RESEARCH ARTICLE

# Trap/Neuter/Release Methods Ineffective in Controlling Domestic Cat "Colonies" on Public Lands

**Daniel Castillo**[1]
**Alice L. Clarke**
Department of Environmental Studies
Florida International University
11200 SW 8th Street
Miami, FL 33199 USA

[1] Corresponding author current address: Florida Fish and Wildlife Conservation Commission, Bureau of Wildlife Management, 10088 NW 53rd St., Sunrise, FL 33351 USA; dan.castillo@fwc.state.fl.us

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**ABSTRACT:** Domestic cat (*Felis catus* L.) advocates have formed coalitions whose goals are to promote the welfare of cats through the use of a specific nonlethal population control method. This method consists of trapping, neutering, and releasing cats into supervised cat colonies located on private and public lands, including state and county parks and natural areas. Advocates believe that this method will help reduce the number of unwanted cats and stabilize the population of unwanted cats over time. Furthermore, advocates claim that established colonies are temporary in nature and will decrease in size over time through death and adoption. This claim was tested through photographic and observational capture-recapture techniques in Miami-Dade County, Florida, USA, in two Metro-Dade County parks (A. D. Barnes Park and Crandon Marina). Although the number of original colony members decreased over time, illegal dumping of unwanted cats and the attraction of stray cats to provisioned food offset reductions in cat numbers caused by death and adoption. Furthermore, overall population size of the colony at A. D. Barnes Park increased over time, and at Crandon Marina neither decreased nor increased over time. Our study suggests that this method is not an effective means to control the population of unwanted cats and confirms that the establishment of cat colonies on public lands encourages illegal dumping and creates an attractive nuisance. We recommend that advocates of cat colonies seek a long-term solution to the pet overpopulation issue by redirecting their efforts toward the underlying problem of managing irresponsible pet owners.

**El Método de Atrapar/Castrar/Soltar muestra inafectiva en controlar las colonias de gatos domésticos en terrenos públicos**

**RESUMEN:** Los defensores de gatos domestico (*Felis catus* L.) han formado coaliciones cuyas metas son de promover el bienestar de los gatos por el uso de un método que no incluye su exterminación para controlar la población de gatos. Este método consiste en atraparlos, castrarlos, y soltarlos dentro de colonias localizadas en terrenos privados y públicos, incluyendo parques estatales, del condado y áreas naturales. Los defensores creen que este método ayudaría en la reducción del numero de gatos silvestres/callejeros y a la misma vez con el tiempo estabilizaría la población de los mismos. Esto fue puesto a prueba con el uso de técnicas fotográficas y observaciones en el condado de Miami-Dade, Florida, USA., en dos parques del condado de Miami-Dade (A.D. Barnes y Crandon Marina). Aunque el número original de gatos disminuyó con el tiempo, el abandono de gatos no deseados y la atracción de gatos callejeros hacia la comida que se les proporcionaba, contrarrestó la reducción en el total que pudiera ver sido causada por muerte o adopción. Además, el tamaño de la población de la colonia en A.D. Barnes creció con el tiempo, y en Crandon Marina ni desminuyo ni creció con el tiempo. Nuestro estudio sugiere que este método no es un medio efectivo de controlar la población de gatos silvestres/callejeros y confirma que el establecimiento de colonias de gatos en terrenos públicos incita mas abandono de gatos no deseados y crea una atracción fastidiosa. Nosotros recomendamos que los defensores de colonias de gatos deben buscar una solución de largo plazo para el tema de la sobre población de mascotas y deben dirigir sus esfuerzos hacia el problema fundamental, los irresponsables dueños de mascotas.

*Index terms:* capture-recapture, *Felis catus*, feral cats, public lands management, trap-neuter-release method

## INTRODUCTION

The number of domestic cats (*Felis catus* L.) in the United States has more than doubled since 1970 and is estimated now to exceed 100 million (Nassar and Mosier 1991, Coleman and Temple 1996). Many of these cats live outdoors as feral, abandoned, or free-roaming animals. This growing population has caused concern on two fronts: conservationists are concerned about the increased predation threat to wildlife species posed by this nonnative species, while cat welfare groups are concerned about the welfare of the domestic cats themselves.

