Intraspecific spatial dynamics of urban stray cats

Sara Steen-Ash

Abstract

Supporters of the TTVAR (trap-test-vaccinate-alter-release) approach for the control of stray cat populations assume that a group of cats sharing a common food source will defend their space and resources from immigrating individuals. Previous studies have indicated that group- living domestic cats exhibit a high degree of home range overlap, associate frequently and amicably with group members, and defend their resources against immigrating individuals. This study was designed to examine the spatial relationships among cats managed with the TTVAR method on the Texas A&M University campus. Specific objectives of this study include quantifying individual home ranges and examining the spatial overlap and degree of association between individuals. Nineteen cats from 6 sites were fitted with radiocollars in September and October 1998, and 11 cats from 5 sites were fitted with radiocollars in January and February 1999. Males ranged an average area of 15.2 ha. The mean female home range size was 12.8 ha. No significant difference was found in home range size between males and females (P< 0.3244, Mann-Whitney U). In all 6 sites, cats exhibited a high degree of home range overlap; however, only 15 individuals were found to associate with other cats. The majority of associating pairs of individuals were found together infrequently. The findings of this study suggest that most cats living on the Texas A&M University campus do not exhibit the same spatial dynamics as expected from colonies of individuals sharing a common food source. Behaviors common to cats living in cohesive groups were observed in this population of cats only occasionally. Consequently, the assumption of resource defense by individuals sharing a common feeding area may not fully apply for this population of stray cats.

INTRODUCTION

The trap-test-vaccinate-alter-release (TTVAR) approach for the management of stray cats (*Felis catus)* was developed in Europe over 20 years ago (Remfry 1996) as an alternative to euthanasia. TTVAR is being used extensively in the United States in a variety of urban locations including city parks, golf courses, residential neighborhoods, and college campuses. In August 1998, a volunteer organization implemented an ongoing TTVAR program for the management of stray cats on the Texas A&M University campus in College Station. Cats living on the campus are captured, vaccinated, neutered, and returned to their capture site. Feeding stations are maintained in areas where cats have been captured or observed.

TTVAR supporters justify their approach on the assumption that groups of neutered cats will defend their food source against immigrating individuals, thereby leading to an eventual reduction in the population through attrition (Patronek 1998). Some support is given to this assumption by previous studies (Dards 1978; Macdonald and Apps 1978; Liberg 1980; Natoli 1985) of domestic cat spatial organization and behavior which show that colonies, defined as a group of cats sharing a predictable and rich food source, consist of closely related females with overlapping home ranges. Liberg and Sandell (1988) postulated that group living occurs when a food source is so rich and predictable that it is impossible to defend by a single cat. Female home ranges overlap and migration between groups is limited, indicating an active defense against immigrating females. Males usually emigrate from the group and establish home ranges that encompass several females (Liberg 1980). Kerby and Macdonald (1988) concluded that these colonies are true social groups exhibiting frequent amicable interactions among members (Dards 1978; Macdonald and Apps 1978).

Author's address: Wildlife and Fisheries Sciences, Texas A&M University, College Station, TX 77843-2258

It is believed that many cats living on the Texas A&M University campus are the result of pet loss or abandonment. Consequently, the spatial dynamics and interactions of the campus cats may operate differently than what has been observed in groups of closely related individuals. This study was designed to examine the spatial relationships among cats managed with the TTVAR method on the Texas A&M University campus. Specific objectives of this study include quantifying individual home ranges and examining the degree of association and spatial overlap between individuals.

METHODS

Study Area

Texas A&M University is located in College Station, Texas, and has a student enrollment of over 42,000. The combined population of College Station and its twin city Bryan is approximately 120,000. The campus covers over 12,844 ha and is surrounded by residential neighborhoods, undeveloped open fields, and farm pastures.

