therefore the cost of another animal was not considered as an option and adoptions decreased. Now that the U.S. economy is recovering encouraging adoptions is one way to decrease the number of animals in shelters as well as decrease euthanasia in the shelter environment. Along with the push for adoptions there is also a need for corresponding owner education. People should be educated on the responsibility of being a cat owner. This should include, but not be limited to, knowledge of normal cat behavior and health as well as cost of maintaining a healthy cat. The goal of this education is to not only increase shelter adoptions but also to reduce the risk of relinquishment.

**Feline Medicine**

According to the Phase III portion of the Bayer Veterinary Care Usage Study conducted in 2012, there are approximately 74.1 million cats in homes and 45% of them did not visit their veterinarian in the last year. Currently many cat owners believe that cats don’t need medical care unless they are exhibiting signs of illness [[6](#_ENREF_6)]. Cats are very resilient and do not display obvious signs of illness therefore by the time a cat is expressing symptoms that are recognized by the owner the cat is often very ill. Veterinarians need to educate owners on subtle signs of illness and this can be done at the time of the cat’s yearly wellness exam. The goals of routine examinations are to detect early signs of disease which then can be managed thereby improving the length and quality of life for the cat.

The AAFP recommends a minimum of an annual wellness examination for all cats however some veterinarians recommend bi-annual exams for all life stages. It is strongly recommended that senior and geriatric cats receive at least bi-annual exams and this may vary depending on medical or behavioral conditions [[56](#_ENREF_56)]. The reasoning for bi-annual exams in even health adult cats is that health status of a cat can change in a short period of time. Remember, cats age differently than people. For example, in the early stages of development a cat ages quickly and then in its adult life one year in a cat’s life is equivalent to four human years. Therefore, a 2 year old cat is really 24 years of age in human years and when its 3 years old it is equivalent to 28 in human years [[56](#_ENREF_56)]. Therefore it ages 4 years in one year and a lot can happen health wise in 4 years. Thus bi-annual or at least annual exams are important in early detection and prevention of disease throughout the cat’s life. A standard for the number of exams for a certain age group should be consistent and decided within the practice [[6](#_ENREF_6)]. The most important thing is that there is consistency within a practice, without it the owner can become confused and less convinced of the importance of an annual exam.

Another way to improve the routine exam in a practice is to develop a checklist of what is to be covered in a routine exam and assign roles to discuss certain aspects [[6](#_ENREF_6)]. For example, the technician can explain the importance of heartworm and flea prevention and promote its use. The staff needs to be educated on the standards and importance of certain aspects of the routine exam so they can explain things to clients when asked. Having a staff that is confident to talk about the wellbeing of the pet allows clients to feel like they are in a place that understands their animals, which is important in feline medicine. One important job of the veterinarian is to explain what they are doing during a physical exam and why they are doing it [[6](#_ENREF_6)]. This can be achieved by doing the physical exam in front of the client and using equipment and/or techniques that they are familiar with; things that are used at their own doctors office. For example, some feline clinics use an electrocardiogram (EKG) machine as a routine part of their annual exam. This is a procedure that most people have done as part of their own yearly exam so they can connect to what you are doing and relate to their pet’s exam. Being able to relate to what is going on with their pet will help owners understand the importance of their pet’s wellness exam. The EKG is important and can be used in combination with other aspects of the exam to asset the health of the patient’s heart. More importantly performing such tasks in front of the owner provides a way to show the client that their money is being well spent and that the wellbeing of their cat is your top priority. Appropriate client involvement and thorough communications in terms that the client understands builds a client-patient relationship and provides a means to educate the client on the importance of the physical exam. Overall, providing a good physical exam on a patient shows how this exam can lead to early disease detection and prevention of illness.

Another tool that can be used to educate clients on the importance of a routine exam is with the use of the internet [[6](#_ENREF_6)]. Most clinics have their own website and should provide reliable sources for owner education. These sources should be interesting, interactive and educational and one way to achieve this may be through the use of infographics, an interactive online chart. An example of this is the website: <http://visual.ly/pets-and-vets-importance-regular-veterinary-care-your-furry-friend>. This is an example of an interactive educational website which allows people to look at the components of the routine physical exam in an interactive way.

As stated above one reason people choose not to take their cat to the veterinarian is the stress of transportation and the stress of the visit on the cat. Veterinarians should educate kitten owners the importance of exposing the kitten to the carrier and traveling at an early age. Owners can leave the carrier out at home and make it a place that the cat can go to relax, play, or eat; making the carrier a positive environment [[49](#_ENREF_49), [56](#_ENREF_56)]. Periodic car rides in the carrier along with positive reinforcement such as treats or going to positive places should be encouraged if the cat tolerates the car well and does not get car sick or overly stressed. For those cats that get motion sickness withholding food prior to travel may prevent sickness [[56](#_ENREF_56)]. Having the cat fasted can also be beneficial if any blood work needs to be done during the examination and could prevent boarding at the clinic or another visit the next day. To help reduce the anxiety of traveling in the kennel, placement of familiar smells such as the owner’s clothing or the cat’s favorite blanket or bed can be used[[56](#_ENREF_56)]. There has also been research done on the effects of synthetic pheromone on anxiety in cats. Studies have shown that the use of synthetic pheromones, which mimic the cat’s own facial pheromones, can aide in reducing anxiety associated with an unfamiliar environment [[57](#_ENREF_57)]. Therefore to help the cat feel more comfortable in the kennel synthetic pheromones may also be applied. During transport the cat may feel more secure if the kennel is covered with a blanket or towel.

Upon arrival at the clinic there are several things a veterinarian can do to reduce the stress of being at the practice. The following are a few suggestions on how to improve a clinic and make it a more cat friendly environment. Starting with the waiting room the décor should include cats and educational and leisure reading material pertaining to cats should be readily available. This will provide the owners with feeling that this place enjoys cats and takes their health just as seriously as they do. Ideally providing a separate waiting room for feline patients is recommended; however, if this cannot be provided, immediate placement into an exam room is an equivalent option [[56](#_ENREF_56), [58](#_ENREF_58)]. It is beneficial to have at least one exam room used exclusively for cats. These exam rooms can be catered to cats by the addition of things to climb, perch, and hide on or within [[58](#_ENREF_58)]. Cushioning on the exam table can be accomplished by the use of a towel that later can be used in the handling of the animal [[58](#_ENREF_58)]. The use of pheromones can be used in both the waiting room and the feline exclusive exam room. The room should be relatively quiet and time should be given to the cat to acclimate to the new environment [[56](#_ENREF_56)]. Opening the door to the kennel or removing the top of it while the technician is taking the patient history can be one way to allow the cat to adapt to the new surroundings. It is important that technicians are trained in the proper handling of cats [[58](#_ENREF_58)]. They should exhibit confidence when handling the feline patients without being rough. The towel is the technician’s and the cat’s best friend during an exam. The towel can be used to allow the cat to hide providing safety or can be used to restrain a cat during an examination – avoid scruffing and use the “kitty burrito” technique with a towel. The veterinarian needs to be flexible in the location of the exam, for example, leaving the cat in the bottom of its kennel or in a bed can help the patient feel more comfortable [[56](#_ENREF_56)]. A good physical exam can be performed regardless of the patient’s location and the comfort of the patient should be considered. Avoid mixing of feline and canine patients within the clinic [[56](#_ENREF_56)]. This includes in the treatment, hospitalization, and boarding areas. If possible the two should be housed in separate areas to reduce anxiety and stress in both species.

These are some suggestions to decrease the stress involved in visiting the veterinarian for both the client and the cat. As mentioned previously the Bayer Veterinary Care Usage Study III has shown that on average a cat owner spends $122 dollars a year for veterinary medical services which is close to $5,000 dollars in the cat’s lifetime. Though veterinarians realize that increasing the amount of cats seen in the office is a win-win situation for the patients and the hospital, the Bayer study found that 35% of veterinary hospitals and clinics have not implemented any changes to provide a more cat-welcoming environment.

**Future Research and Recommendations**

As previously stated areas of continual research pertain mainly to the subject of relinquishment. They include but are not limited to the effects of a behavioral consultation prior to adoption on relinquishment and in general a closer look at those cats that were relinquished due to behavioral issues. In particular were advice and recommendations sought from a veterinarian? Would the establishment of a consultation prior to relinquishment in cases of behavior issues decrease relinquishment of those cats? This consultation could possibly identify the possible causes of the behavior and result in a referral to a veterinarian or behavioral specialist for treatment. It would also be interesting to test the client’s knowledge concerning allergies when people relinquish cats due to allergies. This could provide clinicians with the ability to know if better client education is needed. Another concerning fact is a high number of people use shelters as a means of euthanasia. Further investigation is warranted to determine why people choose a shelter for this process versus their veterinarian.

Another subject that this paper alludes to is the importance of regular veterinary visits. As discussed throughout the zoonotic section a healthy pet can prevent human illness. It is important to have your cat vaccinated and examined for internal and external parasites during regularly scheduled visits to the veterinarian. Remember cats age differently than humans and on average one year of a cat’s life is equal to four human years. In one year of a cat’s life a lot can happen. It is important to realize that though cats are resilient and hide illness well, diseases can be prevented through annual exams. Within the “Feline Medicine” section of the paper there are several suggestions for clinicians on how to make their practice more feline friendly. Also examined were techniques to reduce the stress of the feline patient in travel to the clinic and at the clinic. Though there have been studies that have shown that most veterinarians consider themselves to be dog people there has been little research on why. Knowing why veterinarians prefer dogs to cats may give insight on how this trend could be reversed in the future. One thing for veterinary medicine practice owners to consider is that even though you may not be a cat person there are clinicians out there that are and having a member of your team that enjoys feline medicine can be an easy way to increase your feline clientele.

Cats possess qualities which make then an attractive pet that set them apart from other companion animals. After talking to a variety of people that own just cats the following reasons were determine to be qualities that make cats great pets. Cats are considered low maintenance and require less up-keep then dogs. Just because a cat is reflected as low maintenance does not mean it is less affectionate; however, it does make cats a more appealing as a pet to those individuals that spend less time at home. Also because they are smaller and more independent they do not always require boarding during short out of town trips thus making them a great pet for those owners. Since they are much smaller than your average dog they take up less space in a home and the cost of care on average is less. A cat eats less food than a large dog and, generally speaking, the veterinary medical costs can be less compared to a dog - all due to size. Due to their small size cats make a wonderful addition to apartment life and do not require a large backyard to play in. As discussed in other appendices owning a cat has health benefits and has been shown to decrease depression and improve mental health. For some people owning a pet like a cat provides them with a sense of responsibility and companionship all things that help improve a person’s self-worth. Perhaps the most unique quality a cat has that set sets them apart from other companion animals is their ability to purr. This for many people is relaxing and comforting and is something only a cat has the capability to give. These reasons support the notion that cats make magnificent pets and are special in their own way.

**References:**

1. Olson, P.N. and C. Moulton, *Pet (dog and cat) overpopulation in the United States.* J Reprod Fertil Suppl, 1993. **47**: p. 433-8.

2. Tuzio, *Feline zoonoses guidelines from the American Association of Feline Practitioners.* Journal of feline medicine and surgery, 2005. **7**(4): p. 243-274.

3. Olson, P.N., et al., *Pet overpopulation: a challenge for companion animal veterinarians in the 1990s.* J Am Vet Med Assoc, 1991. **198**(7): p. 1151-2.

4. Rollin, B.E., *Social ethics, veterinary medicine, and the pet overpopulation problem.* J Am Vet Med Assoc, 1991. **198**(7): p. 1153-6.

5. Felsted, K., DVM, CPA, CVPM,MS and John Volk, *Why cats hate your veterinary practice—and how to win back their love*, in *Veterianry Economics*2011, Advastar.

6. Felsted, K., DVM, CPA, CVPM,MS and John Volk, *Why clients are skipping your exam room.* Veterinary Economic, 2011.

7. Dubey, J.P. and J.K. Frenkel, *Cyst-induced toxoplasmosis in cats.* J Protozool, 1972. **19**(1): p. 155-77.

8. Dubey, J.P., *Reshedding of Toxoplasma oocysts by chronically infected cats.* Nature, 1976. **262**(5565): p. 213-4.

9. Dubey, J.P., *Duration of immunity to shedding of Toxoplasma gondii oocysts by cats.* J Parasitol, 1995. **81**(3): p. 410-5.

10. M, K.F.a.W., *Congential toxoplasmosis*, in *Pediatric Neurology: Handbook of Clinical Neurology*, D.O.L.a.S. HB, Editor. 2013, Elsevier: London. p. 1099-1102.

11. Jones, J.L., et al., *Congenital toxoplasmosis: a review.* Obstet Gynecol Surv, 2001. **56**(5): p. 296-305.

12. Bowie, W.R., et al., *Outbreak of toxoplasmosis associated with municipal drinking water. The BC Toxoplasma Investigation Team.* Lancet, 1997. **350**(9072): p. 173-7.

13. Jones, J.L. and J.P. Dubey, *Foodborne toxoplasmosis.* Clin Infect Dis, 2012. **55**(6): p. 845-51.

14. Dubey, J.P., et al., *Prevalence of viable Toxoplasma gondii in beef, chicken, and pork from retail meat stores in the United States: risk assessment to consumers.* J Parasitol, 2005. **91**(5): p. 1082-93.

15. Jiang, W., et al., *An agent-based model for the transmission dynamics of Toxoplasma gondii.* J Theor Biol, 2012. **293**: p. 15-26.

16. Montoya, J.G. and O. Liesenfeld, *Toxoplasmosis.* Lancet, 2004. **363**(9425): p. 1965-76.

17. Jones, J.L., et al., *Surveillance for AIDS-defining opportunistic illnesses, 1992-1997.* MMWR CDC Surveill Summ, 1999. **48**(2): p. 1-22.

18. Wong, S.Y. and J.S. Remington, *Biology of Toxoplasma gondii.* AIDS, 1993. **7**(3): p. 299-316.

19. Di Mario, S., et al., *Prenatal education for congenital toxoplasmosis.* Cochrane Database Syst Rev, 2009(1): p. CD006171.

20. Carter, A.O. and J.W. Frank, *Congenital toxoplasmosis: epidemiologic features and control.* CMAJ, 1986. **135**(6): p. 618-23.

21. Wilson, C.B., et al., *Development of adverse sequelae in children born with subclinical congenital Toxoplasma infection.* Pediatrics, 1980. **66**(5): p. 767-74.

22. Cook, A.J., et al., *Sources of toxoplasma infection in pregnant women: European multicentre case-control study. European Research Network on Congenital Toxoplasmosis.* BMJ, 2000. **321**(7254): p. 142-7.

23. Linn, E.S., *Prenatal Toxoplasma gondii.* Clin Infect Dis, 2011. **53**(11): p. 1090-1.

24. SYROCOT, *Effectiveness of prenatal treatment for congential toxoplasmosis: a meta-analysis of individual patients' data*. Vol. 369. 2007: Lancet.

25. Ferguson, W., et al., *Lack of awareness of risk factors for primary toxoplasmosis in pregnancy.* Ir J Med Sci, 2011. **180**(4): p. 807-11.

26. Montoya, J.G. and J.S. Remington, *Management of Toxoplasma gondii infection during pregnancy.* Clin Infect Dis, 2008. **47**(4): p. 554-66.

27. Dubey, J.P., *Toxoplasmosis.* J Am Vet Med Assoc, 1994. **205**(11): p. 1593-8.

28. Chomel, B.B., et al., *Bartonella henselae prevalence in domestic cats in California: risk factors and association between bacteremia and antibody titers.* J Clin Microbiol, 1995. **33**(9): p. 2445-50.

29. Foley, J.E., et al., *Seroprevalence of Bartonella henselae in cattery cats: association with cattery hygiene and flea infestation.* Vet Q, 1998. **20**(1): p. 1-5.

30. Finkelstein, J.L., et al., *Studies on the growth of Bartonella henselae in the cat flea (Siphonaptera: Pulicidae).* J Med Entomol, 2002. **39**(6): p. 915-9.

31. Higgins, J.A., et al., *Acquisition of the cat scratch disease agent Bartonella henselae by cat fleas (Siphonaptera:Pulicidae).* J Med Entomol, 1996. **33**(3): p. 490-5.

32. Foil, L., et al., *Experimental infection of domestic cats with Bartonella henselae by inoculation of Ctenocephalides felis (Siphonaptera: Pulicidae) feces.* J Med Entomol, 1998. **35**(5): p. 625-8.

33. Brunt, *American Association of Feline Practitioners 2006 panel report on diagnosis, treatment, and prevention of Bartonella spp. infections.* Journal of feline medicine and surgery, 2006. **8**(4): p. 213-226.

34. Boulouis, H.J., et al., *Factors associated with the rapid emergence of zoonotic Bartonella infections.* Vet Res, 2005. **36**(3): p. 383-410.

35. Fisher, M., *Toxocara cati: an underestimated zoonotic agent.* Trends Parasitol, 2003. **19**(4): p. 167-70.

36. Overgaauw, P.A., *Aspects of Toxocara epidemiology: toxocarosis in dogs and cats.* Crit Rev Microbiol, 1997. **23**(3): p. 233-51.

37. Blanton, *Rabies surveillance in the United States during 2010.* Journal of the American Veterinary Medical Association, 2011. **239**(6): p. 773-783.

38. Gerhold, R.W. and D.A. Jessup, *Zoonotic diseases associated with free-roaming cats.* Zoonoses Public Health, 2013. **60**(3): p. 189-95.

39. Richards, *The 2006 American Association of feline practitioners: feline vaccine advisory panel report.* Journal of the American Veterinary Medical Association, 2006. **229**(9): p. 1405-1441.

40. Oehler, R.L., et al., *Bite-related and septic syndromes caused by cats and dogs.* Lancet Infect Dis, 2009. **9**(7): p. 439-47.