Since the early 1990s, United States citizens concerned about the welfare and well being of homeless stray and feral cats have formed coalitions whose goals are to promote cat welfare through the use of a particular nonlethal population control method. This method consists of trapping stray cats, and neutering (sterilizing) and releasing (TNR) them into "managed cat colonies" located on private and public lands, including state and county parks and natural areas. Management of such colonies (no particular social structure

implied) consists of volunteers providing cats with food, water, and health care for sick and injured cats and trapping newcomers to the colony (see www.alleycat.org). The TNR approach is becoming increasingly common and well funded in the United States, especially in California and Florida (Roberto 1995, Balzar 1997, Louma 1997, Clarke and Pacin 2002). In Florida, the TNR approach is extremely popular and supporters have become so vocal that many county commissions are being pressured to allow the establishment of "managed cat colonies" on public lands.

The establishment of cat colonies in public parks and natural areas creates a number of wildlife conservation problems. The most serious of these problems are wildlife predation and disease transmission. Despite the fact that cat colony supporters assert that well-fed colony cats will not prey on wildlife (see www.alleycat.org and www.thecatnetwork.org), numerous scientific studies provide evidence to the contrary (e.g., Adamec 1976, Biben 1979, Leyhausen 1979, Liberg 1984, Fitzgerald 1988, Fitzgerald and Turner 2000). Even neutered cats have been shown to prey successfully on native birds and mammals (Churcher and Lawton 1987).

Predation by cats has been shown to be size dependent and species specific. Biben (1979) found that the incidence of killing in cats decreased when prey was large or difficult to catch. Childs (1986) found that absolute body size of the prey, not age, determines prey selection in cats and that predation by cats on rats (*Rattus* spp.) was limited to small rats weighing less than 200 g. A review of the impacts of feral and domestic cats on Australian native fauna by Dickman (1996) showed that cats had a preference for prey weighing less than 200 g and especially for prey weighing less than 100 g. These results suggest that predation by domestic cats is likely to be most detrimental to small-bodied native rodents.

Species-specific preference by cats is a concern because cats are morphologically and behaviorally best adapted to catching young rabbits and small rodents (Fitzgerald and Turner 2000). Cats can continue to exert heavy predation pressure on favored prey until the point at which their favorite prey reaches extremely low population densities (Fitzgerald 1988). Liberg (1984) found that wild rabbits (*Oryctolagus cuniculus* Lilljeborg) were the most important prey species of the house cats in his study in Sweden.

Conservationists are therefore concerned about the impact that managed cat colonies can have on species composition. Hawkins (1998) studied the impact of organized cat colonies in Alameda County, California, USA, on rodent populations. After two years of live trapping, Hawkins (1998) observed that an area without cats had twice as many rodents as an area supporting a cat colony, and that over 70% of the rodent community in this area was composed of the following native species: California meadow vole (*Microtus californicus* Rafinesque), deer mice (*Peromyscus* spp.), and harvest mice (*Reithrodontomys megalotis* Giglioli). Conversely, almost 90% of the rodent population caught in the area supporting a cat colony consisted of the exotic house mouse (*Mus musculus* L.).

In Florida, domestic cats have also been recognized as predators and a serious threat to the following federally and state-listed endangered and threatened species: Key Largo cotton mouse, (*Peromyscus gossypinus allapaticola* Gloger), rice rat (*Oryzomys palustris natator* Baird), Key Largo woodrat (*Neotoma floridana smalli* Say and Ord), Lower Keys marsh rabbit (*Sylvilagus palustris hefneri* Gray), Choctawhatchee beach mouse (*P. polionotus allophrys* Gloger), Perdido Key beach mouse (*P. polionotus trissyllepsis* Gloger), Anastasia Island beach mouse (*P. polionotus phasma* Gloger), southeastern beach mouse (*P. polionotus niveiventri* Gloger), and roseate tern (*Sterna dougallii dougallii* Montagu) (U.S. Fish and Wildlife Service 1987, 1993, 1999). Forys and Humphrey (1999) found that cats caused 53% of all mortality of both juvenile and adult Lower Keys marsh rabbits, and suggested that efforts to save the marsh rabbit should focus on developing a plan that would help reduce domestic cat use of marsh rabbit habitat. Predation by cats also threatens the existence of rice rats (U.S. Fish and Wildlife Service 1999).

