Expert Statement of Grant C. Sizemore[1]

Trap, Neuter and Release (TNR) Programs Harm Wildlife, the Environment, Public Health, and the Cats They are Designed to Aid; They also Fail to Control Cat Populations

A Need for Management

Management of animal populations is an important element of maintaining a safe, healthy, and enjoyable environment for people and wildlife. When animal populations become too large or adversely affect the communities around them, human intervention is required. In the United States estimates suggest there are 114-188 million domestic cats (*Felis catus*) and that the number of owned cats has tripled in the last 40 years.[2,3,4] Of these, 60-160 million roam outdoors without restriction.[2,3] The presence of these outdoor cats has serious implications for the health and welfare of cats, wildlife, and people. Thus, outdoor domestic cats require effective management solutions.

Although many governments and institutions agree that managing outdoor cats is both necessary and desirable, how to appropriately manage feral domestic cats – those cats that live in a "wild" state – is a matter of public debate. To be effective, management programs for the

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

[3] Lepczyk C.A., N. Dauphine, D.M. Bird, S. Conant, R.J. Cooper, D.C. Duffy, P.J. Hatley, P.P. Marra, E. Stone, and S.A. Temple. 2010. What conservation biologists can do to counter Trap-Neuter-Return: Response to Longcore et al. Conservation Biology 24: 627-629.

[4] Loss S.R., T. Will, and P.P. Marra. 2013. The impact of free-ranging domestic cats on wildlife of the United States. Nature Communications. doi: 10.1038/ncomms2380.

growing number of feral cats, which have been estimated to number from 30-100 million, should eliminate the conditions which necessitated management in the first place.[3,5] The City of Albuquerque's Animal Welfare Department has instituted a feral cat program called Trap, Neuter, Return (TNR)[6]. TNR programs trap feral cats, spay or neuter them, and then release the cats back to the location from which they were trapped. The City's feral cat management strategy is inappropriate because TNR programs are ineffective as a means of population control and do not properly account for animal welfare, ecological, or public health concerns.[7]

TNR Is Ineffective at Population Control

TNR programs are often hailed as the most humane and effective means of feral cat population control by its supporters, despite a preponderance of scientific evidence that suggests otherwise. Numerous studies have analyzed TNR programs to determine their impact on feral cat populations. Overwhelmingly, studies indicate that population control via TNR is either impractical or unachievable. Below is a summary of peer-reviewed scientific studies that assess the efficacy of TNR programs.

Castillo and Clarke (2003)[8]

In a study that analyzed two managed TNR programs in public parks in South Florida, data "contradict[ed] the assertion that managed cat colonies decline in size over time" and "suggest[ed] that trap, neuter, and release programs are not an effective method to help

[5] Jessup D. 2004. The welfare of feral cats and wildlife. Journal of the American Veterinary Medical Association 225: 1377-1383.
[6] Such programs are also referred to as "Trap, Neuter, Release."
[7] Longcore T., C. Rich, and L.M. Sullivan. 2009. Critical assessment of claims regarding management of feral cats by trap-neuter-return. Conservation Biology 23: 887-894.
[8] Castillo D. and A.L. Clarke. 2003. Trap/Neuter/Release methods ineffective in controlling domestic cat "colonies" on public lands. Natural Areas Journal 23: 247-253.

control the population of unwanted feral and free-roaming cats." Not only did these colonies not reduce in size, in one colony the number of cats present actually significantly increased, likely due to illegal dumping of cats and/or the attraction of large numbers of stray cats to food provided by colony caretakers.

Andersen et al. (2004)[9]

TNR and humane euthanasia were evaluated as potential feral cat population control methods. By constructing population models using data from cat populations in urban environments, researchers were able to vary the percentage of cats spayed/neutered or humanely euthanized and to determine the subsequent impact on population. Results indicated that a 50% humane euthanasia rate would yield a reduction in the feral cat population by 10% per year, but even a 75% spay/neuter rate would still yield an increasing feral cat population. A spay/neuter rate as high as 88% of the feral cat population would be needed to merely stabilize population growth.