41. Kass, P.H., et al., *Epidemiologic evidence for a causal relation between vaccination and fibrosarcoma tumorigenesis in cats.* J Am Vet Med Assoc, 1993. **203**(3): p. 396-405.

42. Esplin, D.G., et al., *Postvaccination sarcomas in cats.* J Am Vet Med Assoc, 1993. **202**(8): p. 1245-7.

43. Hendrick, M.J., *Feline vaccine-associated sarcomas: current studies on pathogenesis.* J Am Vet Med Assoc, 1998. **213**(10): p. 1425-6.

44. Jelinek, F., *Postinflammatory sarcoma in cats.* Exp Toxicol Pathol, 2003. **55**(2-3): p. 167-72.

45. Romano, C., L. Valenti, and R. Barbara, *Dermatophytes isolated from asymptomatic stray cats.* Mycoses, 1997. **40**(11-12): p. 471-2.

46. King, D., et al., *Primary invasive cutaneous Microsporum canis infections in immunocompromised patients.* J Clin Microbiol, 1996. **34**(2): p. 460-2.

47. Patronek, G.J., et al., *Risk factors for relinquishment of cats to an animal shelter.* J Am Vet Med Assoc, 1996. **209**(3): p. 582-8.

48. Scarlett, J.M., et al., *Reasons for relinquishment of companion animals in U.S. animal shelters: selected health and personal issues.* J Appl Anim Welf Sci, 1999. **2**(1): p. 41-57.

49. Overall, K.L., et al., *Feline behavior guidelines from the American Association of Feline Practitioners.* J Am Vet Med Assoc, 2005. **227**(1): p. 70-84.

50. Salman, *Behavioral reasons for relinquishment of dogs and cats to 12 shelters.* Journal of applied animal welfare science, 2000. **3**(2): p. 93-106.

51. Morris, D.O., *Human allergy to environmental pet danders: a public health perspective.* Vet Dermatol, 2010. **21**(5): p. 441-9.

52. New, *Characteristics of shelter-relinquished animals and their owners compared with animals and their owners in U.S. pet-owning households.* Journal of applied animal welfare science, 2000. **3**(3): p. 179-201.

53. Shore, E.R., C.L. Petersen, and D.K. Douglas, *Moving as a reason for pet relinquishment: a closer look.* J Appl Anim Welf Sci, 2003. **6**(1): p. 39-52.

54. Kass, *Understanding animal companion surplus in the United States: relinquishment of nonadoptables to animal shelters for euthanasia.* Journal of applied animal welfare science, 2001. **4**(4): p. 237-248.

55. Weng, H.Y. and L.A. Hart, *Impact of the economic recession on companion animal relinquishment, adoption, and euthanasia: a Chicago animal shelter's experience.* J Appl Anim Welf Sci, 2012. **15**(1): p. 80-90.

56. Buffington, *AAFP-AAHA feline life stage guidelines AAHA Long Beach 2010 Proceedings, 18-21 March, 2010. Scientific, management and technician programs*. 2010. 197-200.

57. Pageat, *Current research in canine and feline pheromones.* The Veterinary clinics of North America. Small animal practice, 2003. **33**(2): p. 187-211.

58. Gavezer, K.M., CVPM, *Become cat confidential*, in *DVM360 Magazine*2011, Advanstar.

**Psychology Research**

**Abstract**

The purpose of this research is to seek to understand why there has been a decrease in numbers of cats in households through the psychological perspective. The aspects explored and identified were the cat owners’ personalities, the differences in cat and dog people, and solutions to common behavioral problems using behavioral medicine. The findings suggest that if a cat has a similar personality to their owner, the stronger the human-animal bond will be. Also, it seems the more time the prospective adopter has spent on anticipating and preparing to adopt a cat, the less likely that cat will be relinquished. As well, if the adopter receives a class session on behavioral medicine, learns important responsibilities regarding the cat, and agrees to take the cat to the veterinarian within a short period of time before the adopter leaves the shelter with the cat, the retention rate increases. The findings will allow for reconstructing designs for advertising, cat adoption procedures, and the perception of cat ownership.

**The Question**

When asking the question, “what makes people keep pets 20+ years despite behavior issues, while others will return their pets just months after adoption,” the task is really seeking to understand each individual thoughts, their intentions, and motives and why that same situation drives people into different responses. Going further into understanding the “self,” the self-one’s subjective perception of the social world and where one belongs within that realityf is always changing, as one’s processing perception is constantly changing through new experiences. Self-definition is part of the on-going process of evaluation the intentions of other people that person comes in contact with. Many people would agree that there is an obvious perceived distinction between personality traits among cats and dogs, and that it is likely that people will associate these characteristics to their owner’s personalities, as well. Socially, this automatic association could either be a good thing or a bad thing depending on the individual’s opinions regarding the perceived traits of the animals those people own. There is no way to make a person’s perception change about anything, let alone make them change their negative or positive thoughts about cats. The person must want to, chose to, or allow themselves to change their ideals- it cannot be forced upon them. But keep this in mind, people who do not know what they believe is incorrect, will never change their beliefs. In other words, people will not avoid doing something that is wrong if they are not informed that it is wrong in the first place.

Psychologically, people are inept to make judgments. It is ingrained in our instincts. Sometimes, we make them without even realizing we made them until after the fact. There was a Princeton University study performed by psychologist Alex Todorov that found that people will rapidly pass judgment according to a person’s facial features so fast that our conscious mind may not even have enough time to influence our immediate judgments [2]. These judgments come as a byproduct of people's ability to learn social dynamics through different aspects of socialization. This ability to pass instant judgment using small traits as cues only grows stronger as an individual is exposed to more and more similar circumstances. If exposed to enough social stimuli, an individual will start creating their own mental associations. Common traits that dog and cat people share can start to become evident to an individual as they are exposed to more and more dog and cat owners. Overtime individuals will start to associate certain common traits that most dog and cat owners have by their preference in pets. People can pass the same quick judgment by observing a stranger’s face as they can just by knowing what species of a pet a person owns. Surely, knowing a stranger’s preference in a pet will lead to more inferences about the stranger; which again, a person could determine that to be a positive or negative aspect of that stranger.

This leads into the subject of stereotypes. Stereotypes are cognitive judgments made about the characteristics of psychologically grouped individuals. Stereotyping is a result of the human’s evolutionary ability to predict actions and feelings of others. These judgments and assumptions may be based on some truth but most likely does not reflect the entire group of individuals of which one is predicting. It is highly unlikely that all assumptions made up from one single fact or observation on the group will be the reality for all members of the group. Stereotyping can lead to prejudice, which then can lead to discrimination. These acts occur in such a way that first it is the negative beliefs then it is the emotional reaction because of the beliefs. It also is the act of keeping individuals from a group from succeeding in aspects of life because of one’s assumptions. In order to change feelings towards a group, one must change their thinking, as thinking leads to feeling emotions. If one exhibits this process enough it could possibly become second nature, which will be harder to overcome, but it is not impossible.

Peers sharing common views also strengthen these associative judgments. For example, there could only be a few people who honestly do not like cats because, let’s say, from some horrific event. Then their contagious negative attitude surrounding cats passes along to their friends and family, making the group of people who do not like cats much larger than it should be. People tend to side with their friends and family whether they believe what they say is true or not, and whether they are correct or not. Imagine, a little boy pushes a little girl and she starts crying, and the little boy said to his mom that the little girl hit him first. Then the boy’s family is mad at the little girl, when neither what he said was true nor was he right to push her. Now, let’s project a similar plot with a human and a cat. A person who just adopted a cat does not know much about cat behavior since he has never even read book on it before and the human starts to rub the belly of his new cat vigorously and suddenly the cat latches on and starts to scratch his arm. The man is now mad at the cat with the thought that the cat attacked him for no reason and hurt his arm, so he now does not like cats. The reality of this situation is that the cat felt that the human was being too rough and it was in the cat’s instinct to defend itself in that way. Also, this situation could have been spared if the owner would read more about cat behavior and understand why cats react and behave the way they do.

**Cat v. Dog Owners**

Cat owners typically have a personality that is different than that of a dog owner. Many people claim that cats that have a similar personality to their owners are more likely to be retained and to be considered a better-fit companion than cats that do not have similar personalities to their owners. Many owners are different from one another but finding a cat that has similar personality to each unique individual is the key. The initial goal is to understand the personality of most cat owners and recognize how they could be similar to the personality of cats.

A study using the Eysenck Personality Inventory Extraversion Scale concluded that the cat owner’s personality tends to be more introverted. Introverted personalities typically like some alone time to think deeply and recharge themselves after spending time socializing with people and they like to introspect and analyze their thoughts and feelings to be more in-tune with their mind rather than the external atmosphere around them [1]. This type of personality likes to philosophize about things not easily fit for small talk, so after a few hours being surrounded by people they like to gain back their energy that was spent on mingling by relaxing and thinking by themselves [1]. This by no way means that introverts are asocial or sad, but socializing is a very tiring task to them [1]. This may be viewed as energy consuming because such activities keep them from doing what they are most comfortable with such as thinking [1]. Owners of cats are noted to be more self-assured and more confident than dog owners [5]. This may be because of the time introverts spend reflecting on themselves. They have learned to understand their feelings and motives and stay true to what they believe. Also, according this personality scales, females are more likely than males to be the primary caregiver of cats [7, 14]. There are more female cat owners than male cat owners in the United States [14]. This can be assumed to be the case because females ranked dogs lower in preference and ranked cats higher in preference [7]. With that being said, females see the probability of owning cats more likely than seeing themselves owning dogs [7]. Why could this be the case? Well, we can hypothesize that this reverts back to the traditional stereotypical sex roles of American society of the housewife and working husband where the housewife stays at home, cooks, cleans, and takes care of the children and pets and the husband works from nine to five, comes home and relaxes but also is the provider of money for the family. These sex roles are no longer as prevalent as they once were. Society is changing, and we can use it advantage if we recognize the trends now.

According to another study, performed on Self-identified “dog people” and “cat people,” there are, in fact, differences in the sexes and personality traits in the rates of the ownership of cats and dogs [9]. Self-identified dog people score higher on extraversion, agreeableness, conscientiousness, and lower on neuroticism and openness than self-identified cat people, according to the Big Five personality scale [9]. Stereotypes regarding these differences are usually formed on extended ignorant assumptions such as assuming that being less extroverted is a negative thing, which then may make a person think, “Since cat people are less extroverted that must be bad.” This is not the case since being introverted has its pluses, as well. To name a few, introverts are very smart and they pay attention to and come up with things that an extrovert typically does not while thinking deeply through the process which then yields high quality mental input. Jane Collingwood from Psych Central makes the point that, “while it’s true that extroverts get their energy from relating to other people, that doesn’t necessarily make them good company. Nor are they always the best people at delivering messages — although viewed as natural communicators, if they are always on “send,” others can struggle to “receive” the message and get a word in [3].” There are positive and negative personality traits of both “cat people” and “dog people.” Neither one type of animal nor personality is better than the other. 57.3% of people self-identify himself or herself as either only a cat or only a dog person, but the majority considers themselves dog people [9]. There were 45.7% of the people in the study that call themselves dog people, whereas 11.5% call themselves cat people [9]. It is important that we recognize that one animal, the dog, is preferred over the other more frequently in the United States. Also mentioned in the study of self-identified cat or dog people, is that there are no differences between male or female personality traits of either the cat people or the dog people. The only differences in personality traits are that of self-identified “cat people” versus self-identified “dog people [9].”

In a nutshell, cat owners also tend to be more opinionated and independent. Introverted people happen to make up “sixty percent of the gifted [or highly intelligent] population [1].” A cat owner typically is a well-read and articulate person [11]. They are people that pamper themselves and enjoy their own, unique personality [11]. Another fact about cat owners is that they tend to have choosy and exotic tastes and tend to have non-conforming opinions [11]. Unlike dog owners, they are mostly indoor people with a less rigid approach to life and adjust well to changes [11]. There are many similarities between cat owners and their feline companions; however, the indoor personality trait of owners and the love for the outdoors personality trait of cats are statistically unalike [11]. Most cats tend to enjoy the outdoors, as an expression of instincts, whereas the cat owners would much rather enjoy their time inside [11]. Many cat owners can view the cat’s outdoor necessity as an issue when trying to house their pet. This will be covered more in depth when I explain the many reasons for relinquishment, this being one of them.

When trying to make dog people like cats more, it is important to show that cats can offer similar attributes that make dogs so attractive. For example, a reason why people may choose to own a dog, rather than a cat, is for safety. Contrary to what dog people would assume, 44% of cat owners attain a sense of safety from their cat [8]. For whatever reason that makes cat owners feel safe by having a cat in their house, is more likely than not, the same reasons that a dog owner feels safe by having a dog in their house. Another reason said many times by a dog person may choose a dog over a cat would be that they are more empathetic to people’s emotions. We cannot read any animal’s mind and it may not be that dogs are any more empathic and listen better than cats; however, it may actually be the individual’s perception towards the dog’s or cat’s responses. Many cats carry mutation in their genes which decreases their ability to hear well; therefore some cats might very well not “listen” well because they actually cannot hear. This “knowing” that one animal is more empathic than another just may be created in one’s anthropomorphic perceptions.

**Behavioral Medicine and Cats in Shelters**

“Every year, some 7-8 million animals end up in our nation’s shelters, which struggle valiantly to provide life-saving services to them. Nearly 4 million are euthanized. Now, new research published by AHA indicates that hundreds of thousands of animals who manage to get adopted from the nation’s shelters are no longer in their homes six months later [10].” The number one reason originally was because of the “owner’s circumstance” and the second and further times were returned due to behavioral issues [3]. This could be due to the instinctual nature and how they become naturally more independent which may be perceived as behavioral issues. This could also be because of being placed next to many other cats which makes the cat revert back to the need to mark and defend their territory. Cats do not like to be constrained in a cage while being exposed to the many smells of other cats and animals such as when they are in shelters. Cats are very sensitive to sounds and smells and they can associate the negative experiences at the shelters with cages, cars, and veterinarians. This can be viewed as a misbehaving cat but in reality they have just been through some traumatic experiences.

Cats, just as humans, are very unique and they show their affection and personalities in many different ways. Because cats may show their affection differently than a dog does, some people may tend to favor dogs over cats for their long-term pets. This is not meaning that one animal is actually better than the other; it may just be a person is more accustomed to that style of affection and personality. Not to mention, the cat has a notorious reputation of being a non-loving, bad behaving, aggressive pet. This behavior is not true for all cats, but it is prevalent in some and is made known through all types of media. All too often what we consider to be destructive or inappropriate is natural behavior to the cat. Cats do not know that these behaviors are “bad” unless we tell them through some fashion of operant and/or classical conditioning. If we offer alternatives and convey the correction consistently, the cat will learn. Cats will learn that if they do something and they get a response that they don’t want then they will soon stop doing that behavior. Whereas if they did another behavior, and we give them praise and treats, they will learn that it is a good behavior and they will want to do it more often. Prevention is best but sometimes we have to teach the cat that the undesirable behavior is bad after it already has been performed.

A cat that is said to be preferred is an active, curious, and calm natured cat. A cat that is difficult to live with is a one that has behavioral issues, hates cats, and most people [6]. Cats have different personality types, as do humans. People wishing to own a cat should seek to learn and perform some research about the different personality traits related to different breeds, coat color, and other traits. Temperament testing can be a simple test that allows you to learn a little more about the personality of the cat you’re interested in. Someone who learns about how to look for the desired temperament in their cat is going to be able to make a more confident and educated selection and thus will be happier in the long run. Using an aptitude test geared towards kittens and cats will yield the best results. According to Thomas and Chess, temperament testing can be performed on the following nine areas: activity level, rhythmicity, approach- withdrawal, adaptability, persistence- attention span, intensity of reaction, distractibility, threshold of responsiveness, and quality of mood [12]. If adopting a cat from a shelter it is important to consider the fact that there are a lot of stimuli that can affect the testing.

There are many reasons why people adopt pets and there are many reasons why people do not want to keep pets as well. With education we are able to lessen the return rate and better the chances of increasing the number of cats in households. Having people understand that adopting or buying a pet means a lifetime commitment may make people a little more cautious on their decisions and more apt to seek out information on the process.

Some people adopt animals that do not have known behavioral issues. Some people who adopt animals with behavioral issues were not aware of the issues. And rarely, some people adopt animals that knowingly have behavioral issues. I believe the case we are exploring is the case where someone adopts and animal that happens to have behavioral issues without the knowledge thereof. In this event, people can either choose to keep or return the pet. Assuming all other variables held constant in my assumptions, people who retain the animal believe that they can either deal with or fix the issues; whereas, a person who returns the animal cannot or do not want to do either. What we can do to help people feel that they can control and eliminate the behavioral issues is to educate them. Education on cats’ behavior and personality will help us understand them more, which will create a stronger bond and a better liking nationally.