In addition, public health authorities have raised concerns about the possible transmission of diseases to humans and other species. In Australia, at least 30 species of pathogens that are found in cats have also been found in native fauna (Dickman 1996). The major types of zoonoses that cats could transmit to humans and other species include plague, rabies, toxoplasmosis, and encephalitis. Of these four types, rabies is the most likely to be transmitted by cats to humans and other domestic animals. In 1995, 288 cases of feline rabies were reported in the United States (Patronek 1998). Patronek (1998) considers that the risk of exposure to rabies as a consequence of having contact with feral cats is very real.

The second most likely disease to be transmitted is toxoplasmosis. Several outbreaks of toxoplasmosis in humans have been attributed to soil and water contaminated with oocysts shed from the feces of free-roaming cats (Patronek 1998). Encephalitis and bubonic plague are much less likely to occur, but the threat is still present. In 1994, five Florida children were hospitalized with encephalitis that was associated with cat scratch fever (Patronek 1998). Concerned about possible health hazards, organizations such as the American Association of Wildlife Veterinarians, the National Association of State Public Health Veterinarians, and the United States military have published position statements discouraging the establishment of managed cat colonies (Patronek 1998).

Supporters, unconvinced by the above evidence of predatory behavior, further assert that managed cat colonies are merely temporary in nature. Because the sterilization-based TNR control method will eliminate reproduction, supporters assume cat colony size will decline over time through the euthanasia of unhealthy cats, placement of adoptable cats, and the death of cats from natural causes (see www.thecatnetwork.org). Conservationists counter that colonies simply serve as dumping grounds for unwanted cats by unscru-

pulous owners and that supplemental food also attracts additional stray cats (Roberto 1995). Recruitment, and potentially breeding, may therefore continue and cat numbers may not decrease as expected. The purpose of our study was to test this assumption regarding managed cat colony population dynamics using colonies located in two Miami-Dade County, Florida, parks. Our methods consisted of collecting census data through photographic and observational capture-recapture techniques.

## METHODS

### Study Site

Our study was conducted in Miami-Dade County, Florida, in two Metro-Dade County parks: A. D. Barnes and Crandon Marina. A. D. Barnes Park is a 24-ha park located in the southwestern part of the county, 1 mile east of S.R. 826 and north of SW 40th Street. One-fifth of the park (5 ha) consists of endangered pine rockland and rockland hammock (Metro-Dade County Park and Recreation Department 1992). A. D. Barnes Park is a popular bird-watching site, especially during fall and spring migrations. Over 20 species of warblers and a variety of other bird species, including red-breasted nuthatch (*Sitta canadensis* L.), ovenbird (*Seiurus aurocapillus* L.), and summer tanager (*Piranga rubra* L.), have been recorded at this park (Pranty 1996; D. Castillo, pers. obs.). The managed cat colony at A. D. Barnes is located in the southeastern part of the park, adjacent to a parking lot serving a swimming pool area.

Crandon Marina is a popular site that is part of the facilities located at Crandon Park, a 365-ha park located on the north end of the island of Key Biscayne, 5 miles east of mainland Florida. Crandon Park contains a variety of biotic communities including sand dunes, coastal hammocks, coastal scrub, salt marsh, and mangroves (Metro-Dade County Park and Recreation Department 1991). Crandon Marina is located on the northwest end of the park. The marina contains a protected coastal beach area that has been designated as nesting grounds for the federally endangered least tern (*Sterna antillarum* Lesson). The main cat colony at the marina is found adjacent to the public restrooms, within a dense vegetative strip of coastal hammock.

### Capture-Recapture Techniques

Prior to the commencement of capture-recapture data collection, we spent several months identifying, describing, and photographing each of the cats living in the colonies at A. D. Barnes Park and Crandon Marina. We observed the cats with binoculars and recorded each cat's unique features: specific coat colors, scars, body type (i.e., large or small frame; normal, under, or over-weight); presence or absence of a clipped ear; sex; and degree of friendliness. Additionally, for each colony, we created a photo album containing photos of every cat that we had seen. Photographs were taken with a 35-mm camera, with interchangeable lenses (35 mm–80 mm and 80 mm–200 mm), and 400 ASA color film.