Foley et al. (2005)[10]

In a study published in the Journal of American Veterinary Medicine, scientists evaluated a county TNR program in San Diego County, California, from 1992 to 2003 and a county TNR program in Alachua County, Florida, from 1998 to 2004. Researchers identified the critical neutering fraction, the fraction of the population of feral cats that would have to be spayed or neutered to result in a population decline. The critical neutering fractions were 71% for San Diego County and 94% for Alachua County. In the last year of data collection, the numbers of spayed or neutered cats represented only 0.63% and 9.6% of all feral cats in San Diego County

[9] Andersen M.C., B.J. Martin, and G.W. Roemer. 2004. Use of matrix population models to estimate the efficacy of euthanasia versus trap-neuter-return for management of free-roaming cats. Journal of the American Veterinary Medical Association 225: 1871-1876.

[10] Foley P., J.E. Foley, J.K. Levy, and T. Paik. 2005. Analysis of the impact of trap-neuter-return programs on populations of feral cats. Journal of the American Veterinary Medical Association 227: 1775-1781.

and Alachua County, respectively. In other words, in Alachua County the spay/neuter rate was approximately one tenth of what the researchers concluded was needed to achieve a population decline; in San Diego County the spay/neuter rate was approximately one hundredth of the rate required. Analyses "indicated that any population-level effects were minimal" and that population growth continued. The authors even commented that results were similar to a previous study, which indicated that "no plausible combination of life history variables [e.g., survival, fecundity] would likely allow for TNR to succeed in reducing population size."

Natoli et al. 2006[11]

Researchers in Rome, Italy, evaluated data from an urban feral cat TNR campaign conducted from 1991 to 2000. After evaluating the resulting populations, the authors stated that "although many feral cats are neutered and many neutered cats die (from car accidents, etc.), many cats are introduced into colonies (mainly by abandonment of house cats)." Despite a massive effort that spayed or neutered almost 8,000 cats and removed kittens from colonies, the researchers concluded that, alone, TNR is a "waste of money, time, and energy."

Schmidt et al. 2009[12]

This study evaluated the effects of TNR and humane euthanasia over a 25-year period on a free-roaming cat population in Texas. By using a population model, researchers were able to vary implementation rates of both management strategies and alter immigration rates – the number of cats moving into a feral cat colony – to determine impacts on population size.

[11] Natoli E., L. Maraliano, G. Cariola, A. Faini, R. Bonanni, S. Cafazzo, and C. Fantini. 2006. Management of feral domestic cats in the urban environment of Rome (Italy). Preventive Veterinary Medicine 77: 180-185.
[12] Schmidt P.M., T.M. Swannack, R.R. Lopez, and M.R. Slater 2009. Evaluation of euthanasia and trap-neuter-return (TNR) programs in managing free-roaming cat populations. Wildlife Research 36: 117-125.

Results of the models indicated that humane euthanasia was consistently more effective than TNR with any degree of immigration and at least comparable when no immigration occurred (which is a highly improbable likelihood unless a colony is completely and physically enclosed). The authors also addressed the vacuum effect – the notion that an animal may be "sucked" into a location by resource or niche availability – often cited by TNR practitioners as a benefit of TNR over humane euthanasia. According to the study's authors, "regardless of the treatment type [humane euthanasia or TNR], any population reduction below carrying capacity would result in open niches that would eventually be filled by immigrants." Therefore, it is inappropriate for advocates of TNR programs to claim any superiority in this aspect of population control on the basis of the vacuum effect. Furthermore, the study's authors noted that the conditions often found in feral cat colonies, perpetuated in TNR programs (e.g., provisioning of food), increase the likelihood of immigration, thus suggesting that the vacuum effect actually applies more to TNR programs than any strategy that removes feral cats from the environment.

Gunther et al. 2011[13]

Researchers monitored free-roaming cats in an urban environment and examined population differences between four colonies, two spayed or neutered via a TNR program and two consisting of sexually intact cats. The percentage of cats spayed or neutered in the two spayed and neutered colonies was 73% and 75%. The study's results indicated that the number of cats in the TNR colonies significantly increased during the study period because of higher immigration into the colony, largely from cats not simply abandoned but living a feral lifestyle.