One of the reasons a person may no longer want their cat is because of its destructive behavior. Destructive behaviors such as scratching on furniture are not desirable so it is our job to communicate to the cat that scratching furniture is bad and that we want them to stop. The best way to avoid this behavior is to buy a scratching post. The scratching post will steer them away from destroying the furniture and allow them to scratch on the designated area. Scratching posts only work if the cat chooses to use it. A way to make the cat more interested is by infusing it with catnip. Cats prefer padded areas, unvarnished wood, and carpet like surfaces for scratching. Making sure the scratching post is similar to those materials, and unlike the materials they avoid, may also increase the probability of using the scratching post. It is important to try to have the post as similar to that piece of furniture as possible. Similarities such as incline, height, and material are going to attract the cat. Cats like elevated areas, so by purchasing an elevated scratch post the owner can satisfy both of the want to perch and scratch with one item. Frequent nail trimmings to help skew damages can also lessen this issue. Scratching may also be done out of boredom or by trying to get attention. Providing the cat with play time and plenty of attention will help provide the cat with daily mental stimulation from the owner and not my destroying things. It is sometimes hard to tell if the scratching is from a territorial or another motive but it is good to know that territorial motives are in place when they’re in a new location, in a house with multiple cats, and in the same location with other cats. If the cat has already caused damages, be sure to sand down and cover up surfaces, as they may be supportive of the cat’s behaviors and increase the likeliness for it to occur again due to the scent secreted from their paws and visual marking. Once an owner has purchased the post, location of its placement is important. Placing the post in an area where the cat is most frequently and near the places the owner wants the cats to avoid is crucial to the success of this alternative. The more and more the cat uses the post the closer the owner can move the post to a more convenient location. The owner should place it near the furniture that he or she would like the cat to avoid and when the owner observes the cat scratching on it praise the cat and offer many treats so that cat understands that is a good behavior. Once the cat uses the post frequently the owner can move it away a little every day.

Another reason a person might release a cat to a shelter is the annoyance of their spraying. Spraying is the releasing of a small amount of urine with the primary purpose to release a scent for territorial reasons similar to scratching. For example, if a cat has moved into a new home it may claim the area by spraying its scent. This issue typically arises more frequently when there are multiple cats in a household, and less when there is just one cat. The reason is because the cats may feel they are competing for territory rather than feeling secure in their home territory. Spaying and neutering your cat can often help or remedy this situation.

Many people complain about cats that have issues with litter box avoidance. There are many reasons why a cat may avoid the litter box, but one of those reasons is never out of spite. Cats never intentionally do things because they are mad at their owner. Cats can suffer from health issues which can cause them to not use the litter box. Urinary tract issues are more common with males but females can have it too. This is true because a male cat’s urethra is narrower than a female’s urethra. When cats with urinary tract complications try to urinate the pain caused by the area being plugged or infected may make the cat associate the pain with its litter box and it will not want to use it. These complications can escalate quickly and can lead to emergency situations so visiting the veterinarian is crucial. Litter box avoidance may also be a diabetes related cause as well. The owner’s veterinarian can determine the cause. If litter box avoidance is an issue it is important to see if the issue is medically related.

Rarely is it ever just one single reason that sways a person to relinquish their cat. One of the many reasons for relinquishment is because of behavioral issues. Aside from the behavioral issues, there is a possibility that the real issues reside within the people. For instance, people just may carry an unrealistic idea of the roles of cats in households. Another probability of why this may be true is because some cat owners may have never learned about cat behavior [3]. Sometimes the issue is a fault in the owners view, knowledge, or other aspect such as willingness, budget, or time to work with the cat’s issues, rather than just the cat.

Another thing to think about is the concept of behavioral medicine. Behavioral medicine is an important component in caring for cat wellness. Behavioral medicine is something that can be easily implemented and should be used routinely. Having the knowledge and guidelines for a few behavioral techniques can enhance veterinary medicine through client education and awareness and will trickle down to increase the quality and quantity of cat ownership. Behavioral medicine can be used throughout the cat’s lifetime as a preventative and a solution to behavioral problems. Behavior issues such as inappropriate elimination, aggression, spraying, and scratching will be discussed along with suggestions, solutions, and treatment using behavioral medicine.

Behavioral issues are considered the number one reason for relinquishment and euthanasia for cats in households. Although most of the time they come instinctually, these behaviors can be considered less than ideal when expressed in the house. The key to changing these “unacceptable” behaviors is to set them up for success and correct the problems when they arise. By understanding importance of behavioral medicine and implementing feline behavioral medicine nationally, it will help avoid unnecessary stress and destruction of the house, lengthen the lifespan of the cat and the owner, as well as allow the human-companion bond to strengthen. A well-behaved pet cat can provide many health and psychological benefits to its owner. These benefits include but are not limited to: lowered blood pressure, reduced risk of a heart attack, lessened symptoms of depression and autism, decreased triglycerides, providing companionship and the feeling of a sense of purpose, the feeling to be needed, and increase self-esteem in adolescents.

Cats receive much less veterinary care than do dogs. Behavioral medicine helps benefit the health of the cat and its owner and also benefits the business of veterinary practices. There is a correlation between level of owner attachment to the cat and the frequency of visits to the veterinarian for routine healthcare checkups. For example, the owner who considers their cat a family member, the more likely they are to seek more regular checkups with their veterinarian according to the AVMA [14]. Something to consider is the younger the cat owner, the stronger the human-bond is between the owner and the cat [14]. Incorporating client education about cat behavior and behavioral medicine will allow people to create a close and positive bond with their pet and their veterinarian and increase the probability of the client returning which is very beneficial because there has been a 13.5% drop in veterinary visits for cats since 2006 [14]. Clinics should teach their veterinary staff behavioral and environmental modification techniques and pass their knowledge to their clients which will likely aid in improving the client’s outlook and veterinary experience in the future. To help make the trip to the veterinarian more relaxing and comfortable for the cat, the clinic should be made more cat-friendly and they should educate owners on how the owners can do the same. As one can assume, a happy cat household will also benefit shelters alike. A cat that is loved and is properly cared for is one that is not likely to end up in a shelter. Animal Behaviorist, Dr. Bonnie Beaver of Texas A&M University, College of Veterinary Medicine and Biomedical Sciences, said that a cat that sees a veterinarian within a short amount of time after adoption is more likely to stay in the home than one that does not. If adopting owners receive behavior education before leaving the shelter with the new pet, the owners will be less likely to relinquish their pet. The owners that are more prepared will be more aware of problems that can occur and what to do about them and will be better educated on the entire process of adoptions, commitments involved, and their cat’s life stages.

Education of behavioral medicine through prevention and treatment within veterinary clinics is easy to implement and is very effective. Behavioral medicine can save a cat’s life. It is the job of the veterinarian to care for cats’ wellbeing- physically and psychologically Clients may not tell their veterinarian certain issues unless specifically asked questions addressing the issues. Some clients may not mention the behavioral issues because they do not feel confident in how they are dealing with them. Many owners believe that their cat does things “out of spite.” These misconceptions can easily be addressed and can make a huge difference in the relationship and behaviors between the cats and their owners. If the owner does not visit their veterinarian preventatively, or does not know how to recognize when an issue has arisen, the cat will be untreated. Routine visits help prevent and aid in early recognition of issues whereas being able to recognize an issue will alert the owner that veterinary care is more urgent. It is just as important for an owner to be able to recognize when there is an issue, as is making sure that the cat visits the veterinarian routinely. It is important for cat owners to know that illness and pain are usually detected by a broad change in their cat’s usual behavior. It is necessary for an owner to tell the veterinarian if their cat defecates or urinates outside of the litter box; if their cat is spraying; if the cat shows signs of aggression such as hissing, biting, or scratching specific family members, strangers,; or other animals in the household; if their cats exhibits fearful behaviors; and if their cats show destructive behaviors such as scratching or chewing on objects. Effective communication between the owners and their veterinarian is essential. Measures such as behavior assessments (along with education), physical examination, and diagnostic testing will all coincide together to differentiate causes of behavioral changes.

**Advertising and Why the Majority of People Like Dogs**

It is necessary to examine why the majority of people love dogs rather than cats and why there have been failed attempts to increase the retention rates and ownership of cats. It is not necessarily the issue that previous plans are incorrect but rather the way we have failed to convince those who have the power to implement such things as public policy. Dogs have obtained their title of “man’s best friend,” most likely because dogs have been partnering up with humans from what archeologists and geneticists say was over 100,000 years ago. Dogs are pack orientated and the relationship between humans and dogs date back further than with any other pet. Because of this, humans and dogs have coevolved. Many people claim that human civilization may not be what it is today was is it not for dogs. From the ages of hunters and gatherers, dogs were there working alongside of humans as a team. Over thousands of years, dogs have domesticated far beyond any other animal to the point that wolves raised in the exact same environment as a puppy will behave differently after 8 weeks of age. For example, wolves behave differently in a more aggressive and wild nature past that age. Wolves will remove themselves from new objects placed in a room whereas a dog will embrace ad explore it. A 40-year long study was done on domestication of foxes in Siberia to seek out whether the domestication of dogs was a result of “self-domestication” or “artificial domestication” from humans’ intentional choices. In order to investigate this, it must determine if the morphological and physiological changes were a result of natural selection or of deliberate selection of advantageous traits.

Anthropologist Darcy Morey has noticed that domesticated dogs similarly retain their juvenile traits as adults whereas wolves outgrow those traits [13]. Morey believed that pedomorphosis in domesticated animals such as dogs are a result of natural selection [13]. Geneticist Dmitry Belyaev believes that tamability is a behavior rooted from the body’s hormones and neurochemicals [13]. He believes that, according to evolutionary theory, this is the result of fitness and adaptability to living with humans [13]. Those evolutionary, physiological, and behavioral changes may explain the similarities among domesticated animals and how they share similarities in size, appearance, coat color, reproductive cycles, and behavior [13]. The experiments show that aggression could be removed or enhanced through isolated breeding of the foxes and that they shockingly look more dog-like and tame the more domesticated they become [13]. This suggests that aggression is mainly a genetic component which can reflect why dogs aren’t nearly as aggressive as wolves and why cats still might be a slightly more aggressive population when compared to dogs [13]. Dogs have been selectively domesticated more than cats. This may be a reason why cats are more similar to lions than dogs are to wolves. If a dog and cat were let loose in the wild it can be assumed that the cat will survive longer. Many studies suggest that there is the psychological attachment to the baby-like features in dogs and kittens. With that in mind, scientific research shows that people have the undeniable need to nurture dogs and kittens and that could suggest why people are so attracted to them. Dogs are not as able as cats to take care of themselves so dogs are more dependent, thus subconsciously making the dog more attractive. This is a human instinct to nurture helpless babies.

Dogs and humans are able to better understand each other and communicate with one another. Humans can differentiate emotions through the different sounds of their barks. Barks were only used from wolves as a warning; similarly, meows were only exchanged between a mother and her kittens. Both dogs and cats now use the bark and the meow to portray their emotions to humans. Also, dogs, unlike any other species including human primates, are the only species known to look for facial and emotional expression in the left side of the face like humans do and they also are able to understand direction by a pointing finger or movement from our eyes. Much more research is needed in the area of communication between owners and companion animals.

**The Cat’s New Image**

The decrease in cat ownership can be examined as the byproduct of a supply and demand market that lowers the perceived value of cats. Simple supply and demand economics would dictate that this should lower the demand of cats; however, this cannot be looked at as a simple supply and demand model. Doing so would only attribute the correlation and not attempt to explain the causation of the shortage of in cat ownership. The decrease in cat ownership is best explained by scarcity, future outlook during economic recessions, and shifts in modern lifestyles. The way that individuals value things varies person by person. There are many methods that are subconsciously used when analyzing the value of a commodity. Economists can explain how supply and demand are correlated but do not offer an explanation to why they are correlated at an individual's psychological level. Scarcity is directly linked to the value that people place on something. In a couple of studies conducted in 1975 by Worchel, Lee, and Adewole, 200 undergraduate students were asked to rate the attractiveness of two separate groups of cookies [15]. One group was abundant with supply of cookies, while the other was scarce in cookies. The test subjects were told that the groups of cookies had either been consistently scarce or had begun as abundant and had their supply decrease. The test subjects were informed that the decrease in supply was attributed to either high demand or an error in the preparation of the cookies. The results showed that “cookies in scarce supply were rated as more desirable than cookies in abundant supply” [15]. Just as with the cookies, there is a sudden increase in the supply of cats. The link between scarcity and society's value is evident in how commodities are traded. Beyond simple economics models, there is also a higher value placed on commodities that suddenly became scarce than commodities that have always been scarce. Worchel's study also concluded that “cookies were rated as more valuable when their supply changed from abundant to scarce than when they were constantly scarce” [15]. The study also found that cookies are scarce because of the high demand and they were rated higher than cookies that were scarce because of an accident [15]. On the opposite end of the spectrum, “cookies that were constantly abundant were rated higher than cookies that began scarce but later became abundant” [15]. This study shows how value can be manipulated through the perceived supply and demand for a commodity [15]. This can be true for the perceived value of cats.

Cats are abundantly found in shelters. Cats have become so abundant that they are often given away free of cost or very cheap to owners looking to adopt (versus dogs). While this appears to be a solution in finding a home for animals in need over time it causes harm to the perceived value of cats as pets, as well as placing animals with owners not willing to pay a lot to own the pet as well as ensuring its health and wellbeing care. People in general prefer commodities that have become scarce due to increased demand. People will attribute the abundance of cats to a lack of demand for them as pets rather than any of the other reasons such as increasing cat population.

There has been a large amount of effort put towards educating the public on the abundance of animals in shelters. These groups invest in advertisements to help educate as many people as possible. These advertisements usually have a somber tone and depict how overfilled shelters are. They often show statistics that show how many animals have to be euthanized every year because there is a lack of available owners. These commercials are meant to incite the demand for people to adopt shelter animals. Sometimes what these commercials also do is show how overly abundant the supply of animals are which decreases the appeal of owning those animals. They even explain how there has been a decrease in the amount of willing owners. As shown with the cookie experiment, when an over abundant commodity is thought to have become abundant because of lack of demand, it is perceived as being of lower value. The widespread education of animal neglect and abandonment into shelters has over time lowered the perceived value of pets. As for dogs, they are still more popular because they were always perceived as an abundant supply and as the cookie study demonstrated, that was also ranked high in value because it was constantly abundant. The constant availability of dogs does not hurt people’s perceived value of dogs so they still want and adopt them.

Funding and intentions of marketing campaigns seems not to be the issue, but the method in which those campaigns were executed could have adversely influenced the overall value of shelter pets. An overhaul of current pro-animal marketing needs to be done. It is only acceptable to display how overly abundant the cat population is in the shelters, as long as there is an explanation that does not emphasize the decrease in the demand for cats. A proper campaign would depict cats as a heavily wanted commodity, and emphasize the positive traits that are linked with cat ownership. Traits such as pet of choice amongst the higher educated and a pet of the artistic and unconventional owner. The campaign needs to bring about a positive light upon the animals in shelters, and educate the public about the positive characteristics of the animals and how they help their owners, physically and psychologically.

It may even be that cats in households are not decreasing; it may just be that the cat owners are just underrepresented. Since cat owners are dominantly introverted it just may be their nature to not publicly express their love for their cat like dog owners do. Cat owners are unlike the majority of the United States population. Cat owners in the U.S. have higher educational degrees than the majority of the population. Cat owners are smart and introverted and have unorthodox ideals. Because their owners are unlike the majority of the population, we should advertise their animals (cats) the same way. Instead of trying to make cats fit in and be equal with dogs, we should make them stand out and make cats more desirable.

**Future Recommendations and Research**

There are numerous recommendations for research and implementation of programs in the discipline of psychology related to cats The first recommendation is to implement behavioral medicine. Adoptees should complete a behavioral course on cats before leaving the shelter with their cat. During this time, it should be made known that having a pet is a lifetime commitment and it should be highly recommended to visit a veterinarian in a short period of time after adopting the cat from the shelter. Both of these methods could help increase the retention rate.

Increase the primary research on training a cat to make cats acceptable service animals as defined in ADA law. This could reduce the number of cats in shelters and increase the pool of service animals. Making shelter cats therapy animals for animal assisted therapy could save lives of shelter animals and improve the quality of life for humans as well.

Cats need to be advertised and marketed in a positive light targeting the intelligent, yet unorthodox, views of the majority of cat owners. During this campaign, the untrue and stigmatized stereotypes of cat owners need to be addressed and reversed.

Shelters should be encouraged to start a foster-to-adopt program, where owners may return the animal if they do not see that they and the cat are a match. Shelter staff trained in cat behavior and care should be in shelters to counsel and take care of any needs and answer specific questions from adoptees. A shelter-on-wheels campaign could be implemented. This would be a mobile adopting site that tours the U.S. and allows cats to find their forever homes. Shelters should have more personalized advertisements for their shelter animals, such as “glamour shots”, etc. in order to increase interest in adoption.

Overall, the public should know that adopting and rescuing animals is a good thing to do and that the owners should feel good about themselves. They should know that they did their commitment is making a difference, especially with the animal.

**References:**

1. Bainbridge, Carol. "Introvert." *About.com*. N.p., 2013. Web. 22 Aug. 2013.
2. Boutin, Chad. "Snap Judgments Decide a Face's Character." *Princeton.edu*. Princeton University, 22 Aug. 2006. Web. 22 Aug. 2013.
3. Casey, Rachel A., Sylvia Vandenbussche, John Bradshaw, and Margret A. Roberts. "Reasons for Relinquishment and Return of Domestic Cats to Rescue Shelters in the UK." *Behumane.org*. N.p., n.d. Web. 22 Aug. 2013.
4. Collingwood, Jane. "The Benefits of Being an Introvert." *PsychCentral.com*. Psych Central, 2007. Web. 21 Aug. 2013.
5. Coren, Stanley. "Personality Differences Between Dog and Cat Owners." *Psychologytoday.com*. SC Psychological Enterprises Ltd., 17 Feb. 2010. Web. 22 Aug. 2013.
6. Dodman, Nicholas. "Feline Personalities." *PetPlace.com*. Intelligent Content Corporation, 2013. Web. 21 Aug. 2013.
7. Edelson, J., and D. Lester. "Personality and Pet Ownership: A Preliminary Study." *Psychological reports* 53.3 I (1983): 990. Print.
8. Faver, Catherine A., and Cavazos M. Alonzo, Jr. "Love, Safety, and Companionship: The Human-animal Bond and Latino Families." *Petpartners.org*. Delta Society, 2008. Web. 22 Aug. 2013.
9. Gosling, S. D., C. J. Sandy, and J. Potter. "Personalities of Self-Identified "Dog People"and "Cat People"." *Anthrozoos* 23.3 (2010): 213-22. Print.
10. "Keeping Pets (Dogs and Cats) in Homes Retention Study." *Behumane.org*. American Humane Association, 2013. Web. 22 Aug. 2013.
11. Kumar, Manibharathi M. "Dog & Cat Owners Have Different Personalities." Pace University, July 2010. Web. 22 Aug. 2013.
12. Thomas, Alexander, Stella Chess, and Herbert Birch. "The Origin of Personality." *Acamedia.info*. Scientific American, 1970. Web. 22 Aug. 2013.
13. Trut, Lyudmila N. "Early Canid Domestication." *Arizona.edu*. Sigma Xi, The Scientific Research Society, 2013. Web. 22 Aug. 2013.
14. "U.S. Pet Ownership & Demographics Sourcebook." American Veterinary Medical Association, 2013. Web. 22 Aug. 2013.
15. Worchel, Stephen, Jerry Lee, and Akanbi Adewole. "Effects of Supply and Demand on Ratings of Object Value." *PsycNET.apa.org*. American Psychological Association, Nov. 1975. Web. 22 Aug. 2013.