Observational and photographic capture-recapture data were collected at A. D. Barnes Park from 20 December 1999 to 7 January 2001, between the hours of 0700 and 1000, and at Crandon Marina from 3 January 2000 to 24 January 2001, between the hours of 1700 and 2200. The time blocks selected for each colony represented the best time of the day to see all cats. The cats were fed by colony managers between 0815 and 0900 at A. D. Barnes Park and between 1830 and 2030 at Crandon Marina. Throughout the course of the study, A. D. Barnes Park was sampled every 40 days after the completion of the initial visual capture session, and each capture-recapture session lasted 3 consecutive days. Crandon Marina was sampled every 35 days after the completion of the initial visual capture session, and each capture-recapture session lasted 4 consecutive days. The duration of data collection differed between parks because the colony at Crandon Marina had a larger population and we assumed it would take longer to capture all the individuals of this larger population. Each day of the visual capture-recapture sessions was considered an independent capture occasion. On each day, a cat was classified as captured (captured = 1) only if it was clearly identified based on unique features, and was classified as not captured (not captured = 0) if it was not seen or clearly identified. In each capture-recapture session, only adult or juvenile cats that were clearly identified at least once were included. Kittens were not included in the capture-recapture analysis. Any cat that was observed during the preliminary observations but was not present during the first capture-recapture session was not considered an original colony member. Furthermore, cats seen for the first time during a capture-recapture session were identified, photographed, categorized, and added to the checklist.

### Analysis

Data sets corresponding to each capture-recapture session were analyzed using the program CAPTURE (Otis et al. 1978). CAPTURE, a user-friendly program, has been extensively used to aid in estimating the size of closed populations (Otis et al. 1978). Readers are referred to Patuxent Wildlife Research Center Software Archives website (http://hinesj.er.usgs.gov/software.html) and Rexstad and Burnham (1991) for a detailed description of the CAPTURE analytical models. We could justify using a closed population model because our goal was to provide estimates of colony population size at distinct points in time and we could minimize the effect of emigration and immigration by limiting the length of each capture-recapture session to only a few days (Otis et al. 1978).

The CAPTURE program takes into account time, behavior, and heterogeneity (e.g., differences in age or sex) parameters and is capable of generating population estimates based on seven different models. The time parameter allows capture probabilities to vary by time (e.g., each capture-recapture session). The behavioral parameter allows capture probabilities to vary by behavioral responses (e.g., the animal may become trap wary and subsequently will not be captured again). The heterogeneity parameter allows capture probabilities to vary by individual animal (Otis et al. 1978). To analyze the data set for each capture-recapture session, we used

CAPTURE in a mode that sequentially ran all model types. Each model generated an estimated total population size (N), standard error value (SE), probability of capture ($P$), and 95% confidence interval (CI). The program generates a model selection criteria table that indicates which model has yielded the most appropriate sample estimator. In cases where we doubted the program's recommendations, we chose either the model that incorporates heterogeneity, the most robust of all the models (Jim Hines, USGS Patuxent Wildlife Research Center, pers. com.), or the model that we felt was the most appropriate sample estimator based on events that influenced the outcome of the capture-recapture session (i.e., heavy rain or strong wind influencing particular sessions).

The non-parametric Cox and Stuart test for trend was used to test for change in colony size (Conover 1999). For each park, lower and upper tail tests were conducted based on the number of original colony members, the total number of cats that were identified in a capture-recapture session, and estimates of total population size generated by CAPTURE. An alpha level of significance of 0.05 was applied throughout. Additionally, we used SPSS 10.0 for Windows to generate corresponding linear regression analyses.

## RESULTS

The low standard error values (A. D. Barnes: max = 1.96, min = 1.07; Crandon Marina: max = 2.62, min = 0.41) and high probability of capture values (A.D. Barnes: max = 0.90, min = 0.83; Crandon Marina: max = 0.90, min = 0.79) generated by CAPTURE during our analyses show that in each capture-recapture session we were able to identify almost all the cats present in the colonies. The maximum value for the probability of capture variable is 1.00.