[13] Gunther I., H. Finkler, and J. Terkel. 2011. Demographic differences between urban feeding groups of neutered and sexually intact free-roaming cats following a trap-neuter-return procedure. Journal of the American Veterinary Medical Association 238: 1134-1140.

The number of cats in the sexually intact colonies actually decreased during the same period. The study's authors proposed that a "behavioral vacuum" led to increased immigration when cats were spayed or neutered because of decreased aggressive behaviors by resident cats following surgery, allowing other cats to move into the colony. This finding is in direct contradiction to the frequent claim by TNR practitioners that spayed or neutered cats will hold a territory and keep other cats out, a major tenet of TNR philosophy.

Summary

These studies confirm that TNR programs do not successfully reduce feral cat populations. The sterilization percentage required for each feral cat colony even to merely stabilize populations is impractical and potentially unachievable. For example, even for the 10-year, intensive TNR programs in San Diego County and Alachua County, the percentage of feral cats spayed or neutered required for program success (i.e., population decline) was "far greater than what was achieved."[10] In addition, Gunther et al. (2011) found that, even with relatively high spay/neuter rates, cat colony numbers still did not decline.[12] Furthermore, due to the conditions within cat colonies (e.g., feeding cats), TNR programs are likely to actually increase the number of cats in an area. The City of Albuquerque's Animal Welfare Department has stated it is following the advice of organizations such as The Humane Society of the United States, which advocates that TNR programs feed cat colonies.[14,15] Even if Albuquerque staff do not feed the colonies, the colony presence often encourages individuals to provide food.[13] Finally, because TNR programs

[14] Ayres K. Animal Activist Fights Feral Cat Programs. KRQE News 13, 12/8/2013, https://www.youtube.com/watch?v=3YT1hdQdG9E.

[15] The Humane Society of the United States. Outdoor Cats: Frequently Asked Questions. 6/20/2014, http://www.humanesociety.org/issues/feral_cats/qa/feral_cat_FAQs.html?credit=web_id83574224#Do_people_take_care_of_feral_cats_What_d. accessed 6/25/2014.

do not completely enclose feral cat colonies, immigrant or abandoned cats are drawn into colonies and ensure that the population will not reduce.

TNR Sacrifices Animal Welfare

Although animal welfare concerns are often used to justify TNR programs, these programs actually decrease the welfare of both cats and wildlife by enabling feral cats to continue to roam outdoors. Feral cats are subject to disease, predation, trauma, and poisoning from toxic materials. For feline leukemia virus and feline immunodeficiency virus, for example, risk of infection with these two potentially fatal viruses is significantly greater in cats living outdoors.[16] In fact, studies indicate that stray and feral cats are far more likely to be infected by disease-causing pathogens than owned cats, including those that roam.[6] Feral cats are also a potential reservoir for parasites like hookworms, and one study found that over 92% of randomly selected feral cats were infested with fleas, which are both uncomfortable and dangerous for cats.[17,18] Outdoor cats are also at risk of being attacked and/or killed by dogs, raptors, or coyotes. Coyotes, in particular, are adept cat predators. Although not always killing cats for food, studies have found coyote diets with up to 42% cat content.[19,20] Conditions are such that People for the Ethical Treatment of Animals vigorously opposes TNR, taking the

[16] Levy J.K., H.M. Scott, J.L. Lachtara, and P.C. Crawford. 2006. Seroprevalence of feline leukemia virus and feline immunodeficiency virus infection among cats in North America and risk factors for seropositivity. Journal of the American Veterinary Medical Association 228: 371-376.
[17] Akucewich L.H, K. Philman, A. Clark, J. Gillespie, G. Kunkle, C.F. Nicklin, E.C. Greiner. 2002. Prevalence of ectoparasites in a population of feral cats from north central Florida during the summer. Veterinary Parasitology 109: 129-139.
[18] Andersen T.C., G.W. Foster, and D.J. Forrester. 2003. Hookworms of feral cats in Florida. Veterinary Parasitology 115: 19-24.
[19] Gehrt S.D. 2007. Ecology of coyotes in urban landscapes. Proceedings of the 12th Wildlife Damage Management Conference 303-311.
[20] Grubbs S.E. and P.R. Krausmann. 2009. Observations of coyote-cat interactions. The Journal of Wildlife Management 73: 683-685.