**Wildlife Research**

**Abstract**

Despite being a common pet, cat ownership in the United States has decreased over the past years according to recent surveys from the American Veterinary Medical Association. According to surveys conducted in 2007 and 2012, the percentage of households owning pet cats went from 32.4% in 2007 to 30.4% in 2012, while the total number of pet cats went down from 81,721,000 to 74,059,000 individuals (AVMA 2012).

There are several ways to classify domestic cats (*Felis catus*), based on their level of ownership and their degree of tameness, however the status of a cat can change through its lifetime and this consideration is important when describing their impacts and outlining management strategies.

There is extensive evidence on the impact of cats on wildlife populations and native species mainly through their role as introduced predators, reservoirs of human and animal diseases (with their subsequent role in zoonotic diseases), and the risk they pose to genetic pools of native species through hybridization. From a wildlife perspective, the controversy centers around the best approach to the issue of free-roaming cats, acknowledging there is a cat overpopulation problem, but disagreeing on the ethical, ecological and management implications.

Cats are innate predators and even well fed cats will have the instinct to hunt, with possible negative implications for native wildlife populations, especially rare species that occur in low densities, but even problematic for some common and widespread species in urban settings. Cat predation is an issue not only for prey but also for other native predators sharing a common prey with cats. The interaction between cats and wildlife is not static and changes over time and space, its implications will depend on the type of habitat, prey species, predator community, and time of the year. The best course of action is restricting cat movements and keeping them indoors, with implications for pet owners, highlighting the importance of responsible pet ownership and education for owners, future owners, and the general public.

Free-roaming cat interactions with wildlife and other cats increase the risk of disease and parasite transmission to humans (zoonotics), wildlife and pets. While wild populations are controlled by prey availability, predation, competition and disease, free ranging cat populations are largely protected from the above by human caretakers. Vaccination may protect cats from various diseases, but they still may act as reservoirs and vectors of several diseases and pathogens of concern to wildlife. Thus vaccination is a safe practice for cats in general (both owned and non-owned individuals), but if not accompanied by responsible ownership and management practices, such as restriction of cat movements and strict vaccination programs, it might still pose a risk to pets, humans, and wildlife.

The genetic integrity of several wildcat subspecies is considered to be seriously threatened by increased crossbreeding with free-ranging domestic cats due to human population expansion into new habitats close to natural and semi-natural areas. Crossbreeding can be prevented through responsible pet ownership practices which include neutering and spaying of pet cats and restriction of outdoor movements. The problem with feral and stray cats is different, since not all individuals in a population of un-owned cats can be altered, and even a small proportion of fertile individuals from a widespread species can interbreed with wild, fragmented species, with disproportionate effects for the second one.

Cats are not bad per se. They make great pets for many households and have several advantages compared to other types of pets. However, risk factors related to poorly developed management plans and deficient pet ownership promote a negative perception of cats among specific sectors of the society. Limited and sometimes ambiguous information on the effects of cats on wildlife populations stresses even further the importance of education, responsible management and ownership practices, and interdisciplinary approaches. Education of the general public and understanding of the risks associated with poor practices are pivotal in the management of the free roaming cat overpopulation.

In this review, I intend to present available information (negative and positive) on the effects of cats on wildlife using available information exclusively coming from scientific articles in the peer reviewed literature for consistency. Management of cats, with its implications for wildlife welfare through responsible pet ownership, is discussed at the end of the Discussion section. The final part of this review consists of recommendations for future research, highlighting areas where knowledge gaps are hindering efforts towards a holistic approach to management and responsible ownership of cats.

**Discussion: Cats on Wildlife**

***Predation***

A recent publication about the impact of free-ranging domestic cats on wildlife estimated annual mortality of mammals due to cat predation to range between 6.9 and 20.7 billion individuals with un-owned cats causing the majority of this mortality (Loss et al. 2013) starting a vivid debate among wildlife professionals from different fields and animal welfare advocates. The controversy centered around the best approach to the issue of free-roaming cats, acknowledging there is a cat overpopulation problem, but disagreeing on the ethical, ecological and management implications.

There is extensive evidence of the impact of cats on wildlife populations and native species mainly through their role as introduced predators, reservoirs of human and animal diseases (with their subsequent role in zoonotic diseases), and the risk they pose to genetic pools of native species through hybridization.

There are several ways to classify domestic cats (*Felis catus*), and several categories have been proposed based on their level of ownership and their degree of tameness (Dickman 1996, Turner and Bateson 2000, Hildreth et al. 2010). On this review I am following the categories described below.

*Pet cat:* A cat that is owned and lives in close connection with humans who assume all responsibility for providing the basic food and shelter requirements.

*Stray cat:* A cat that lives in close proximity to humans and might be partially taken care of by them, but is not totally dependent on humans for the provision of its basic food and shelter requirements. This category includes farm cats and community cats.

*Feral cat*: A cat that is free-living and do not rely on humans for any portion of their basic requirements. These cats have formed self-sustained populations.

Cats are the most common pet worldwide with about 600 million cats living among humans (Driscoll et al. 2009). Although exact numbers are difficult to estimate, the American Pet Products Manufactures Association reported that approximately 93.6 million cats were owned in the U.S. in 2009. Of these owned cats, the majority of them (65%) are allowed to roam outdoors, but there is a tendency to keep cats inside only rather than outside only and slightly more cats remain indoors at night compared to during the day (APPMA 2005). Estimates of feral and stray cats are mainly speculations but it has been suggested that as many as 60 to 100 million exist in North America (Jessup 2004). Free-roaming cats are those individuals let to roam outside without confinement, independent of their tameness or ownership status. An important point has to be highlighted: the status of a cat can change through its lifetime, and that consideration is important when describing their impacts and outlining management strategies. Owned cats exclusively kept indoors are not the focus of this review.

Cats are one of the few wild species that have been domesticated for the sole purpose of companionship without providing any direct benefits to human sustenance. The first evidence of cat domestication dates back 9500 years in Cyprus (Vigne et al. 2004), although evidence suggests domestication has taken place in several locations at different times (O’Brien et al. 2008). Despite having a long history of domestication, during this process there has been little selective pressure on the ancestral form (*Felis silvestris*); consequently, few morphological and behavioral changes have taken place in the domesticated cat (Bradshaw 1992).

Domestic cats are different from other wild predators in several ways. They receive either partial or complete care which protects them from diseases, predation, and competition, and gives them a competitive advantage over other predators. They have some sort of food supply and their numbers are not regulated by prey availability or intraspecific competition for limited resources. They are not territorial and interference competition is not a regulating factor of population growth (Coleman et al. 1997).

Domestic cats are meat eaters, properly equipped with teeth adapted for gripping, tearing, and shearing; they possess retractable claws, and excellent vision and sense of smell (Russell and Bryant 2001, Case 2003). Cats are unable to taste carbohydrates and have a limited ability to digest any plant-based food. Their physiology requires a diet providing at least 30% of animal protein (compared to 18% in dogs) due to a lack of key metabolic enzymes (Zoran 2002) which restrict their dietary choices, as is the case of all felid species, making them obligate carnivores (Bradshaw et al. 1996, Bradshaw 2006). Additionally to the high dietary protein demand, it has been shown that cats’ hunting instinct remains largely unaltered even on well fed cats, which will hunt and kill prey without consuming it (Adamec 1976), prompted more by their natural instinct as hunters than by hunger. Nonetheless, evidence on this respect is ambiguous. For example, Liberg (1984) found that females fed at home spent about half of the hunting time than their feral counterparts did; however, he noted that in times with easy access to natural prey, domestic house cats tended to prefer that to house food.

The activity patterns of domestic cats has been described as diurnal, nocturnal, crepuscular, and polycyclic; however, these labels are misleading because the same individual may exhibit all different patterns on different occasions (Randall et al. 1987), allowing them more opportunities to hunt. Feeding behavior studies have shown that a considerable proportion of a cat’s kill is not consumed and that they tend to play with their prey before killing it (George 1974). Body condition, diet, and frequency of feeding did not seem to influence the rate of predation by domestic cats (Robertson 1998). However, studies comparing the predatory behavior of pet cats with those of stray or feral cats have shown that urban and sub-urban cats tend to hunt less frequently and kill less wild prey compared to rural cats (Churcher and Lawton 1987).

Location can play an important role in cat hunting patterns. A study comparing the diet of a domestic cat in a rural area with those of four urban cats found the rural cat captured considerably more native species than the urban cats (Mitchell and Beck 1992), suggesting the effects of cat predation are site specific and extrapolations are difficult to perform with confidence. Similarly, Barratt (1998) reported the predation rates of cats in rural areas were higher than those of cats in suburban settings.

Domestic cats are generalist and opportunistic predators showing seasonal and spatial variation in their diet, switching from one type of prey to the other according to its abundance (Barratt 1997b, Fitzgerald and Turner 2000); however, there are cases when a certain degree of specialization or tendency to capture a specific type of prey might occur, highlighting the necessity of measuring prey availability when conducting studies on diet preferences and selectivity.

It has been shown that cats tend to kill smaller prey generally weighing less than themselves (Burbidge and McKenzie 1989), as well as ground nesting and feeding animals (Coleman et al. 1997), and experimental studies on captive cats indicate that early exposure to a particular prey type or capture technique influences later behavior and preference (Carol 1980). For example, a single cat was responsible for the extinction of an entire population of the once common Angel de la Guarda deer mouse (*Peromyscus guardia*) on Estanque Island (Mellink et al. 2002, Vazquez-Dominguez et al. 2004), with 93% of its diet containing the deer mouse. Cats can use several hunting techniques for capturing prey, including mobile and stationary strategies, relying heavily on concealment and crypsis to secure prey (Fitzgerald and Turner 2000). Similarly, Read and Bowen (2001) found that in Australia, smaller cats preyed upon smaller, native prey, while larger cats tended to hunt heavier prey, usually introduced species. This flexibility in feeding behavior and habits confers them great potential for being successful, effective predators.

The majority of studies on cat predation have focused on birds, but studies of feeding habits of free-ranging cats indicate that small mammals are the item most consumed by cats (Fitzgerald 1988). Cat’s diet consists of mammals (68.6%), birds (23.6%), amphibians (4.9%), invertebrates (1.2%), reptiles (0.9%), and fish (0.2%), with the remaining percentage accounting for unknown prey items (Woods et al. 2003),; however, studies show great spatial and temporal variation in the number and types of animals killed by cats (Coleman et al. 1997). They predate upon common species as well as on endangered or rare species, and on invasive species as well as on native species (Glen et al. 2010, Van Heezik et al. 2010).

Although there is consensus in the fact that cats kill wildlife and can be effective predators, inclusion in the diet does not necessarily imply deleterious effects on the prey species (Denny and Dickman 2010). Furthermore, some studies acknowledge that cat predation might be compensatory, removing weak individuals that would otherwise die (Balogh et al. 2011), while other studies suggest cat predation is a major source of mortality for certain species of birds (Baker et al. 2008), suggesting the effects of cat predation warrant further investigation. Therefore the magnitude of this impact on wildlife populations and the management strategies to control such effect remain a topic of debate.

Most of the studies dealing with cat predation have used indirect measures of predation such as owners interviews (Lepzyk et al. 2004, Baker et al. 2005, Tschanz et al. 2011), but few studies have used direct measures such as recording the number of prey returned home versus the number of prey left in situ (Keys and DeWan 2004, Loyd et al. 2013), and even fewer have measured the prey population upon which cats are predating (Risbey et al. 2000, Baker et al. 2008). Since an impact will only occur if the level of harvest is higher than the rate of increase of the prey (Krebs 2009), and without data on the size of the prey population and its demographics (mortality and natality rates, and net reproductive rates), it is impossible to estimate rates of increase based on empirical data. Any estimation of the effects of cat predation on prey populations trends is speculative unless such data are available, which is rarely the case. Similarly, evidence of the negative effect of predators on the population trends of a prey species does not necessarily imply that was the initial or only cause of the decline (Hone 1999).

Most studies focus on pet cats in urban and rural areas, but information about feral cats is scarce probably due to the logistics and effort necessary to conduct studies on such populations, and few studies have been conducted on their feeding ecology or behavior. Liberg (1984) found that feral cats showed similar diet composition to pet cats but had much higher intake rates, while Short et al. (2002) found feral cats included rodents, birds and reptiles more frequently in their diets compared to pet cats; however, dietary diversity was similar between both groups. Beckerman et al. (2007) tied the declines of starlings (*Sturnus vulgaris*) in the UK to heavy predation by pet cats, while Barratt (1997b) found this bird species to be abundant in Australia despite heavy house cat predation.

Several factors have been postulated as causes for the decline and extinction of many species, among them habitat destruction, fragmentation, and introduction of exotics (Chapin et al. 2000). Cats have been included in the list of the top 100 worst invasive species (Lowe et al. 2000) and multiple studies have reported the negative effects of cat predation on wildlife abundance and diversity, causing extinctions and dramatic reductions of native wildlife populations (Keitt et al. 2002, Blackburn et al. 2004).

Most of these studies have been conducted on islands. It has been suggested that 54% and 26% of predator driven bird extinctions on islands world-wide has been caused by rats and cats, respectively (Dowding and Murphy 2001). For example, Burbidge and Manly (2002) found a positive correlation between the presence of feral cats and the extinction of some native fauna on Australian islands, and there is evidence from correlative and modeling studies that feral cats cause declines or local extinctions of islands’ fauna (Nogales et al. 2004). It has been documented that the rate of diversification and occurrence of endemisms, as well as risk of extinction and susceptibility to introduced predators is higher on isolated ecosystems (Courchamp et al. 2003, Harris 2009, Salo et al. 2010); therefore, findings on islands might not be applicable to continental areas on a 1 to 1 basis.

That being said, urban and semi-urban habitats such as city parks and preserves may act as isolated ecosystems within a matrix of unsuitable habitat for many wild and urban-adapted species and the impact of cat predation on such suitable habitat remnants should not be overlooked. For example, in remnants of scrub habitat canyons in California, a negative relationship between cat abundance and diversity of scrub birds was found, suggesting the pressure from cat predation was having an impact on those populations already affected by habitat fragmentation (Crooks and Soule 1999).

Given their high densities and the fact that they are frequently allowed to roam outside, owned cats living in urban areas could have a significant negative effect on prey populations in such areas even if per capita rate of predation is low (May 1988). For example, Baker et al. (2008) found the ratio of the density of the most common prey species taken by cats to cat density to be very small, suggesting the compound effect of individual cats could be substantial on the dynamics of local urban bird populations. Similarly, Churcher and Lawton (1987) reported House sparrows (*Passer domesticus*), a very common bird species in England, comprising up to 17% of the diet of pet cats in an English village.

The effects of cat predation on wildlife have also been documented in continental ecosystems (Mitchell and Beck 1992, Burbidge and Manly 2002, Dauphine and Cooper 2009). In North America, Dunn and Tessaglia (1994) found domestic cats to be significant predators of birds at feeders but predation rates in home gardens were similar to rates in other areas, suggesting birds at feeders can employ alternative tactics for predator avoidance such as increased group vigilance or decreased feeding time (Popp 1988). A study comparing the hunting habits of pet cats in a rural and an urban setting in Virginia found cats in the rural area brought home a significantly greater number of native species compared to the urban area (Mitchell and Beck 1992). In a riparian reserve in California, Hall et al. (2000) reported feral cats foraged mostly on small, native mammal species.

As mentioned earlier, cats are adaptable and opportunistic predators that have retained much of their wild behavioral and morphological traits, making them very successful when reverted to a feral state (Bradshaw et al. 1996). Cats are effective hunters, preying upon a wide gamma of prey species, including introduced and nuisance rodents (Turner and Bateson 2000), but killing also native species, already stressed by other factors such as habitat loss. For example, in a study in two parks in California, one without cats and the other one with a population of 20 cats, Hawkins (1998) found 85% of the native rodent species were trapped in the no cat park, while 79% of the an exotic, pest mice species, were trapped in the cat area, suggesting a decrease in the abundance of native rodent population and a change in rodent species composition driven by high densities of predators.

In North America, it is estimated that cats kill over a billion small mammals each year (Coleman et al. 1997). Hall et al. (2000) reported that cats in urban areas of California tended to prey upon smaller prey, suggesting prey size and ease of capture were good predictors of predation attempts. A study conducted in two parks in California, found that in the park with no cats, there were almost twice as many birds than in the park with a cat colony of about 20 individuals (Hawkins et al. 2004), and common ground nesting bird species were never seen in the park with cats. Crooks and Soule (1999) estimated the annual amount of prey brought home by pet cats surrounding remnant scrub habitat in California to be 840 rodents, 525 birds and 595 lizards, of which the majority were native species, suggesting an unsustainable rate of bird predation and a sources- and sinks population dynamics in which the local bird population (a sink population) was maintained by immigration of individuals coming from adjacent source populations.