For both A. D. Barnes Park and Crandon Marina, the results of a lower tail Cox and Stuart test for trend in the number of original colony members identified per capture-recapture session were significant (A. D. Barnes: $T \leq 0$, $P = 0.03$; Crandon Marina: $T \leq 0$, $P = 0.03$). However, for both A. D. Barnes Park and Crandon Marina the results of a lower tail Cox and Stuart test for trend in the total number of cats identified per capture-recapture session (A. D. Barnes: $T \leq 5$, $P = 1.00$; Crandon Marina: $T \leq 3$, $P = 0.81$) and in estimated total population size (A. D. Barnes: $T \leq 5$, $P = 1.00$; Crandon Marina: $T \leq 3$, $P = 0.81$) were nonsignificant. The results (A. D. Barnes identified, A. D. Barnes estimated, Crandon Marina identified, and Crandon Marina estimated) failed to support the hypothesis that managed cat colonies will decrease in size over time. Furthermore, for A. D. Barnes Park significant $P$-values were obtained on both the total number of cats identified per capture-recapture session (A. D. Barnes: $T \geq 5$, $P = 0.03$) and estimated population size (A. D. Barnes: $T \geq 5$, $P = 0.03$) when a Cox and Stuart test

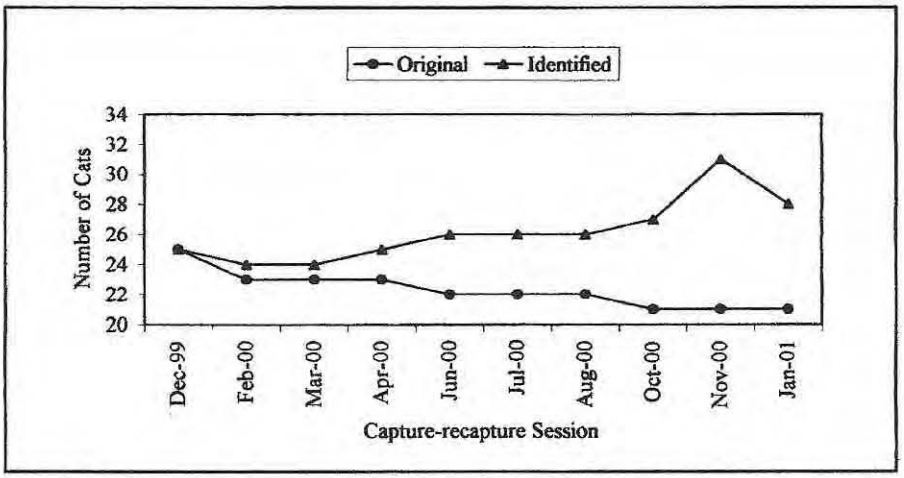


**Figure 1. Comparison of the number of original colony members and total number of cats identified per capture-recapture session for the cat colony at A.D. Barnes Park, Miami-Dade County, Florida. The line marked "Original" represents the trajectory of the original colony members during the course of our study. The total number of cats identified per capture-recapture session ("Identified") is presented for comparison.**

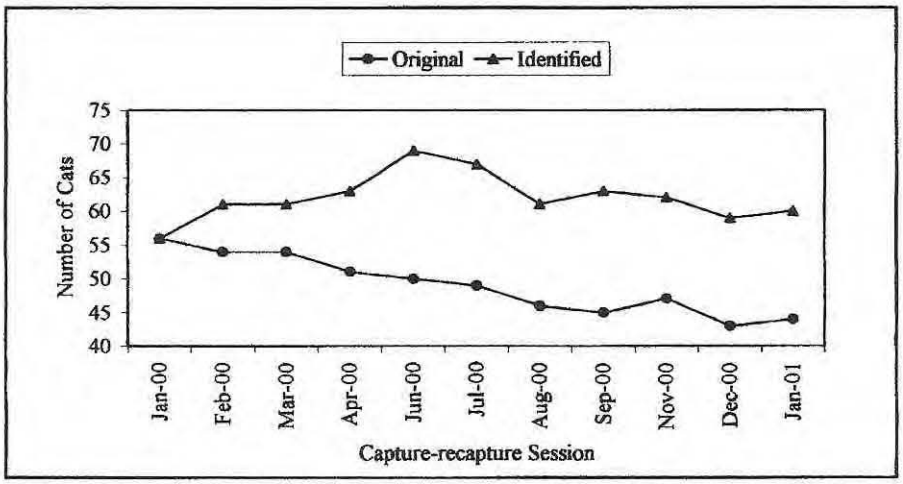


**Figure 2. Comparison of the number of original colony members and total number of cats identified per capture-recapture session for the cat colony at Crandon Marina, Miami-Dade County, Florida. The line marked "Original" represents the trajectory of the original colony members during the course of our study. The total number of cats identified per capture-recapture session ("Identified") is presented for comparison.**