position that it is inhumane for the cats as well as the wildlife they hunt, injure, and/or kill.[21] In the Journal of American Veterinary Medicine, veterinarian David Jessup acknowledged the implications for wild animal welfare as well, stating that "wild animals are not only killed by cats but are also maimed, dismembered, ripped apart, and gutted while still alive, and if they survive the encounter, they often die of sepsis because of the virulent nature of the [bacteria in the mouths] of cats."[5] The cumulative result of these threats for cats and wildlife is an often an untimely death and what the American Veterinary Medical Association calls "a national tragedy of epidemic proportions."[22]

TNR Sacrifices Wildlife

Domestic cats are a product of thousands of years of artificial selection, and these cats are now a distinct and separate species from their wild ancestors. As a domesticated species, cats have not shaped and been shaped by their natural environment as many other predators have. Consequently, domestic cats are a non-native species that has been artificially introduced by people into environments in the United States and globally, with significant impacts to natural systems. TNR programs, by maintaining cats in the environment, facilitate these impacts.

Feral and free-roaming cats are a well-known threat to wildlife. Globally, cats have contributed to the extinction of 33 species and remain the principal threat to 8% of the critically

[21] People for the Ethical Treatment of Animals. 2013. The Great Outdoors? Not for Cats! http://www.peta.org/issues/companion-animals/the-great-outdoors-not-for-cats.aspx, accessed 6/18/2014.
[22] American Veterinary Medical Association. 2014. Free-roaming abandoned and feral cats. https://www.avma.org/KB/Policies/Pages/Free-roaming-Abandoned-and-Feral-Cats.aspx, accessed 6/18/2014.

endangered birds, mammals, and reptiles.[23] Due to the scale and severity of their impacts outdoors, the International Union for the Conservation of Nature (IUCN) lists domestic cats as one of the world's worst non-native invasive species.[24] An invasive species is one whose introduction causes "economic, or environmental harm or harm to human health."[25] Cat impacts to wildlife are particularly severe because domestic cats are instinctive predators that will hunt and kill regardless of hunger. While indoors, this prey drive is evident when cats chase feather toys, balls of yarn, or lasers. When outdoors, however, these toys are replaced by birds, mammals, and reptiles. This instinctive predatory drive of cats and the resulting environmental impacts are amplified with feral cats because of their constant presence outdoors and their ability to maintain a much closer affiliation with people than native predators. Cats are generally far more comfortable around people, and people are generally more comfortable around cats than native predators (e.g., coyotes, skunks, or cougars). Furthermore, outdoor cats may exist in densities 10-100 times greater than native predators and reach over 3,885 animals per square mile.[26,27]

[23] Medina F.M., E. Bonnaud, E. Vidal, B.R. Tershy, E.S. Zavaleta, C.J. Donlan, B.S. Keitt, M. Le Corre, S.V. Horwath, and M. Nogales. 2011. A global review of the impacts of invasive cats on islands endangered vertebrates. Global Change Biology 17: 3503-3510.

[24] Lowe S., M. Browne, S. Boudjelas, and M. De Poorter. 2000. 100 of the World's Worst Invasive Alien Species: A Selection from the Global Invasive Species Database. The Invasive Species Specialist Group, International Union for the Conservation of Nature.

[25] Executive Order Number 13112, 64 Federal Register 6183-6186 (February 3, 1999).

[26] Liberg O., M. Sandel, D. Pontier, and E. Natoli. 2000. Density, spatial organization and reproductive tactics in the domestic cat and other felids. pp. 119-147 *in* D.C. Turner and P. Bateston (Ed.), The Domestic Cat: the Biology of its Behavior, Cambridge University Press.