Cats were introduced in North America during colonial times and became abundant in the late eighteen hundreds (Driscoll et al. 2007), when they were used for rodent control. Given their flexibility and adaptability, cats’ diet is highly variable both spatially and temporally and evidence of their role in keeping populations of pest rodents under control is ambiguous. For example, one study in California showed rats being more abundant in plots where cats were present compared to those areas devoid of cats, where native rodents were more abundant (Hawkins 1998), while another study revealed that cats in Port-Cross Island prey largely upon introduced black rats, due to the rats’ high abundance on the island, but also on a protected and endemic seabird, having a severe negative effect on the population persistence of the bird (Bonnaud et al. 2007).

From the evidence just mentioned, it follows that free-roaming cats may have a potentially positive effect on some species through the suppression of lower level predators (such as rats). For example in urban and sub-urban areas of Australia, Barratt (1997b) found that cats brought home a high percentage of introduced mammals, suggesting a potential positive effect on native species; however, population trends of the invasive species suggest that cats are not impacting their populations to an extent at which it could be beneficial for the native species. It has been reported cats preying heavily on introduced rabbits in Australia (Read and Bowen 2001, Short et al. 2002), but they also seemed to prey heavily on native rodents when rabbit abundance declined (Risbey et al. 2002). Similarly, a study of cat predation on Norway rats reported occasional predation of cats on juvenile rats, with little impact on the size of the rat population but possible effects on the age structure of this population (Glass et al. 2009).

It has been proposed that in those ecosystems where top predators keep populations of meso-predators in check, some prey species will be benefited through a decrease in predatory pressure from the meso-predator (Soule et al. 1988, Fan et al. 2005). However, conclusive evidence of his trophic interaction is not available, and while some studies have shown that such chain effect exists in ecosystems with a native top predator, several introduced and native meso-predators, and a shared prey species (Crooks and Soule 1999, Johnson et al. 2007), other researchers have found no evidence of such cascade effects (Bonnaud et al. 2010) suggesting bottom up mechanisms such as food availability, maintain meso-predator populations in check. In addition, mice and rats were rarely predated by cats in an urban habitat where pest rodent population was high (Dards 1980), supporting the observation that prey size and ease of capture play an important role in cat predation and thus foraging on large rats is relatively less than predation on native, small, and probably naïve wildlife (Hall et al. 2000).

Population size is controlled in part by food availability (Krebs 2009), and a negative feedback on population growth is imposed by the amount of resources available. Populations will grow exponentially until a break is posed on that growth as the population approaches to the carrying capacity of a particular site at a particular time. This is the case for all natural populations, including those of truly feral cats who are dependent on the availability and abundance of natural prey, and therefore most studies documenting the impact of cats on wildlife involve stray cats (Meffe and Carroll 1997). This logistic growth experienced by natural populations is altered in the case of companion animal populations, such as pet cats, whose populations are completely independent of the availability and abundance of natural prey, and therefore can grow beyond carrying capacity of the environment reaching high densities around human settlements (Sims et al. 2008).

Since pet cats and stray cats are not regulated by food availability their populations do not respond to changes in prey abundance, having deleterious effects by exerting continuous pressure on their prey population, without allowing time for recovery (Krebs 2009). This continuous predation is exacerbated by the fact that domestic cats can reach high densities, due to the reliability of forage resources and to their high reproductive rates (Nutter et al. 2004a). In fact, in North America, free ranging cats reach abundances several times those of all mid-size native predators (Coleman and Temple 1993), resulting in a potential greater impact on prey species (Crooks and Soule 1999).

The effects of domestic cat predation on wildlife can also be indirect. Cats can compete with native predators and prey for limited food or shelter sources (Burbidge and Manly 2002, Glen and Dickman 2005), or can change their prey behavior in such way that the avoidance mechanisms put in place by a species to escape predation can impair its reproductive success and fitness (Lima and Dill 1990, Korpimaki and Krebs 1996, Beckerman et al. 2007).

***Disease transmission***

Domestic species act as reservoirs for many diseases (Gittleman et al. 2001) and domestic cats, in particular, act as reservoirs in the transmission of numerous diseases to other species (Artois and Remond 1994, Daniels et al. 1999). Free-roaming cat interactions with wildlife and other cats increase the risk of disease and parasite transmission to humans (zoonotics), wildlife and pets (Eberhart et al. 2006, Hill and Dubey 2002).

Diseases of concern to humans and wildlife include rabies, toxoplasmosis, scratch fever, ringworms, salmonellosis, distemper, and several endo- and ecto- parasites (Fitzwater 1994, Danner et al. 2007, Miller et al. 2007). These diseases can be transmitted both ways, from free-roaming cats to wildlife and from wildlife species to pet cats, with the subsequent risk of transmission to humans. Other risks to humans include injury and infection from bites and scratches, usually after cats have been provoked (Patrick and O’Rourke 1998).

The dynamics of disease transmission indicate that as populations become larger they serve as reservoirs for pathogens, and infections that were sporadic become common and persistent with outbreaks when suitable conditions are found (Krebs 2009). While wild populations are controlled by prey availability, predation, competition and disease, free ranging cat populations are largely protected from the above by human caretakers. Being able to reach high densities this cycle becomes a loop in domestic cat populations, as new individuals are continuously adding to the pool of susceptible cats, whereas wild species even if susceptible to the same diseases, maintain densities at which the disease cannot sustain itself forever, since the number of susceptible individuals becomes smaller as the number of infected and resistant individuals increases. As the disease spreads through the population, no susceptible individuals are found and the cycle ends (Krebs 2009).

Vaccination may protect cats from various diseases, but they still may act as reservoirs and vectors of several diseases and pathogens of concern to wildlife (Danner et al. 2007, Work et al. 2000). While diseases carried by wild species might also be present in cat populations, the impact of such diseases at the population level and the roles of wildlife, pet, stray, and feral cats are frequently unknown. For example, the intestinal nematode parasite *Baylisascaris procyonis* found in raccoons is a type of roundworm that can cause death in humans and other primates (Kazacos et al. 1981, Kazacos 2001) and transmission of eggs occurs through infected raccoon feces. In places where inter-specific interactions of wild and domestic animals increases, the risk of transmission among species also increases; this is of particular concern to wild and human population health. Further research is needed in order to determine the role both cats and wildlife have on disease transmission and the effects of such diseases in the population dynamics of native species (Dabritz et al. 2006, Eymann et al. 2006, Bevins et al. 2012).

Reports of viral pathogens transmitted by domestic cats to wildlife species include feline leukemia virus (FeLV), a retrovirus that causes immunosuppression of hosts increasing the susceptibility to other disease agents in Mountain Lions (*Felis concolor*) (Jessup et al. 1993, Cunningham et al. 2008), wild cats (*Felis silvestris sp*)(Millan and Rodriguez 2009), and Iberian lynx (*Lynx pardinus*) (Meli et al. 2009); and feline distemper virus(FPV), a viral panleukopenia frequently fatal in kittens in Florida panthers (*Felis concolor coryi*), a subspecies threatened with extinction (Roelke et al. 1993, Pain 1997), Iberian lynx (Millan et al. 2009), the most endangered feline in the world, and wildcats (Millan and Rodriguez 2009). These viruses are important pathogens in domestic cats and are of concern for all wild felid species. FeLV is transmitted by direct contact while FPV is transmitted through contact with bodily fluids and feces (Hartman 2011), and both have a higher incidence in feral than wild cats (Duarte et al. 2012), suggesting a risk for wild species.

Parasites of consideration that spread from cats to wildlife are *Spirometra erinacei* (a tapeworm that infests the gut of carnivores) and *Toxoplasma gondii* (a non-host specific parasite responsible for Toxoplasmosis)*.* The life cycle of the tapeworm *S. erinacei* starts with eggs that live in the small intestine of the carnivore host and are passed to freshwater crustaceans and copepods, where they transform into procercoids. Once they are consumed, they develop into plerocercoids, an intermediate development phase that has been reported in mammals, reptiles, and amphibians (Berger et al. 2009). Cats also serve as definitive hosts of the Toxoplasma parasite, which is spread by insects that come in contact with oocysts that were deposited through the cat’s feces, by trans-placental transfer, or transferred to herbivores that eat plant material containing these oocysts (Miereles et al. 2004).The Toxoplasmosis parasite can live outside its host for several months (Kazacos 2001) and infection to both wildlife and humans can result in abortion of the fetus, cellular damage to internal organs, or damage to the central nervous system (Portas 2010, McAllister 2005). This disease has been reported on the endangered Hawaiian crow (*Corvus hawaiiensis*) and the threatened Southern sea otter (*Enhydra lustris*) (Work et al. 2000, Miller et al. 2007), as well as several bird species (Dubey 2002, Work et al. 2002, Gerhold and Yabsley 2007), and Australian marsupials (Dubey and Odening 2001, DeThoisy et al. 2003)

Diseases carried by cats and of special concern to humans are rabies and toxoplasmosis (Warfield and Gay 1986). Krebs et al. (2001) reported cats as being the domestic animals with the highest prevalence of rabies and although wild species such as raccoons are also carriers of the disease, recent studies have shown that acquisition of rabies in humans is more likely associated with pet cats, since people tend to come in contact more frequently with cats than wildlife. For example, Rosevare et al. (2009) reported stray cats to be disproportionally associated with human exposure to rabies and were the domestic species most frequently reported rabid. In another study in New York, cats were associated with 32.8% of cases of human exposures to rabies and 31.8% of treatments (Eidson and Bingham 2010).

Toxoplasmosis in humans is contracted after ingesting contaminated meat tissue, soil or water (Elmore et al. 2010), but the role of cats in transmission to humans is still unclear. A study examining exposure of sympatric wild and domestic species to three pathogens found extremely low seroprevalence for *T. gondii* in cats, supporting the idea that human exposure to this parasite is mainly through consumption of contaminated meat (Bevins et al. 2012). However, recent findings indicate that feral cats are the most likely source of wildlife exposure to *T. gondii* in both natural and urban areas and they certainly play a role in Toxoplasmosis dynamics (Fredebaugh et al. 2011), with implications for zoonotics.

Cats also serve as reservoirs of *Helicobacter heilmannii* (a bacteria that causes gastritis in humans), *Campylobacter spp*. transmitted by kittens (Hald and Madsen 1997), and *Bartonella henslae* (bacteria responsible for cat-scratch disease), which can be transmitted between individuals by the cat flea, without direct contact (Meining et al. 1998, Chomel 2000). The prevalence of *B. henslae* in cats ranges from 15% to 93% and feral cats have a higher incidence than pet cats (Dubey et al. 2002, Nutter et al. 2004b).

Ecto- and endo-parasites include fleas associated with cat-scratch disease, flea-borne typhus, and plague (McElroy et al. 2010), and several species of roundworms, hookworms, and tapeworms which can cause several diseases including gastric and skin affections both in humans and wildlife (Bowman et al. 2010).

The risk of zoonotics might increase in those areas in which populations of feral and stray cats concentrate, such as around areas with open access to food and shelter. It has been reported that approximately 75% of feral cats in a study in Florida were positive for a species of hookworm (Anderson et al. 2003), and it also appears that high population densities of stray cats increases the risk of diseases in kittens since interactions among individuals increase as size of the social group increases (Natoli 1994).

A potential positive effect cats could have on the dynamics of infectious diseases is through their role as predators of pest rodents, maintaining or improving the health of human populations that can suffer from transmission of pathogens circulating in the cat’s prey population (Daszak et al. 2000, Ostfeld et al. 2008). This claim is justified by observations of cascade effects and counter-intuitive responses of related species in the predator-prey interaction; responses that could also take place in predator-prey-parasite systems. However, evidence supporting this claim is debatable. For example, studies have suggested predators having a positive effect on the health of their prey populations by removing mainly sick individuals, with subsequent implications for transmission to humans by limiting the capacity of these sick individuals to spread the disease (Packer et al. 2003, Ostfeld and Holt 2004). On the other hand, studies have reported circumstances where predation increases the prevalence of infection (Holt and Roy 2007) by relaxing density-dependent constraints on the prey population and promoting an increase in young, susceptible individuals. Additionally, in places where cats’, rats’, or fleas’ densities are high, the human health risks associated with typhus increase (Case et al. 2006).

Given the cats’ feeding behavior and their broad diets, they are not limited by individual prey populations and it is unlikely they are able to limit the size of individual prey populations (Hanski et al. 2001, Ostfeld and Holt 2004) however, the dynamics of disease transmission could be altered through predation of specific age classes and subsequent alteration of the prey population structure.

***Hybridization***

The effects of domestic cats on wildlife vary in space and are highly dependent on their local densities and use of space (Roland and DeWan 2004). The spatial distribution, home range, and abundance of domestic cats are closely related to human activities and settlements providing favorable habitat through refuge and readily available food sources (Kerby and Macdonald 1988, Liberg and Sandell 2000). For example, Ferreira et al. (2012) were unable to detect cats living freely far away from people; however, male cats can roam far away from any human settlement during the mating season (Barratt 1997a, Germain et al. 2008), but even in this case they are still tied to a core activity area established around human settlements.

Despite this close relationship, some truly feral cats in natural areas might be able to live totally independent from humans, but as human population expands into new habitats and close to natural and semi-natural areas the frequency of encounters between domestic cats and wild species will increase with the subsequent increase in inter-specific interactions such as hybridization.

Wild cats and domestic cats are genetically distinct (Driscoll et al. 2007), and hybridization between domestic and wild cats has been extensively reported (Hubbard et al. 1992, Pierapoli et al. 2003, Lecis et al. 2006); nevertheless, genetic diversity of populations and interbreeding with domestic cats remain poorly studied (Oliviera et al 2008a).

The wild cats (*Felis silvestris*) is a polytypic species with three distinct but closely related subspecies: the African wildcat (*F. s. lybica*), the European wild cat (*F. s. silvestris*), and the Asian wild cat (*F. s. ornata*) (Sunquist and Sunquist 2002). The domesticated form (*F. s. catus*) can successfully breed with any wild species of the *silvestris* group (O’Brien and Johnson 2007), posing a serious threat to the wild sub-species throughout their range.

In areas where domestic and wild cats’ range overlap extensively, they mate creating viable and fertile individuals that dilute the native species genetic pool, which eventually might take some of this subspecies to extinction through hybridization and genetic introgression (the movement of a gene from one species into the gene pool of another by repeated crossing of an hybrid with a parent) (Biro et al. 2004, Randi 2008).

Extinction is a possibility, but there are several evolutionary outcomes of hybridization, some of them without major impacts for the parental taxa (Arnold 1992). Genetic pool alteration as well as behavioral changes might occur as a result of hybridization with consequences for social structure, movement patterns, territoriality and mating systems (Gompper et al. 1998). Some authors argue against any positive role of hybridization and others focus on its potential as a source of genetic variation, functional novelty, and new species (Seehausen 2004). The extent and rate of hybridization however, is difficult to determine without samples of genetically pure individuals to serve as a reference, which might be difficult to obtain since the phenomenon of hybridization between native and introduced populations is common (Rhymer and Simberloff 1996) and the frequency and level of hybridization vary geographically (Oliviera et al. 2008b).

***Implications***

Ecological systems are complex and interactions among and within levels might obscure other mechanisms responsible for the decline of prey species, thus management practices have to be carefully planned based on the best available information. Furthermore, public attitudes toward control measures play an important role on the implementation and feasibility of such management strategies. In a study on public preferences for free-ranging domestic cat management strategies, Ash and Adams (2003) found while surveyed participants recognized the predatory impact of cats on wildlife species, they did not consider this a legitimate reason for controlling population numbers, highlighting a discrepancy between public perception and management implications.

Several lethal and non-lethal methods have been proposed to reduce the effect of cat predation on wildlife populations, but applicability and effectiveness are still debatable. The efficiency of fitting cats with bells is unclear. Barratt (1998) found this tactic had no significant effect on the amount of prey caught while, on the other hand, Ruxton et al. (2002) suggested that cats with bells showed reduced prey delivery rates and Woods et al. (2003) reported capture rates were not affected by the use of bells, but the number of mammals killed and brought home by bell-equipped cats was smaller compared to cats without bells. These findings suggest wild animals do not recognize the bell as a warning sound and that some cats learn to stalk their prey silently, reducing the effectiveness of the bell (Coleman et al. 1997), furthermore, predation reduction will not reduce sub-lethal effects such as prey’s behavioral changes in response to high densities of potential predators (Beckerman et al. 2007).

It has been shown that cats have activity peaks mainly during dawn and dusk (Goszczynsk et al. 2009), but their activity patterns are highly variable. Therefore the strategy to keep them indoors only at night is not really an effective approach to reducing cat predation since they will hunt even during the day. Nonetheless it has been shown that cats that were kept indoors at night brought home fewer mammals than those that were allowed outside (Woods et al. 2003) and movement of pet cats from urban areas into surrounding habitat was significantly larger at night than during daylight (Barratt 1997a) .

Like other felines, cats tend to be solitary and roaming, but unlike their wild counterparts, when resources are abundant domestic cats do not maintain territories and tend to congregate around sources of food, forming breeding and feeding colonies (Natoli and DeVito 1988, Coleman and Temple 1993).