for an upward trend was conducted, indicating that the colony was increasing in size over time. The results of both a lower and an upper tail Cox and Stuart test for trend in the total number of cats identified per capture-recapture session and in estimated total population size showed that there was insufficient evidence to conclude that the cat colony at Crandon Marina was either decreasing or increasing over time.

Additionally, a regression curve of the original numbers of colony cats identified per capture-recapture session at A. D. Barnes Park showed that the number of original cats in the colony was decreasing over time ($r^2 = 0.853$, $F(1,8) = 46.42$, $P < 0.001$, slope = -0.010). However, a regression curve based on total number of cats identified per capture-recapture session at A. D. Barnes Park showed that, overall, the cat colony was increasing over time ($r^2 = 0.676$, $F(1,8) = 16.70$, $P = 0.004$, slope = 0.014). The regression curve based on the number of original colony members identified per capture-recapture session at Crandon Marina showed that the number of original cats in the colony was also decreasing over time ($r^2 = 0.932$, $F(1,9) = 122.64$, $P < 0.001$, slope = -0.037). However, the regression curve based on total number of cats identified per sampling at Crandon Marina did not show a significant trend ($r^2 = .003$, $F(1,9) = 0.03$, $P = 0.863$, slope = 0.002). Figures 1 and 2 depict the number of original colony members and total number of cats that we identified per recapture session.

The overall population size of the colonies at A. D. Barnes Park and Crandon Marina did not follow the trend depicted by the trajectory of original colony members (Figures 3 and 4). Cats did disappear from the colonies. Some were adopted-out by colony managers. Others died from natural or human induced causes, or disappeared due to unknown causes. However, these reductions in cat numbers were counter-balanced by the addition of new cats to the colonies. During almost every capture-recapture session, we witnessed the introduction of at least one new cat into each of the two parks. These new cats were most likely the result of either illegal dumping of unwanted cats or the attraction of stray cats to the provisioned food. Occasionally, new cats taken away by colony volunteers to be sterilized were later brought back to the colony if the cat did not prove friendly enough for adoption. A constant trap and removal effort by three dedicated colony volunteers was the only reason the Crandon Marina colony did not increase in size over time.

## DISCUSSION

Our results contradict the assertion that managed cat colonies decline in size over time. Even though the number of original colony members decreased over time, illegal dumping of unwanted cats prevented the colonies at A. D. Barnes Park and