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

In the United States and Canada, predation by outdoor cats is the number one source of direct, human-caused mortality to birds.[4,28] A study by scientists from the Smithsonian Conservation Biology Institute and the U.S. Fish and Wildlife Service in 2013 estimated that cats kill approximately 2.4 billion birds and 12.3 billion mammals every year in the lower 48 states alone.[4] In this study, 69% of bird mortality and 89% of mammal mortality was caused exclusively by un-owned (e.g., feral) cats. These estimates are often surprising to many people, including cat owners, because cat owners significantly underestimate their owned cat's hunting prowess. In a study that attached cameras to owned cats allowed outdoors, researchers identified that only 23% of all wildlife kills made by cats were returned to the home, thus suggesting that personal observations are insufficient to accurately evaluate total wildlife mortality caused by cats.[29]

Even when feral cats do not directly kill or maim wildlife, their mere presence is enough to cause sublethal effects (e.g., altered prey behavior) that can have lethal results. Scientists have evaluated the sublethal effects of cats on nesting birds and observed a reduction in feeding of young and an increase in nest predation by other predators when cats are simply nearby.[30] This observed phenomenon may contribute to the "reduced chick conditions and smaller clutch sizes that characterize urban bird populations [where cats are more abundant] in comparison with their rural [counterparts]."[27,31] By altering the behavior of wildlife, outdoor

[28] Blancher P. 2013. Estimated number of birds killed by house cats (Felis catus) in Canada. Avian Conservation and Ecology 8: 3. http://dx.doi.org/10.5751/ACE-00557-080203.
[29] Loyd K.A.T., S.M. Hernandez, J.P. Carroll, K.J. Abernathy, and G.J. Marshall. 2013. Quantifying free-roaming domestic cat predation using animal-borne video cameras. Biological Conservation 160: 183-189.
[30] Bonnington C., J.J. Gaston, and K.L. Evans. 2013. Fearing the feline: domestic cats reduce avian fecundity through trait-mediated indirect effects that increase nest predation by other species. Journal of Applied Ecology 50: 15-24.
[31] Chamberlain D.E., A.R. Cannon, M.P. Toms, D.I. Leech, B.J. Hatchwell, and K.J. Gaston. 2009. Avian productivity in urban landscapes: a review and meta-analysis. Ibis 151: 1-18.

cats disrupt ecological communities with potentially fatal consequences for individuals and widespread consequences for populations.

TNR Endangers Public Health

TNR programs fail to address the public health concerns associated with colonies of feral cats roaming outdoors. Not only do feral cats have the potential to bite or scratch, they also carry a number of parasites and diseases. The Centers for Disease Control and Prevention (CDC) recognizes 16 separate diseases and parasites that cats may transmit to people.[32] These include cat scratch disease, hookworms, *salmonella*, roundworms, and plague. Since 2004, 70 cats have tested positive for plague in New Mexico alone.[33] The Centers for Disease Control and Prevention recognizes cats as a "highly susceptible" and "common source of…infection in humans."[34] Perhaps the most insidious of the diseases cats can spread to people, however, are rabies and toxoplasmosis.

Rabies is a fatal viral disease that affects all mammals, including cats and people. Although wildlife species account for the majority of rabid animals in the United States, domestic cats are consistently the top source of rabies among domestic animals.[35] Furthermore, domestic cats represent a far greater risk of human exposures to the disease

[32] Centers for Disease Control and Prevention. 2014. Cats. http://www.cdc.gov/healthypets/pets/cats.html, accessed 6/19/2014.
[33] New Mexico Department of Health. Confirmed Pet Plague, New Mexico, 2004-2012. http://nmhealth.org/ERD/HealthData/documents/ConfirmedPetCases_NM_2004_2012.pdf, accessed 9/23/2013.
[34] Centers for Disease Control and Prevention. 2012. Plague, Information for Veterinarians. http://www.cdc.gov/plague/healthcare/veterinarians.html, accessed 7/28/2014.
[35] Dyer J.L., R. Wallace, L. Orciari, D. Hightower, P. Yager, and J.D. Blanton. 2013. Rabies surveillance in the United States during 2012. Journal of the American Veterinary Medical Association 243: 805-815.