Home ranges in cats are highly variable depending on several factors including gender, location, body weight, and availability of food (Dards 1983, Gunther and Terkel 2002). It has been shown that home ranges of carnivores are inversely related to availability of food (Sandell 1989). Forge availability has been found to be the best predictor of free-roaming cats’ home ranges (Liberg et al. 2000) with true feral cats living on natural live prey to have the largest home ranges. Males tend to have larger territories than females (Liberg et al. 2000) and heavier cats tend to have larger home ranges (Molsher et al. 2005) resulting in higher densities of cats in urban areas where resources are readily available and home ranges overlap to a great extent compared to densities in rural areas. This suggests their impact is highly variable and depends on several factorshighlighting the importance of restricting cat movement, especially in those urban and suburban zones adjacent to natural areas or remnant habitats where the effect of cat predation on local populations is largely unknown (Ferreira et al. 2011).

Despite high mortality rates during the first year of life (Natoli 1994), fecundity rates, gestation periods, and litter size make cats a prolific species being able to reproduce any month of the year given proper food and habitat (Fitzwater 1994). Implications for cat neutering and spaying suggest females and young individuals should be the focus of sterilization efforts. In the U.S. 85 to 92% of pet cats are neutered (Centonze and Levy 2002, Chu et al. 2009). However, due to their high reproductive potential the remaining percentage reproductively active may have an important role in cat overpopulation. Additionally, several studies confirm that neutered cats tend to remain or become accomplished hunters (Calver et al. 2007, van Heezik et al. 2010) and although neutering seems to reduce roaming this reduction is not statistically significant (Lilith et al. 2008), stressing even further the importance of keeping cats indoors.

Crooks and Soule (1999) reported 21% of coyote scats collected contained cat remnants in remnant habitat in California. Furthermore, 46% of cat owners in those areas restricted their cat’s outdoor activity when coyotes were in the vicinity emphasizing the fact that keeping cats indoors might not only benefit wildlife populations but the cats themselves.

Responsible pet ownership is so far the best available approach to the problem of cat overpopulation. Other management approaches include lethal methods of cat removal and trap-neuter-release (TNR).

TNR has been shown to be an alternative to lethal methods of population control in some cases (Neville and Remfry 1984, Natoli 1994, Gibson et al. 2002, Levy et al. 2003) and has failed in some others (Clarke and Pacin 2002, Castillo and Clarke 2003). The most successful example (Levy et al. 2003) was accompanied by an intensive removal of individuals through adoption. This approach is not suitable for every situation such as around ecologically sensitive areas or in areas where native wildlife conservation is of particular concern. Additionally, there is limited evidence of the success of TNR programs on effectively controlling or reducing feral cat populations while there is a large volume of scientific evidence that refute TNR as an effective management strategy (reviewed in Longcore et al. 2009, Lepzyck et al. 2010). It is a long term solution to reach stable or declining populations and not a feasible practice in situations or places where high predation rates are negatively influencing population trends of other species.

Lethal methods of cat population control have proven effective on several island ecosystems (Algar et al. 2002, Nogales et al. 2004) but its effectiveness has been limited in mainland ecosystems due to immigration and emigration. Schmidt et al. (2009) reported a greater decrease in population size of demographically open populations when lethal strategies were implemented at high rates compared to any other strategy. The application of lethal methods is subject of concern and debate and in many places it is not possible to carry them out given high densities of owned, free-roaming cats or public disapproval.

Despite evidence that cat predation upon native and endangered species occurs and that they can transmit disease to wildlife and humans, the role of cats on the decline of several wildlife species remains unclear. Pet cats have lower infection rates than stray and feral cats for several pathogens of concern to wildlife (Longcore et al. 2009); however, the potential of disease and parasite transmission from cats to wildlife and vice versa exists and increases as population densities and inter- and intra-specific interactions increase.

Consideration of public health should play a role in management strategies of free-roaming cats since they may facilitate range expansion of pest mice (Hawkins et al. 2004) and may defecate in public places, parks, campuses, and hospitals with implications for zoonotic diseases (Lee et al. 2010).

Spaying and neutering cats has been shown to reduce aggression and fighting behavior and these subsidized cats might be vaccinated against several diseases preventing their spread. However, feral or stray cats that congregate at high densities around specific feeding sites are often exposed to dangerous and unsanitary conditions (Winter 2004) and procedures and policies for vaccination and alteration vary from site to site (Centonze and Levy 2002). The recommended number of vaccinations against diseases such as rabies is very difficult to achieve since it is unlikely that cats will be recaptured for boosters (Loyd and DeVore 2010). Levy and Crawford (2004) suggest only one doses of the rabies vaccine helps protect feral cats against the disease. Surveillance studies found the prevalence of intestinal parasitism in cats was low (Spain et al. 2001, Mekaru et al. 2007) suggesting the human health risks associated with feral cats is low. Nonetheless, vaccinated feral cats might still be carriers of diseases (Murray et al. 2009) and it is almost impossible to determine whether a free-roaming animal has been exposed to a disease and very difficult to determine its vaccination status since vaccination policies for feral and stray cats are highly variable. With the current cat overpopulation, the control of free-roaming cats becomes a matter of public health with related economic implications. Post exposure prophylaxis (PEP) treatments, the course of action after exposure to rabies, are highly effective but also expensive with costs up to $8,000 per individual case which are frequently covered by public health agencies (Recuanco et al. 2007). Other treatments such as antibiotics and possible hospitalizations are often associated with cat bites and scratches and add to the toll of treatment expenses (Talan et al. 1999)

Confinement is unpopular among cat owners with a small percentage of owners keeping their cats indoors. However, this tactic enhances animal welfare by protecting the cat from contracting and transmitting diseases (Courchamp et al. 2000)

Free-roaming cats suffer considerably higher rates of injury and disease (Jessup 2004). Nutter et al. (2004b) found the prevalence of *T. gondii* to be the lowest in pet cats kept indoors stressing even further the importance of such practice. The abundance and high densities in some areas of free-roaming cats pose a significant risk for wildlife as well as domestic species and human populations.

The efficacy of TNR programs in disease transmission dynamics and health risks is debatable because even if high vaccination rates are achieved vaccinated stray cats might still be carriers of diseases. Additionally, the feeding programs associated with TNR promote high multi-species aggregations increasing the rate of contact among the wild and domestic individuals that visit these sites with consequences for disease transmission. However, sterilizing and vaccinating cats are different activities than feeding them and it is illogical to suggest that an unmanaged population of feral or stray cats is better than a managed one, even if there are many deficiencies.

Current management strategies to control the cat population include education, removal, and trap-neuter-release programs. The management of feral cats requires a flexible approach in which each case is considered separately, and in some cases a combination of strategies will be needed. TNR programs might be more adequate for urban areas where trapping cats is easier and where more people would volunteer in such effort, whereas controlling cat populations by removal would be recommended for ecologically sensitive areas and natural settings where the risk of disease transmission among species and the effects of predation might be greater.

The effectiveness of each practice will depend on public support, ease of implementation, and rates of application. Pre- and post-implementation monitoring is necessary to properly quantify efficacy (Schmidt et al. 2009). It is important to understand that cats are not “bad” *per se*; they are an exotic species introduced by humans into novel environments, whose effects on wildlife populations and human health are only a consequence of deficient ownership practices and anthropogenic induced changes.

The fact that cats are currently the domestic species most commonly infected with rabies is also a consequence of deficient ownership practices. Cats are not vaccinated as frequently as they should be and they are allowed to roam outside (Krebs et al. 2003).

Education of pet owners plays a vital role not only on risk of disease transmission but also on cat population control. One study reported that the risk of developing toxoplasmosis is three times greater among women who have cats at home than among those who don’t (Al-Hamdan and Mahdi 1997). Another study found cats that had been vaccinated for rabies were 15 times more likely to be sterilized than those that have not been vaccinated and educated pet owners were less likely to abandon or relinquishing their animals (Ramon 2006) stressing even further the importance of pet owners’ education, proper pet care, and the owner-patient-veterinary bond.

The genetic integrity of several wildcat subspecies is considered to be seriously threatened by crossbreeding with free-ranging domestic cats. Extensive hybridization has been recorded throughout their range, posing challenges to conservation strategies of several endangered, threatened, and vulnerable species of wildcats.

The ability of domestic cats to hybridize with all the subspecies of wildcats is a challenge for implementation of wildcat conservation strategies since rates and proportions of admixture are difficult to determine and might be higher that currently estimated. This limitation becomes especially problematic given the rarity of many of the wild species and the abundance and spatial extent of the domestic form. On the other hand, the genetic similarity of the domestic cat with other wild felids has proven advantageous from another perspective: wildlife replication. Cloning has the potential to be a tool in conservation. Many of the rare, threatened wild cat species could benefit from interspecies nuclear transfer, a technique of duplicating endangered animals using a common, closely related species to serve as egg donors and surrogate mothers. This method has been successfully implemented to replicate Arabian and Asian wildcats using domestic cats as surrogate mothers (Anthes 2013). This is a promising approach to conservation of endangered species but not a solution to the problems that put them at risk in the first place.

That said, introduced species pose a threat to the genetic integrity of local species and attempts to reduce or eliminate such free roaming populations should be made. In many cases, as is the case of domestic cats, elimination is not feasible in many areas and other measures have to be put in place.

Crossbreeding can be prevented through responsible pet ownership practices, which include neutering and spaying of pet cats and restriction of outdoor movements. The problem with feral and stray cats is different. Not all individuals in a population of un-owned cats can be altered. If even a small proportion of fertile individuals from a widespread species can interbreed with wild, fragmented species disproportionate effects can occur for the wild species. Removal of individuals from these populations can be achieved through increased adoption rates and higher spaying and neutering rates could be implemented; however, the logistics of such increased effort are not straightforward and deserve consideration.

**Future Recommendations and Research**

Extensive evidence supports the fact that cats are effective predators preying upon native, introduced, common, and rare species and being responsible for the extinction of many populations and suspects of the decline of many others. However, in many cases evidence is indirect and until more extensive studies on the effects of cat predation on the population dynamics of the species preyed upon and the effects of competition with other predators are carried out, a definitive statement on the effects of cat predation on wildlife cannot be made. It is highly probable that the impacts of such predation will depend on several variables that might change across time and space.

Public attitudes toward control measures play an important role on the implementation and feasibility of such management strategies. Education of several sectors of the society following a multi-disciplinary approach is necessary in order to reconcile public preferences for free-ranging domestic cat management and the implications associated with such strategies.

Several tactics such as anti-predatory devises, partial restriction of cats’ movements, TNR programs, and lethal methods have been proposed to reduce the predation, disease transmission, and hybridization impacts of cats on wildlife populations. Evidence, however, suggests no single alternative is applicable or effective in all cases. It is imperative to recognize that management strategies will have to be applied on a one-to-one basis and that in many cases a combination of strategies will be the best approach.

Restriction of movement is not a popular practice among cat owners. Special efforts have to be made in order to make current and prospective owners aware of the benefits of keeping cats indoors, not only for wildlife and the environment, but also for the cats themselves and their human caretakers. Understanding the implications of keeping a pet exclusively indoors is fundamental to avoid posterior abandonment or relinquishment since this practice requires the willingness to spend time educating your pet, providing it with the proper space and accommodations for daily activities, and the time to be able to deal with any changes or behavioral issues.

Independently of the ownership status, vaccination rates have to increase in order to minimize the health risks to both humans and wildlife. The benefits of vaccination for owned cats is evident, but for stray and feral cats further research is needed in order to better estimate the efficacy of TNR programs on disease transmission dynamics and health risks. The best course of action so far is responsible pet ownership where owners keep their cats exclusively indoors and restrain from abandoning their pets.

Un-owned and free roaming cats are an issue of special interest from a wildlife perspective because of the controversy involved with their management. Within this context, the subject of community cats needs further study to really understand and evaluate the effectiveness of this approach on population growth, disease transmission, and hybridization rates.

Both lethal and non-lethal methods will find obstacles as long as there is a favorable, artificial environment that promotes immigration and supports a high density of cats. Since intact individuals will continue to breed the surplus of resources will promote addition of new individuals coming from within the population (reproduction), from immigration (other populations) or from abandonment (pet relinquishment).

Despite acknowledging the uncertainty inherent to the study and research of cats’ impact on wildlife, it is not wise to wait for all the data to be available before implementing management strategies. Several studies, using different methods and approaches, have concluded that cat predation is one of the main factors contributing to the decline of several species of wildlife and have already caused the extinction of many others.

The status of cats (from feral to stray to owned) can change over time. Gender and age specific traits seem to influence predatory and behavior and use of space. This makes it especially difficult to assess their impact but stresses the importance of studies pertaining to population structure and demographic metrics.

Responsible pet ownership will have a positive impact on public attitudes toward owned cats. However, un-owned cats might still be perceived as a nuisance factor, and efforts have to be made in order to make people aware of the societal implications of pet abandonment and the negative implications it has on prospective pet ownership. Education of the general public is also pivotal in the management of cat overpopulation: avoiding contact with feral and stray cats, restricting artificial feeding of free-roaming cats, and understanding the human and wildlife health risks associated with poor practices is central in achieving the goal of free-roaming cats’ population control and improving public attitudes toward cat ownership.

To achieve the goal of shrinking free-roaming cat populations and reducing their impacts on wildlife through predation, disease transmission, and hybridization several things need to happen. Pet adoption rates have to increase, pet relinquishment and abandonment rates have to decrease, vaccination and neutering have to be promoted, and owner education programs have to be put in place such as pet owners and the general public are aware of the impacts and consequences of the current free-roaming cat overpopulation.

**References:**

Adamec, R. E. 1976. The interaction of hunger and preying in the domestic cats (Felis catus): and adaptive hierarchy. *Behavioral Biology* 18: 263-272

Al-Hamdan, M. M., and N. K. Mahdi. 1997. Toxoplasmosis among women with habitual abortion. *WHO* publication 3: 310-315

Algar, D. A., A. A. Burbidge, and G. J. Angus. 2002. Cat eradication on Hermite Island, Montebello Islands, Western Australia. *In*: Veitch, C. R., and M. Clout (eds.). Pp. 14-18. Tuning the tide: the eradication of invasive species. IUCN SCC Invasive Species Specialist Group. IUCN. Gland, Switzerland and Cambridge, UK.

American Veterinary Medical Association Website. Pet Ownership Statistic. AVMA Website <https://www.avma.org/KB/Resources/Statistics/Pages/Market-research-statistics-US-pet-ownership.aspx>. Last Accessed June 2013

American Pet Products Manufacturers Association. 2005. 2005-2006 National pet owners survey. American Pet Products Manufacturers Association, Inc. Greenwich, CT.

Anderson, T. C., G. W. Foster, D. J. Forrester. 2003. Hookworms of feral cats in Florida. *Veterinary Parasitology* 10: 19-24

Anthes, E. 2013. Ditto. *Conservation Magazine*. <http://www>.conservationmagazine.org/2013/06/ditto/

Arnold, M. L. 1992. Natural hybridization as an evolutionary process. *Annual Review of Ecology and Systematics* 23: 237-261

Artois, M., and M. Remond. 1994. Viral diseases as a threat to free living wild cats (Felis silvestris) in continental Europe. *Veterinary Record* 134: 651-652

Ash, S. J., and. C. Adams. 2003. Public preferences for free-ranging domestic cat (*Felis catus*) management options. *Wildlife Society Bulletin* 31: 334-339

Baker, P. J., A. Bentley, R. Ansell, and S. Harris. 2005. Impact of predation by domestic cats Felis catus in an urban area. *Mammal Review* 35: 302-312

Baker, P. J., S. E. Molony, E. Stone, I. C. Cuthill, and S. Harris. 2008. Cats about town: is predation by free-ranging pet cats *Felis catus* likely to affect urban bird populations? *Ibis* 150: 86-99

Balogh, A. L., T. B. Ryder, and P. Marra, 2011. Population demography of Gray catbirds in the suburban matrix: sources, sinks, and domestic cats. *Journal of Ornithology* doi: 10.1007/s10336-011-0648-7

Barratt, D. G. 1998. Predation by house cats, *Felis Catus (L)* in Camberra, Australia, II. Factors affecting the amount of prey caught and estimates of the impact on wildlife. *Wildlife Research* 25: 475-487

Barratt, D. G. 1997a. Home range size, habitat utilization and movement patterns of suburban and farm cats *Felis catus. Ecography* 20:271-280

Barratt, D. G. 1997b. Predation by house cats, Felis Catus (L) in Canberra, Australia, I. Prey composition and preference. *Wildlife Research* 24: 263-277

Beckerman, A. P., M. Boots, and K. J. Gaston. 2007. Urban bird declines and the fear of cats. *Animal Conservation* 10: 320-325.

Berger, L., L. Skerratt, X. Zhu, S. Young, and R. Speare. 2009. Severe sparganosis in Australian tree frogs. *Journal of Wildlife Diseases* 45: 921-929

Bevins, S., S. Carver, E. Boydston, L. Lyren, M. Alldredge, K. Logan, S. Riley, R. Fisher, T. Vickers, W. Boyce, M. Salaman, M. Lappin, K. Crooks, and S. VandeWoude. 2012. Three pathogens in sympatric populations of pumas, bobcats, and domestic cats: implications for infectious disease transmission. *PLoS One* 7(2): e31403 doi:10.1371/journal.pone.0031403

Blackburn, T. M., P. Cassey. R. P. Duncan, K. L. Evans, and J. Gaston. 2004. Avian extinctions and mammalian introductions on oceanic islands. *Science* 305: 1955-1958

Biro, Z., L. Szemethy, and M. Heltai. 2004. Home range sizes of wild cats (Felis silvestris) and feral domestic cats (Felis silvestris catus) in a hilly region of Hungary. *Mammalian Biology* 69: 302-310

Bonnaud, E., K. Burgeois, E. Vidal, Y. Kayser, Y. Tranchant, and J. Legrand. 2007. Feeding ecology of a feral cat population on a small Mediterranean island. *Journal of Mammalogy* 88:1074-1081

Bonnaud, E., D. Zarzoso-Lacoste, K. Bourgeois, L. Ruffino, J. Legrand, and E. Vidal. 2010. Top-predator control on islands boosts endemic prey but not mesopredator. *Animal Conservation* 13: 556-561

Bowman, D. D., S. P. Montgomery, A. M, Zajac, M. L. Eberhard, and K. Kazacos. 2010. Hookworms of dogs and cats as agents of cutaneous larvae migrans. *Trends in Parasitology* 26: 162-167

Bradshaw, K. W. S. 1992. The cat: domestication and biology. *In*: Bradshaw K. W. S. (ed.). The behavior of the domestic cat. Pp. 1-15. CAB International. Wallingford, Oxon, UK

Bradshaw, J. W., D. Goodwin, V. Legrand-Defretin, and H. M. Nott. 1996. Food selection by the domestic cat, an obligate carnivore. Comparative Biochemistry and Physiology Part A. *Physiology* 114: 205-209

Bradshaw, J. W. S. 2006. The evolutionary basis for the feeding behavior of domestic dogs (*Canis familiaris*) and cats (*Felis catus*). *The Journal of Nutrition* 136: 1927S-1931S.