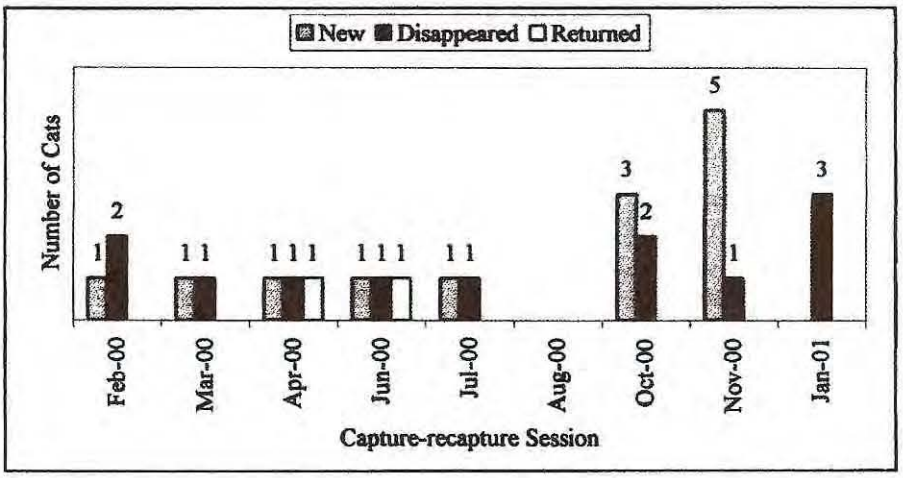


**Figure 3. Population dynamics for the cat colony at A. D. Barnes Park, Miami-Dade County, Florida. Light gray bars represent cats abandoned at the colony and/or cats newly introduced to the colony by colony managers. Black bars represent cats that disappeared from the colony because they were adopted, died from natural or human-induced causes, or disappeared due to unknown causes. White bars represent (1) shy cats that were present during certain capture-recapture sessions but absent during others, and (2) new cats that were not friendly enough to be adopted that were taken away to be neutered but were later brought back to the colonies by colony volunteers.**

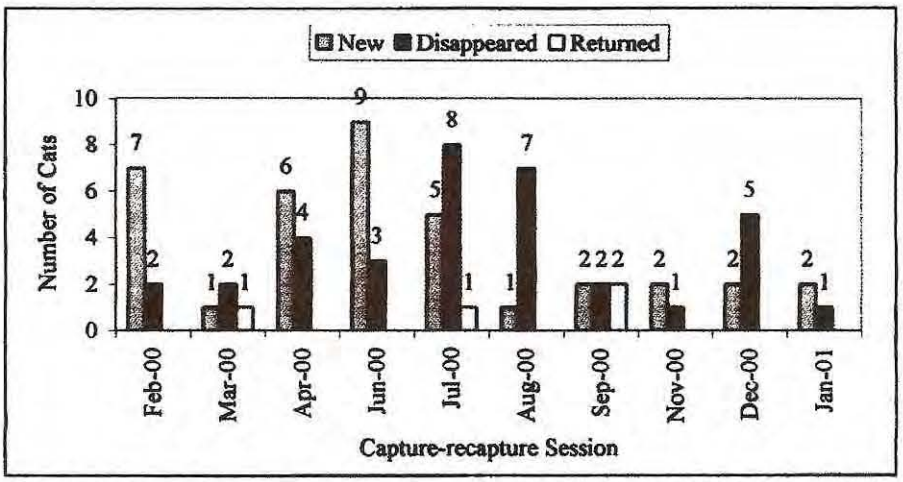


**Figure 4. Population dynamics for the cat colony at Crandon Marina, Miami-Dade County, Florida. Light gray bars represent cats abandoned at the colony and/or cats newly introduced to the colony by colony managers. Black bars represent cats that disappeared from the colony because they were adopted, died from natural or human-induced causes, or disappeared due to unknown causes. White bars represent (1) shy cats were present during certain capture-recapture sessions but absent during others, (2) new cats that were not friendly enough to be adopted that were taken away to be neutered but later brought back to the colonies by colony volunteers.**

Crandon Marina from decreasing. Our results emphasize the role that human interference and negligence play in the population dynamics of managed cat colonies. Illegal dumping of unwanted cats and the attraction of stray cats to the provisioned food counter-balanced reductions in cat numbers caused by death or adoption. During the course of our study, we observed 37 cats in the colony at A. D. Barnes Park and 91 cats in the colony at Crandon Marina. Twelve of the 37 cats (32.4%) seen at A. D. Barnes Park, and 35 of the 91 cats (38.5%) seen at Crandon Marina, were new cats. The primary cause for the addition of these new cats was the illegal dumping of unwanted cats. On several occasions, we witnessed people abandoning unwanted cats. Additionally, numerous kittens and females with litters were also abandoned at the parks. At A. D. Barnes Park 22 kittens were dumped and at Crandon Marina 14 kittens were dumped. The high number of cats and kittens that were dumped at the colonies throughout the course of our study confirms that the establishment of cat colonies on public lands with unrestricted access encourages illegal dumping of cats and creates an attractive nuisance.

Our small sample size (two cat colonies) and short time duration of observation (1 year) may limit the strength of our results. Therefore, we encourage future monitoring of cat colonies on public lands and suggest that data be collected for longer periods. It is important to note that discrepancies in management practices among volunteers at different sites can greatly influence the population dynamics of the cat colonies. Based on our findings, we predict that colonies established in parks frequently visited by the public, and in parks located in densely populated neighborhoods or cities, will experience the highest rates of illegal dumping of unwanted cats and will attract large numbers of stray cats to the provisioned food.