because people, especially children, are more likely to interact with cats than wildlife.[36] According to a study led by CDC scientists, TNR programs – even those that incorporate a one-time rabies vaccine – "[do] not adequately meet feral cat population control needs that public health and animal welfare necessitate" and "should not be endorsed as an effective approach for mitigating health concerns related to feral cat colonies."[36] In 2012, at least a dozen residents in Carlsbad, New Mexico, were forced to undergo post-exposure prophylaxis injections and 30 dogs had to be euthanized after being exposed to rabies by feral cats released back into the environment through the city's TNR program.[37] The National Association of State Public Health Veterinarians' (NASPHV) *Compendium of Animal Rabies Prevention and Control, 2011*, which is endorsed by the American Public Health Association, American Veterinary Medical Association, Association of Public Health Laboratories, Council of State and Territorial Epidemiologists, and National Animal Control Association, recommends that stray cats should be removed from the community.[38] The NASPHV, recognizing the public health risks from feral cats, also takes the position that "there is no evidence that colony management programs will reduce diseases such as bartonellosis, larval migrans, toxoplasmosis, and vector-borne diseases. Rabies will also continue to be a risk, as such colonies are not closed."[39]

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[36] Roebling A.D., D. Johnson, J.D. Blanton, M. Levin, D. Slate, G. Fenwick, and C.E. Rupprecht. 2013. Rabies prevention and management of cats in the context of Trap-Neuter-Vaccinate-Release programmes. Zoonoses and Public Health. doi: 10.1111/zph. 12070.

[37] Justin D.A. 2012. Feral Cats Cause Rabies Outbreak in New Mexico. Opposing Views (April 17, 2012), http://www.opposingviews.com/i/society/animal-rights/feral-cats-cause-rabies-outbreak-new-mexico.

[38] National Association of State Public Health Veterinarians. 2011. Compendium of Animal Rabies Prevention and Control, 2011. http://www.nasphv.org/Documents/RabiesCompendium.pdf.

[39] National Association of State Public Health Veterinarians. 1996. Free-roaming/Unowned/Feral Cats. Position Statement. http://www.abcbirds.org/abcprograms/policy/cats/pdf/NASPHV%201996%20%20-%20Free-roaming,%20unowned,%20feral%20cats.pdf.

Toxoplasmosis, a disease caused by infection with the parasite *Toxolasma gondii*, is another public health risk that TNR entirely fails to address and, in fact, exacerbates. *T. gondii* relies on felids, animals in the cat family – including domestic cats – to complete its life cycle but may infect a wide variety of intermediate hosts, including humans and all other warm-blooded species.[40] As many as 74% of all domestic cats will acquire *T. gondii* during their lifetime and excrete hundreds of millions of tiny, infectious eggs called oocysts in their feces.[40] These highly resilient eggs can survive periods of cold and dehydration and may remain infectious in the environment for up to 18 months.[40,41] A study published in 2013 by scientists from The Stanley Medical Research Institute and Johns Hopkins University admitted that "because cats are now so ubiquitous in the environment, one may become infected by neighboring cats which defecate in one's garden or play area, or by playing in public areas such as parks or school grounds. Indeed, as cats increasingly contaminate public areas with *T. gondii* [eggs] it will become progressively more difficult to avoid exposure."[42]

Toxoplasmosis in humans can be contracted in multiple ways and may be severe. Humans may acquire infection with *T. gondii* by ingesting or inhaling the parasite's eggs, by eating undercooked and infected meat, from a pregnant woman to her fetus, or through blood transfusions and organ transplants.[40,43] Although tracking the source of infection has historically been difficult and pathways may vary by country, exposure in the United States is

[40] Tenter A.M., A.R. Heckeroth, and L.M. Weiss. 2000. Toxoplasma gondii: from animals to humans. International Journal of Parasitology 30: 1217-1258.
[41] Frenkel J.K. 2000. Biology of Toxoplasma gondii. pp. 9-25 *in* P. Ambroise-Thomas and E. Peterse (Ed.), Congenital Toxoplasmosis: Scientific Background, Clinical Management, and Control. Springer-Verlag, Paris.
[42] Torrey E.F. and R.H. Yolken. 2013. Toxoplasma oocysts as a public health problem. Trends in Parasitology 29: 380-384.
[43] Hill D. and J.P. Dubey. 2012. *Toxoplasma gondii*: transmission, diagnosis, and prevention. Clinical Microbiology and Infection 8: 634-640.