Burbidge, A. A., and N. L. McKenzie. 1989. Patterns in the modern decline of Western Australia’s vertebrate fauna: Causes and conservation implications. *Biological Conservation* 50: 143-198

Burbidge, A., and B. Manly. 2002. Mammal extinctions on Australian Islands: factors influencing species richness. *Journal of Biogeography* 24: 703-715

Calver, M., J. S. S. Thomas, S. Bradley, and H. McCutcheon. 2007. Reducing the rate of predation on wildlife by pet cats: the efficacy and practicability of collar-mounted pounce predators. *Biological Conservation* 137: 341-348

Carol, T. M. 1980. The effects of experience on the predatory pattern of cats. *Behavioral Neurobiology* 29: 1-28

Case, L. P. 2003. The Cat: Its Behavior, Nutrition, and Health. Iowa State University Press. Ames, IA

Case, J. B., B. Chomel, W. Nicholson, and J. E. Foley. 2006. Serological survey of vector borne zoonotic pathogens in pet cats and cats from animal shelters and feral colonies. *Journal of Feline Medicine and Surgery* 8:11-117

Castillo, D., and L. Clarke. 2003. Trap/neuter/release methods ineffective in controlling domestic cat colonies on public lands. *Natural Areas Journal* 23: 247-253

Centonze, L. A., and J. K. Levy. 2002. Characteristics of free-roaming cats and their caretakers. *Journal of the American Veterinary Medical Association* 220: 1627-1633

Chapin, F. S., E. S. Zavaleta, V. T. Evine, R. L. Naylor, P. M. Vitousek, H. L. Reynolds, D. U. Hooper, S. Lavorel. O. Sala, S. Hobbie, M. Mack, and S. Diaz. 2000. Consequences of changing biodiversity. *Nature* 405:234-242

Chomel, B. B. 2000. Cat-scratch disease. *Revue Scientifique et Technique Office Intenational des Epizooties* 19: 136-150

Chu, K., W. Anderson, and M. Rieser. 2009. Population characteristics and neuter status of cats living in households in the United States. *Journal of the American Veterinary Medical Association* 234: 1023-1030

Churcher, P. B., and J. H. Lawton. 1987. Predation by domestic cats in an English Village. *Journal of Zoology, London* 212: 439-455

Clarke, A. L., and T. Pacin. 2002. Domestic cat colonies in natural areas: a growing exotic species threat. *Natural Areas Journal* 22: 154-159

Coleman, J. S., and S. A. Temple. 1993. Rural residents’ free-ranging domestic cats: a survey. *Wildlife Society Bulletin* 21: 381-390

Coleman, J.S., S. A. Temple, and S. R. Craven. 1997. Facts on cats and wildlife: a conservation dilemma. Misc. Publications, USDA cooperative extension, University of Wisconsin. <http://wildlife.wisc.edu/extension/catfly3.htm>.

Courchamp, F., L. Say, and D. Pontier. 2000. Transmission of feline immunodeficiency virus in a population of cats (*Felis catus*). *Wildlife Research* 27: 603-611

Courchamp, F., J. L. Chaupis, and M. Pascal. 2003. Mammal invaders on islands: impact, control, and control impact. *Biological Reviews* 78: 347-383

Crooks, K. R. and M. E. Soule. 1999. Mesopredator release and avifaunal extinctions in a fragmented system. *Nature* 400: 563-565

Cunningham, M., M. Brown, D. Shindle, S. Terrell, K. Hayes, B. Ferree, R. McBride, E. Blankenship, D. Jansen, S. Citino, M. Roelke, R. Kiltie, J. Troyer, and S. O’Brien. 2008. Epizootiology and management of feline leukemia virus in the Florida puma. *Journal of Wildlife Diseases* 44: 537-552

Dabritz, H. A., E. R. Atwill, I. A. Gardner, M. A. Miller, and P. A. Conrad. 2006. Outdoor fecal deposition by free-roaming cats and attitudes of cat owners and non-owners toward stray pets, wildlife, and water pollution. *Journal of the American Veterinary Medical Association* 229: 74-81

Daniels, M. J., M. C. Golder, O. Jarret, and D. Macdonald. 1999. Feline viruses in wildcats from Scotland. *Journal of wildlife Diseases* 35: 121-124

Danner, R. M. D. M. Golitz, S. M. Hess, and P. C. Banko. 2007. Evidence of feline immunodeficiency virus, feline leukemia virus, and Toxoplasma gondii in feral cats on Mauna Kea, Hawaii. *Journal of Wildlife Diseases* 43: 315-318

Dards, J. L. 1980. The ecology and control of feral cats. In: Proceedings of a symposium held at Royal Holloway College University of London Pp. 30-49. Published by: The universities federation for animal welfare 8 Hamilton Close, South mimms, Potters Bar, Hertfordshire.

Dards, J. L. 1983. The behavior of dockyard cats: interactions of adult males. *Applied Animal Ethology* 10: 133-153

Daszak, P., A. A. Cunningham, and A. D. Hyatt. 2000. Emerging infectious diseases of wildlife: threats to biodiversity and human health. *Science* 287: 443-449

Dauphine, N., and R. J. Cooper. 2009. Impacts of free ranging domestic cats (*Felis catus*) on birds in the United States: A review of a recent research with conservation and management recommendations. Proceedings of the Fourth International Partners in Flight Conference: Tundra to Tropics Pp. 205-219.

deThoisy, B. M. Demar, C. Aznar, and B. Carme. 2003. Ecologic correlates of Toxoplasma gondii exposure in free-ranging Neotropical mammals. *Journal of Wildlife Diseases* 39: 456-459

Denny, E., and C. Dickman. 2010. Review of cat ecology and management strategies in Australia. A report for the Invasive animals cooperative research centre. Canberra.

Dickman, C. R. 1996. Overview of the impacts of feral cats on Australian fauna. Australian Nature Conservation Agency, Canberra.

Dowding, J. E., and E. C. Murphy. 2001. The impact of predation by introduced mammals on endemic shorebirds in New Zealand: a conservation perspective. *Biological Conservation* 99: 47-64

Driscoll, C. A., M. Menotti-Raymond, A. L. Roca, K. Hupe, W. E. Johnson, E. Geffen, E. H. Harley, M. Delibes, D. Pontier, A. Kitchener, N. Yamaguchi, S. O’Brien, and D. W. Macdonald. 2007. The Near Eastern origin of cat domestication. *Science* 317: 519-523.

Driscoll, C. A., J. Clutton-Brock, A. C. Kitchener, and S. J. O’Brien. 2009. The taming of the cat. *Scientific American* June 2009.

Duarte, A., M. Fernandes, N. Santos, and L. Tavares. 2012. Virological survey in free-ranging wild cats (Felis silvestris) and feral domestic cats in Portugal. *Veterinary Microbiology* 158: 400-404

Dubey, J. P. 2002. A review of Toxoplasmosis in wild birds. *Veterinary Parasitology* 106: 121-153

Dubey, J. P., and K. Odening. 2001. Toxoplasmosis and related infections. *In*: Parasitic diseases of wild mammals. Samuel, W.M. , Pybus, M. J., and A.A. Kocan (eds.).  
State University Press, Ames, Iowa, Pp. 478–519

Dubey, J. P., W. J. A. Saville, J. F. Stanek, S. M. Reed. 2002. Prevalence of *Toxoplasma gondii* antibodies in domestic cats from rural Ohio. *Journal of Parasitology* 88:802-803.

Dunn, E. H., and D. L. Tessaglia. 1994. Predation of birds at feeders in winter*. Journal of Field Ornithology* 65: 8-16

Eberhart, J. M., K. Neal, T. Schackelford, and M. R. Lappin. 2006. Prevalence of selected infectious disease agents in cats from Arizona. *Journal of Feline Medicine and Surgery* 8: 164-168

Eidson, M., and A. Bingman. 2010. Terrestrial rabies and human post exposure prophylaxis, New York, USA. *Emerging Infectious Diseases* 16 (3): 10.3201/eid1603.090298

Elmore, S. A., J.L. Jones, P. A. Conrad, S. Patton, D. S. Lindsay, and J. P. Dubey. 2010. *Toxoplasma gondii*: epidemiology, feline clinical aspects, and prevention. *Trends in Parasitology* 26: 190-196

Eymann, J., C. A. Herbert, D. W. Cooper, and J. P. Dubey. 2006. Serologic survey for *Toxoplasma gondii* and *Neospora caninum* in the common bushtail possum (*Trichosurus vulpecula*) from urban Sydney, Australia. *Journal of Parasitology* 92: 267-272

Fan, M., Y. Kuang, and Z. Feng. 2005. Cats protecting birds revisited. *Bulletin of Mathematical Biology* 67: 1081-1106

Ferreira, J. P., I. Leitao, M. Santos-Reis, E. Revilla. 2011. Human-related factors regulate the spatial ecology of domestic cats in sensitive areas for conservation. *PLos ONE* 6 (10): e25970

Fitzgerald, B. M. 1988. Diet of domestic cats and their impact on prey populations. Pp. 123-147. *In*: Turner, D. C., and P. Bateson (eds.). The Domestic Cats: The Biology of its Behaviour. Cambridge University Press. Cambridge.

Fitzgerald, B., and B. Turner. 2000. Hunting behavior of domestic cats and their impact on prey populations. Pp. 151-175. *In*: Turner, D. C., and P. Bateson (eds.). The Domestic Cats: The Biology of its Behaviour. Cambridge University Press. Cambridge.

Fitzwater, W. D. 1994. House cats (feral). Prevention and control of wildlife damage. Cooperative extension division; institute of Agriculture and Natural Resources. University of Nebraska-Lincoln. United States department of Agriculture. Animal and plant health inspection service. Animal damage control and Great Plains agricultural council wildlife committee.

Fredebaugh, S. L., N. E. Mateus-Pinilla, M. McAllister, R. E. Warner, and H. Weng. 2011. Prevalence of antibody to Toxoplasma gondii in terrestrial wildlife in a natural area. *Journal of Wildlife Diseases* 47: 381-392

George, W. G. 1974. Domestic cats as predators and factors in winter shortages of raptor prey. *Wilson Bulletin* 86: 384-396

Gerhold, R. W., and J. Yabsley. 2007. Toxoplasmosis in Red-bellied Woodpecker (*Melanerpes carolinus*). *Avian Diseases* 51: 992-994

Germain, E., S. Benhamou, and M. L. Poulle. 2008. Spatio-temporal sharing between the European wild cat, the domestic cat, and their hybrids. *Journal of Zoology* 276: 195-203

Gibson, K. L., K. Keizer, and C. Golding. 2002. A trap, neuter, and release program for feral cats on Prince Edward Island. *Canadian Veterinary Journal* 43: 695-698

Gittleman, J. L., S. M. Funk, D. Macdonald, and R. Wayne. 2001. Carnivore conservation. Cambridge University Press. Cambridge. 690 Pp.

Glass, G. E., L. C. Gardner-Santana, R. D. Holt, J. Chen, T. M. Shields, M. Roy, S. Schachterle, and S. Klein. 2009. Trophic garnishes: cat-rat interactions in an urban environment. *PLos ONE* 4(6): e574 doi:10.1371/journal.pone.0005794

Glen, A., and C. R. Dickman. 2005. Complex interactions among mammalian carnivores in Australia, and their implications for wildlife management. *Biological Review* 80: 387-401

Glen, A., O. Berry, D. Sutherland, S. Garretson, T. Robinson, and P. de Torres. 2010. Forensic DNA confirms intraguild killing of a chuditch (*Dasyurus geoffroii*) by a feral cat (*Felis catus*). *Conservation Genetics* 11: 1099-1101

Goszczynsk, J., D. Krauze, and J. Gryz. 2009. Activity and exploration range of house cats in rural areas of central Poland*. Folia Zoologica* 58:363-371

Gunther, I., and J. Terkel. 2002. Regulation of free roaming cat (Felis silvestris catus) populations: a survey of the literature and its implication to Israel. *Animal Welfare* 11: 171-188.

Hald, B., and M. Madsen. 1997. Healthy puppies and kittens as carriers of Campylobacter spp. with special reference to Campylobacter upsaliensis. *Journal of Clinical Microbiology* 35: 3351-3352

Hall, L. S., M. A. Kasparian, D. Van Vuren, and D. A. Kelt. 2000. Spatial organization and habitat use of feral cats (Felis catus L.) in Mediterranean California. *Mammalia* 64: 19-28.

Hanski, I., H.Henttonen, E. Korpimaki, L. Oksanen, and P. Turchin. 2001. Small rodent dynamics and predation. *Ecology* 82: 1505-1520

Harris, D. B. 2009. Review of negative effects of introduced rodents n small mammals on islands. *Biological Invasions* 7:1611-1630

Hartman, K. 2011. Clinical aspects of feline immunodeficiency and feline leukemia virus infection. *Veterinary Immunology and Immunopathology* 143: 190-201

Hawkins, C. C. 1998. Impact of a subsidized exotic predator on native biota: effect of house cats (Felis catus) on California birds and rodents. Ph. D. Dissertation. Texas A&M Unversity, College Station, TX. USA

Hawkins, C. C., W. E. Grant, and M. T. Longnecker. 2004. Effect of house cats, being fed in parks, on California birds and rodents. Pp. 164–170. In:Shaw, W. W., L. K. Harris, and L. Dandruff (eds.). Proceedings of the 4th International Urban Wildlife Symposium. School of Natural Resources, College of Agriculture and Life Science, University of Arizona, Tucson, AZ

Hildreth, A. M., S. M. Vantassel, S. E. Hygnstrom. 2010. Feral cats and their management. University of Nebraska, Lincoln, Nebraska Extension, EC1781

Hill, D., and J. P. Dubey. 2002. *Toxoplasma gondii*: transmission, diagnosis and prevention. *Clinical Microbiology and Infection* 8: 634-640

Holt, R. D., and M. Roy. 2007. Predation can increase the prevalence of infectious disease. *American Naturalist* 169: 690-699

Hone, J. 1999. Fox control and rock-wallaby population dynamics- assumptions and hypotheses. *Wildlife Research* 26: 671-673

Hubbard, A. L., S. McOrist, T. W. Jones, R. Biod, R. Scott, and N. Easterbee. 1992. Is survival of European wild cats in Britain threatened by interbreeding with domestic cats? *Biological Conservation* 61: 203-208

Jessup, D. A. 2004. The welfare of feral cats and wildlife. *Journal of the American Veterinary Medical Association* 225: 1377-1383

Jessup, D. A., K. C. Pettan, L. J. Lowenstine, and N. C. Pedersen. 1993. Feline leukemia virus infection and renal spirochetosis in free-ranging cougar (*Felis concolor*). *Journal of Zoo and Wildlife Medicine* 24: 73-79

Johnson, C. N., J. L. Isaac, and D. O. Fisher. 2007. Rarity of a top predator triggers continent wide collapse of mammal prey: dingoes and marsupials in Australia. *Proceedings of the Royal Society B-Biological Sciences* 274: 341-346

Kazacos, K., L. Wirtz, P. P. Burger, and C. S. Christmas. 1981. Raccoon ascarid larvae as a cause of fatal central nervous system dis ease in subhuman primates*. Journal of the American Veterinary Medical Association* 179: 1089-1094.

Kazacos, K. R. 2001. Baylisascaris procyonis and related species. *In*: Parasitic diseases of wild mammals. Samuel, W. M., M. J. Pybus, and A. A. Kocan (eds.). Second edition. Iowa State University Press. Iowa, USA

Keitt, B. S, C. Wilcox, B. R. Tershy, D. A. Croll, and J. Donlan. 2002. The effect of feral cats on the population viability of black vented shearwaters on Navidad Island, Mexico. *Animal Conservation* 5: 217-223

Kerby, G., and D. W. Macdonald. 1988. Cat society and the consequences of colony size. *In*: Turner, D. C., and P. Bateson (eds.). The domestic cat: the biology of its behavior. Cambridge Universti Press. Cambridge. Pp. 67-81

Korpimaki, E., and C. J. Krebs. 1996. Predation and population cycles of small mammals. *BioScience* 46: 754-764

Krebs, C.J. 2009. Ecology: The Experimental Analysis of Distribution and Abundance. 6th ed. [Benjamin Cummings, San Francisco](http://www.pearsonhighered.com/educator/academic/product/0,3110,0321507436,00.html). 655 pp.