The establishment of cat colonies in public parks could also have negative direct and indirect impacts on visitors and on native wildlife species that reside in the parks or use parks as migratory stopover grounds. Even though our study did not focus on predation, we saw cats kill a juvenile common yellowthroat (*Geothlypis trichas* L.) and a blue jay (*Cyanocitta cristata* L.). Cats also caught and ate green anoles (*Anolis carolinensis* Voight), bark anoles (*A. distichus* Cope), and brown anoles (*A. sagrei* Dumerial and Bibron). In addition, we found the carcasses of a gray catbird (*Dumetella carolinensis* L.) and a juvenile opossum (*Didelphis virginiana* L.) in the feeding area. A better understanding of the impacts of cat colonies on park wildlife may be gained by collecting data on species composition and abundance before and after the colonies are established, or by collecting data on species composition and abundance when colonies are active and after the colonies have been removed. Cat removal studies have shown that prey species populations increase once cats were removed or cat populations were reduced (Cooper et al. 1995, Dickman 1996).

In addition, the potential for cats to transmit zoonotic diseases, such as rabies, encephalitis, and toxoplasmosis, to wildlife and park visitors could result in a public health hazard. At A. D. Barnes Park, some visitors fed the cats on top of the picnic tables and cats were seen defecating in the picnic areas. At Crandon Marina, feeders would attempt to provide the cats with additional shelter by leaving the door to the women's restroom open.

Our results suggest that trap, neuter, and release programs are not an effective method to help control the population of unwanted feral and free-roaming cats on public lands. Controlling the population size of cat colonies and the number of new cats joining the colonies is and will continue to be an impossible task as long as the colonies are established in places where public access is unrestricted and unregulated. Furthermore, it is important to promote a better understanding of the impacts that managed cat colonies might have on native wildlife because, as metropolitan areas continue to grow, public parks will play an increasingly important role in providing native species with viable habitat. Studies by Matthiae and Stearns (1981), on public parks in metropolitan Milwaukee, USA, showed that public parks serve as refuge for small rodents, large nocturnal scavengers, and omnivores (squirrels and raccoons) (Adams and Dove 1989). Additionally, Blake (1986) concluded that even small patches of natural habitat might increase the ability of migratory birds to successfully pass over highly urbanized landscape (Adams and Dove 1989). We suggest that supporters of managed cat colonies seek a long-term solution to the pet overpopulation issue by redirecting their efforts toward the underlying problem of managing irresponsible pet owners.

The establishment of cat colonies in public parks creates management and sociopolitical problems (Clarke and Pacin 2002). Attempts by park managers to remove cats are often met by strong and vocal opposition by cat colony proponents. Park managers faced with domestic cat populations, within parks managed as natural areas, should implement the following plan.

*Educate cat colony proponents about the impacts that cat colonies have on natural areas and native species.* Encourage cat colony proponents to remove cat colonies from parks, and establish a deadline for voluntary removal to be completed. Initiate mandatory humane trapping and removal of all cats and feeding stations from parks, and establish a deadline for the elimination of cat colonies from parks. Enforce current ordinances. Encourage local governments to create pet policies that would hold irresponsible pet owners financially and legally accountable for their actions.

*Maintain a nuisance animal control program focused on cats.* The primary goal of the program should be to maintain parks free of cats. Create a committee composed of wildlife experts from academia, county/state agencies, conservation groups, humane societies, and animal shelters, to work together to solve current and future cat problems.

*Increase the awareness of visitors, local residents, and school children through educational materials that explain the importance of preserving and protecting natural areas and native species.* Educational material should emphasize the impacts that

exotic species, including domestic animals, have on native wildlife. Promote national spay/neuter day and educate cat owners on the importance and benefits of keeping cats indoors (e.g., indoor cats live longer and healthier lives and make better pets; see www.abcbirds.org).

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*Daniel Castillo is now a Biologist with the Florida Fish and Wildlife Conservation Commission, Bureau of Wildlife Management. His interests include conservation biology, restoration ecology, and animal behavior.*

*Alice Clarke is an Assistant Professor in the Department of Environmental Studies at Florida International University. She is a behavioral ecologist and demographer and now focuses on human dimensions of environmental issues in south Florida.*

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