most likely from infectious eggs excreted in cat feces because there is not a strong tradition of eating undercooked foods. Indeed, evidence suggests that infections from *T. gondii* eggs excreted by cats are more prevalent than from eating undercooked meat, and one study of mothers with infants born with toxoplasmosis found that 78% were infected by cat-excreted parasitic eggs.[44,45] TNR programs purposefully maintain cats outdoors, where they are likely to acquire and transmit *T. gondii* infection.

The consequences of human infection vary depending on how the parasite is acquired. Toxoplasmosis acquired by a fetus from its mother may experience blindness, deafness, seizures, mental retardation, abortion, or neonatal death.[40,42] Infection can also be fatal for individuals with weakened immune systems, such as those with HIV, AIDS, or undergoing chemotherapy.[40,42,46] Even in adults with healthy immune systems toxoplasmosis has been linked to chorioretinitis, lymphadenopathy, multi-organ failure, schizophrenia, Alzheimer's Disease, depression, and brain cancer.[40,42,44,47,48] A 2014 study found a "remarkable" 35% reduction in certain memory capabilities in elderly adults infected with *T. gondii*.[49] These varied

[44] Hill D., C. Coss, J.P. Dubey, K. Wroblewski, M. Sautter, T. Hosten, C. Munoz-Zanzi, E. Mui, S. Withers, K. Boyer, G. Hermes, J. Coyne, F. Jagdis, A. Burnett, P. McLeod, H. Morton, D. Robinson, and R. McLeod. 2011. Identification of a sporozoite-specific antigen from *Toxoplasma gondii*. Journal of Parasitology 97: 328-337.

[45] Boyer K., D. Hill, E. Mui, K. Wroblewski, T. Karrison, J.P. Dubey, M Sautter, A.G. Noble, S. Withers, C. Swisher, P. Heydmann, T. Hosten, J. Babiarz, D. Lee, P. Meier, and R. McLeod. 2011. Unrecognized ingestion of *Toxoplasma gondii* oocysts leads to congenital toxoplasmosis and causes epidemics in North America. Clinical Infectious Diseases 53: 1081-1089.

[46] Montoya J.G. and O. Liesenfeld. 2004. Toxoplasmosis. The Lancet 363: 1965-1976.

[47] Kubesci O.Y., O. Miman, M. Yaman, O.C. Aktepe, and S. Yazar. 2011. Could *Toxoplasma gondii* have any role in Alzheimer's disease? Alzheimer Disease and Associated Disorders 25: 1-3.

[48] Undseth O., P. Gerlyng, A.K. Goplen, E.S. Holter, E. Von Der Lippe, and O. Dunlop. 2014. Primary toxoplasmosis with critical illness and multi-organ failure in an immunocompetent young man. Scandinavian Journal of Infectious Diseases 46: 58-62.

[49] Gajewski P.D., M. Falkenstein, J.G. Hengstler, and K. Golka. 2014. *Toxoplasma gondii* impairs memory in infected seniors. Brain, Behavior, and Immunity 36: 193-199.

negative health effects and clear connection with cats indicate that any program, such as TNR, that keeps cats roaming outdoors jeopardizes public health.

Conclusion

The need to humanely and effectively manage feral cat populations in Albuquerque and the rest of the United States is evident; however, the scientific evidence and New Mexico Department of Game and Fish concur that TNR is not a viable solution.[50] TNR programs not only fail to reduce populations of feral cats, they also diminish the health and welfare of cats, wildlife, and people. The City of Albuquerque's Animal Welfare Department, in the interest of animals and people, should discontinue its TNR program and instead establish an evidence-based feral cat management program that is proven to reliably reduce cat populations and simultaneously eliminate the many risks posed by roaming feral cats.

[50] New Mexico Department of Game and Fish. Letter to Albuquerque Mayor Richard J. Berry. 9/16/2013.