Krebs, J. W., A. M. Mondul, C. E. Rupprecht and J. E. Childs. 2001. Rabies surveillance in the United States during 2000. *Journal of the American Veterinary Medical Association* 219: 1687-1699

Krebs, J. W., H. R. Noll, C. E. Rupprecht, and J. Childs. 2003. Rabies surveillance in the United States during 2001. *Journal of the American Veterinary Medical Association* 221: 1690-1701

Lecis, R., M. Pierapoli, Z. S. Biro, L. Szemethy, B. Ragni, F. Vercillo, and E. Randi. 2006. Bayesian analyses of admixture in wild and domestic cats (*Felis silvestris*) using linked microsatellite loci. *Molecular Ecology* 15: 119-131

Lee, A. C., P. M. Schantz, K. R. Kazacos, S. P. Montgomery, and D. D. Bowman. 2010. Epidemiologic and zoonotic aspects of ascarid infections in dogs and cats. *Trends in Parasitology* 26: 155-161

Lepzyk, C. A., A. G. Mertig, J. G. Liu. 2004. Landowners and cat predation across rural-to urban landscapes. *Biological Conservation* 115: 191-201

Levy, J. K., D. W. Gale, and . A. Gale. 2003. Evaluation of the effect of a long term trap-neuter-return and adoption program on a free-roaming cat population. Journal of the American Veterinary Medical Association 222: 42-46

Levy, J. K., and P. C. Crawford. 2004. Humane strategies for controlling feral cat populations. *Journal of the American veterinary Medicine Association* 225: 1354-1360

Liberg, O., and M. Sandell. 2000. Spatial organization and reproductive tactics in the domestic cat and other felids. *In*: Turner, D. C., and P. Bateson (eds.). The domestic cat: the biology of its behavior. Cambridge Universti Press. Cambridge. Pp 83-98

Liberg, O., M. Sandell, D. Pointer, and E. Natoli. 2000. Density, spatial organization and reproductive tactics in the domestic cat and other felids. *In*: The domestic cat: The biology of its behavior. Second edition. Turner, D. C., and P. Bateson (eds.). Pp. 119-147. Cambridge University Press. Cambridge

Liberg, O. 1984. Food habits and prey impact by feral and house based domestic cats in a rural area in southern Sweden. *Journal of Mammology* 65: 424-432

Lilith, M., M. Calver, and M. Garkaklis. 2008. Roaming habits of pet cats on the suburban fringe in Perth, Western Australia: what size buffer zone is needed to protect wildlife reserves? *In*: Lunney, D., A. Munn, and W. Meikle (eds.). Too close for comfort: contentious issues in human-wildlife encounters. Royal Zoological Society of New South Wales. Sydney, Australia Pp. 65-72

Lima, S. L., and L. M. Dill. 1990. Behavioral decisions made under the risk of predation: a review and prospectus. *Canadian Journal of Zoology* 68: 619-640

Longcore, T., C. Rich, and M. L. Sullivan. 2009. Critical assessment of claims regarding management of feral cats by trap-neuter-return. *Conservation Biology* 23: 887-894

Loss, S. R. T. Will, and P. Marra. 2013. The impact of free-ranging domestic cats on wildlife of the United States. *Nature Communications* Volume:

4. Article number: 1396 DOI:

doi:10.1038/ncomms2380

Lowe S., M. Browne, S. Boudjelas, M. De Poorter. 2000. 100 of the World’s Worst Invasive Alien Species A selection from the Global Invasive Species Database. Published by The Invasive species Specialist Group (ISSG**)** a specialist group of the Species Survival Commission (SSC) of the World Conservation Union (IUCN), 12 pp.

Loyd, K., and J. DeVore. 2010. An evaluation of feral cat management options using a decision analysis network. *Ecology and Society* 15(4):10

Loyd, K. A., S. Hernandez, J. Carroll, K. Abernathy, and G. Marshall. 2013. Quantifying free roaming domestic cat predation using animal-borne video cameras. *Biological Conservation* 160: 183-189

May, R. M. 1988. Control of feline delinquency. *Nature* 332: 392-393

McAllister, M. 2005. A decade of discoveries in veterinary protozoology changes our concept of subclinical toxoplasmosis. *Veterinary Parasitology* 132: 241-247

McElroy, K. M., B. L. Bagburn, E. B., Breitschwerdt, P. S. mead, and J. H. McQuiston. 2010. Flea associated zoonotic diseases of cats in the USA: bartonellosis, flea-borne rickettsioses, and plague. *Trends in Parasitology* 26: 197-204

Mead, C. J. 1982. Ringed birds killed by cats. *Mammal review* 12: 183-186

Meffe, G. K. and C. R. Carroll. 1997. Principles of Conservation Biology. Sinauer Associates. Sunderland, MA

Meining, A., G. Kroher, and M. Stolte. 1998. Animal reservoirs in the transmission of Helicobacter heilmanii. Results of a questionnaire-based study. *Scandinavian Journal of Gastroenterology* 33: 795-798

Mekaru, S. R., S. L. Marks, A. J. Felley, et al. 2007. Comparison of direct immunofluorescence, immunoassays, and fecal flotation for detection of Cryptosporidium spp. and Giardia spp. In naturally exposed cats in 4 Northern California animal shelters. *Journal of Veterinary Internal Medicine* 21: 959-965

Meli, M. L., V. Cattori, F. Martinez, G. Lopez, A. Vargas. 2009. Feline leukemia virus and other pathogens as important threats to the survival of the critically endangered Iberian lynx (Lynx pardinus). *PLoS ONE* 4: e4744 doi:10.1371/jornal.pone.0004744

Mellink, E., G. Ceballos, and J. Luevano. 2002. Population demise and extinction threat of the Angel de la Guarda deer mouse (*Peromyscus guardia*). *Biological Conservation* 108: 107-111.

Miereles, L. R., A. J. Galisteo, E. Pompeu, and H. F. Andrade. 2004. *Toxoplasma gondii* spreading in an urban area evaluated by seroprevalence in free-living cats and dogs. *Tropical Medicine and International Health* 9: 876-881

Millan, J., and A. Rodriguez. 2009. A serological survey of common feline pathogens in free-living European Wildcats (*Felis silvestris*) in Central Spain. *European Journal of Wildlife Research* 55: 285-291

Millan, J., M. G. Candela, F. Palomares, M. J. Cubero, A. Rodriguez. 2009. Disease threats to the endangered Iberian lynx *(Lynx pardinus*). *The Veterinary Journal* 182: 114-124

Miller, M. A., M. E. Grigg, W. A. Miller, H. A. Dabritz, E. R. James, A. C. Melli, A. E. Packham, D. Jessup, and P. A. Conrad. 2007. *Toxoplasma gondii* and *Sarcocystis neurona* infections on pacific coastal sea otters in California, USA: evidence for land-sea transfer of biological pathogens. *Journal of Eukaryotic Microbiology* 54: 48S-49S

Mitchell, J. and R. A. Beck. 1992. Free-ranging domestic cat predation on native vertebrates in rural and urban Virginia. *Virginia Journal of Science* 43: 197-206

Molsher, R., C. Dickman, A, Newsome, and W. Muller. 2005. Home ranges of feral cats (Felis catus) in central-western New South Wales, Australia. *Wildlife Research* 32: 587-595.

Murray, K. O., K. C. Holmes, and C. A. Hanlon. 2009. Rabies in vaccinated dogs and cats in the United States, 1997-2001. *Journal of the American Veterinary Medical Association* 235: 691-695

Natoli, E. 1994. Urban feral cats (*Felis catus*): perspective for a demographic control respecting the psycho-biological welfare of species. Annalidell Istitute Superiore di Santa Anita (Roma) 30: 223-227

Natoli, E., and E. DeVito. 1988. The mating system of feral cats living in a group. Pp. 99-108. *In*: Turner, D. C., and P. Bateson (eds.). The domestic cat: the biology of its behavior. Cambridge University Press, Cambridge.

Neville, P., and J. Remfry. 1984. Effect of neutering on two groups of feral cats. *Veterinary Record* 114: 447-450

Nogales, M., A. Martin, B. Tershy, J. Donlan, D. Vietch, N. Puerta, B. Wood, and J. Alonso. 2004. A review of feral cat eradication on islands. *Conservation Biology* 18: 310-319

Nutter, F., J. Levine, and M. Stpskopf. 2004a. Reproductive capacity of free roaming domestic cats and kitten survival rate. *Journal of the American veterinary Medical Association* 225: 1399-1402

Nutter, F. B., J. P. Dubey, J. F. Levine, E. B. Breitschwerdt, R. B. Ford, M. K. Stoksopf. 2004b. Seroprevalences of antibodies against *Bartonella henselae* and *Toxoplasma gondii* and fecal shedding of *Cryptosporidium* spp, *Giardia* spp, and *Toxocara cati* in feral and pet domestic cats. *Journal of the American Veterinary Medical Association* 225:1394-1398

O’Brien, S. J., and W. E. Johnson. 2007. The evolution of cats Scientific American 297: 68-75

O’Brien, S. J. , W. Johnson, C. Driscoll, J. Pontius, J. Pecon-Slattery, and M. Menotti-Raymond. 2008. State of cat genomics. *Trends in Genetics* 24: 268-279

Oliviera, R., R. Godinho, E. Randi, N. ferrand, and P. C. Alves. 2008a. Molecular analysis of hybridization between wild and domestic cats (*Felis silvestris*) in Portugal: implications for conservation. *Conservation Genetics* 9: 1-11

Oliviera, R., R. Godinho, E. Randi, N. ferrand, and P. C. Alves. 2008b. Hybridization versus conservation: are domestic cats threatening the genetic integrity of wildcats (Felis silvestris silvestris) in Iberian Penninsula? *Philosophical Transactions of the Royal Society B*. 363: 2953-2961

Ostfeld, R. S., and R. D. Holt. 2004. Are predators good for your health? Evaluating evidence for top down regulation of zoonotic disease reservoirs. *Frontiers in Ecology & Environment* 2: 13-20

Ostfeld, R. S., F. Kessing, and V. T. Eviner. 2008. Infectious disease ecology: effects of ecosystems on disease and of disease on ecosystems. Princeton University Press. Princeton.

Packer, C., R. D. Holt, P. J. Hudson, K. D. Lafferty, and A. P. Dobson. 2003. Keeping the herd’s health and alert: implications of predator control for infectious disease. *Ecology Letters* 6: 797-802.

Pain, S. 1997. The plague dogs. *New Science* 154: 32-37

Patrick, G. R., and K. M. O’Rourke. 1998. Dog and cat bites: epidemiologic analyses suggest different prevention strategies. *Public Health Reports* 113: 252-257

Patronek, J. G. 1998. Free-roaming and feral cats-their impact on wildlife and human beings. *Journal of the American Veterinary Medical Association* 212: 218-226.

Pierapoli, M., Z. S. Biro, M. Hermann, K. Hupe, M. Fernandes and B. Ragni. 2003. Genetic distinction of wildcat (Felis silvestris) populations in Europe, and hybridization with domestic cats in Hungary. *Molecular Ecology* 12: 2582-2598

Popp, J. W. 1988. Scanning behavior of finches in mixed species groups. *Condor* 90: 510-512

Portas, T. 2010. Toxoplasmosis in macrocodes: a review. *Journal of Zoo and Wildlife Medicine* 41: 1-6

Ramon, M. E. 2006. The effects of demographics and pet ownership on attachment towards and opinion about owned and unowned free-roaming cats. MSc Thesis. Texas A&M University, College Station TX

Randall, W., J. Thomas Cunningham, S. Randall, J. Luttschwager, and R. Johnson. 1987. A two-peak circadian system in body temperature and activity in the domestic cat, Felis catus L. *Journal of Thermal Biology* 12: 27-37

Randi, E. 2008. Detecting hybridization between wild species and their domestic relatives. *Molecular Ecology* 17: 285-293

Read, J., and Z. Bowen. 2001. Population dynamics, diet and aspects of the biology of feral cats and foxes in arid South Australia. *Wildlife Research* 28: 195-203

Recuenco, S., B. Cherry, and M. Eidson. 2007. Potential cost savings with terrestrial rabies control. *BMC Public Health* 2007, **7**:47 doi:10.1186/1471-2458-7-47

Rhymer, J. M., and D. Simberloff. 1996. Extinction by hybridization and introgression. *Annual Review of Ecology and Systematics* 27: 83-109

Risbey, D. A., M. C. Calver, J. Short, J. S. Bradley, and I. Eright. 2000. The impact of cats and foxes on the small vertebrate fauna of Heirisson Prong, Western Australia. II. A field experiment. *Wildlife Research* 27: 223-235

Robertson, I. D. 1998. Survey of predation by domestic cats. *Australian Veterinary Journal* 76: 551-554

Roelke, M. E., D. J. Forester, E. R. Jacobson, G. V. Kollias, F. W. Scott, M. C. Barr, J. F. Evermann, and E. C. Pirtel. 1993. Seroprevalence of infectious disease agents in free ranging Florida panthers (*Felis concolor coryi*). *Journal of Wildlife Diseases* 29: 36-49

Roland, K., and A. DeWan. 2004. Ecological impacts of inside/outside cats around a suburban nature preserve. *Animal Conservation* 7: 1-11

Roseveare, C. W., W. D. Goolsby, and I. M. Foppa. 2009. Potential and Actual Terrestrial Rabies Exposures in People and Domestic Animals, Upstate South Carolina, 1994–2004: A Surveillance Study. *BMC Public Health* 9**:**65 doi:10.1186/1471-2458-9-65

Russell, A. P., and H. N. Bryant. 2001. Claw Retraction and Protraction in the Carnivora: The Cheetah (Acinonyx Jubatus) as an Atypical Felid. *Journal of Zoology* 254 (1): 67–76.

Ruxton, G. D., S. Thomas, and J. W. Wright. 2002. Bells reduce predation of wildlife by domestic cats (*Felis catus*). *Journal of zoology* 256: 81-83

Salo, P., P. B. Banks, C. R. Dickman, and E. Korpimaki. 2010. Predator manipulation experiments: impacts on populations of terrestrial; vertebrate prey. *Ecological monographs* 80: 531-546

Sandell, M. 1989. The mating tactics and spatial patterns of solitary carnivores. *In*: Carnivore Behaviour, Ecology and Evolution. Gittleman, J.J. (ed.). Pp. 164-182. Chapman & Hall, London & Cornell University Press. New York.

Schmidt, P., T. M. Swannack, R. Lopez, and M. Slater. 2009. Evaluation of euthanasia and trap-neuter-return (TNR) programs in managing free-roaming cats populations. *Wildlife Research* 36: 117-125

Seehausen, O. 2004. Hybridization and adaptive radiation. *Trends in Ecology and Evolution* 19: 198-207

Short J., M. C. Calver, and D. A. Risbey. 2002. The impact of cats and foxes on the small vertebrate fauna of Heirisson Prong, Western Australia I. Exploring potential impact using diet analysis. *Wildlife Research* 26: 621-630

Sims, V. K. L. Evans, S. E. Newson, S. A. Tratatols, K. J. Gaston. 2008. Avian assemblage structure and domestic cat densities in urban environments. *Diversity and Distributions* 14: 387-399

Soule, M. E., D. T. Bolger, A. C. Alberts, J. Wright, M. Sorice, and S. Hill. 1988. Reconstructed dynamics of rapid extinctions of Chaparral-requiring birds in urban habitat Islands. *Conservation Biology* 2: 75-92.

Spain, C. V., J. M. Scarlett, S. E. Wade, and P. McDonough. 2001. Prevalence of enteric zoonotic agents in cats less than 1 year old in Central New York State. *Journal of Veterinary Internal Medicine* 15: 33-38.

Sunquist, M., and F. Sunquist. 2002. Wild cats of the world. The University of Chicago Press. Chicago and London.

Talan, D. A., D. M. Citron, F. M. Abrahhamian, G.J. Morgan, and E. J. Goldstein. 1999. Bacteriologic analysis of infected dog and cat bites. Emergency medicine animal bite infection study group. *New England Journal of Medicine* 340: 85-92

Tschanz, B., D. Hegglin, S. Gloor, and F. Bontadina. 2011. Hunters and non-hunters: skewed predation rate by domestic cats in a rural village. *European Journal of Wildlife Research* 57: 597-602

Turner, D. C. and P. Bateson. 2000. The domestic cat: the biology of its behavior. Second Edition. University Press. Cambridge

Van Heezik, Y. A. Smyth, A. Adams, and J. Gordon. 2010. Do domestic cats impose an unsustainable harvest on urban bird populations? *Biological Conservation* 143: 121-130

Vazquez-Dominguez, E., G. Caballos, and J, Cruzado. 2004. Extirpation of an insular subspecies by a single introduced cat: the case of the endemic deer mouse Peromyscus guardia on Estanque Island, Mexico. *Oryx* 38: 347-350.

Vigne, J. D., J. Guilaine, K. Debue, L. Haye, and P. Gerard. 2004. Early taming of the cat in Cyprus. *Science* 304: 259

Warfield, M. S., and W. I. Gay. 1986. The cat as a research subject. Pp. 41-54. *In*: Gay, W.I. (ed.). Health benefits of animal research. Foundation for biomedical research, Washington, D. C.

Winter, L. 2004. Trap-neuter-return programs-the reality and the impacts. *Journal of the American Veterinary Medical Association* 65: 1369-1376.

Woods, M., R. A, McDonald, and S. Harris. 2003. Predation of wildlife by domestic cats *Felis catus* in Great Britain. *Mammal Review* 33: 174-188

Work, T. M., J. G. Massey, D. S. Lindsay, and J. P. Dubey. 2002. Toxoplasmosis in three species of native and introduced Hawaiian birds. *Journal of Parasitology* 88: 1040-1042

Work, T. M., J. G. Massey, B. A. Rideout, C. H. Gardiner, D. B. Ledig, O. C. Kwok, and J. P. Dubey. 2000. Fatal toxoplasmosis in free ranging endangered ‘Alala from Hawaii. *Journal of Wildlife Diseases* 36: 205-212

Zoran, D. L. 2002. The carnivore connection to nutrition in cats. *Journal of the American Veterinary Medical Association* 221: 1559-1567.