Trapping

The methods of this study complied with the surgery schedules of the campus TTVAR program. Trapping occurred on 5-7 consecutive nights prior to the neuter/spay surgeries which were scheduled monthly. Nineteen cats from 6 sites were fitted with radiocollars in September and October 1998, and 11 cats from 5 sites were fitted with radiocollars in January and February 1999. Sites 1-6 were located in areas with high building density. Sites 7-10 were located in open areas such as vacant property surrounding construction areas, open fields, and the University dairy farm.

Telemetry

Locations of the cats were obtained by homing-in on individuals using a hand-held antenna and radioreceiver supplied by Wildlife Materials, Inc., Carbondale, IL. Individuals were located an average of once nightly for the duration of the battery life of the radiocollar which ranged from 30 to 60 days. Diurnal locations were obtained approximately 3/ week. Locations were plotted on rectified aerial photographs (1 inch = 100 feet) of campus. The software CALHOME was used to calculate home range sizes using the minimum convex polygon method (MCP) to facilitate comparisons with other studies. Area of buildings within the individual home ranges was subtracted from the MCP estimation.

Data Analysis

Differences in mean home range size between males and females were tested using the Mann-Whitney U test. Degree of association among individuals was estimated using a coefficient of association (CA) as described by White and Garrot (1995). The coefficient of association (CA) is equal to 2(AB)/A+B, where A is the number of times individual A is observed in a given time period, B is the number of times individual B is observed in the same time period, and AB is the number of times individuals are found together. Degree of home range overlap was reported as the percentage of each home range overlapped by adjacent individuals.

RESULTS

Results include data obtained on 25 individuals (14 males, 11 females). An additional 5 individuals were not located a sufficient number of times for home range analysis. One individual died during the study and 4 others disappeared. One was later retrapped in another area of campus.

Males ranged over an average area of 15.2 ha (Table 1). The mean female home range size was 12.8 ha. No significant difference was found in home range size between males and females ($P < 0.3244$, Mann-Whitney U).

Home range overlap is reported for 17 individuals from 6 sites in Tables 2-7. Individuals from other sites could not be included because no other cats were tracked from those areas. In all 6 sites, cats exhibited a high degree of home range overlap.

Fifteen individuals were found to associate with other cats. The coefficients of association for these cats are reported in Table 8. The highest degree of association occurred at sites 2 and 7. Two adult males in site 5 also associated frequently. All observed incidences of association between cats in site 9 occurred during the day when the cats rested together. Most individuals associated with other cats infrequently as indicated by the low coefficients.

DISCUSSION

Based on previous studies of cat spatial dynamics and behavior (Kerby and Macdonald 1988; Liberg and Sandell 1988), group-living domestic cats are expected to exhibit a high degree of home range overlap, associate frequently and amicably with group members, and defend their resources against immigrating individuals. While all of the cats in this study exhibited a high degree of home range overlap within sites and exploited a common and predictable food source, only 15 cats exhibited any association with other individuals. Those pairs of cats that exhibited the highest degree of association (787/ 918 and 560/ 001) consisted of at least 1 juvenile or sub-adult. Cats 787 and 918 were suspected to be littermates. Consequently, it is expected that they would associate frequently before reaching full maturity. The familial

relationship between cats 560 and 001 could not be ascertained. However, in past years, it was observed that several litters of kittens were produced at that site, indicating that the individuals from that site may have closer genetic relationships than cats in other locations. In addition to the overall low degree of association, there were suspected incidences of immigration into the feeding stations of 4 sites. Two confirmed cases of migration occurred when cat 216 left site 1 and established a home range in site 8, and when cat 033 immigrated to site 9 where at least 3 other cats were located.

What explanations can be offered about the disparity between these results and other studies of cat spatial dynamics and group behavior? First, it is suspected that many of the cats living on campus are the result of pet loss or abandonment. As a result, the genetic relatedness among individuals is expected to be lower than among the individuals in groups reported in other studies. Group living has not been documented for unrelated cats living outside human habitation. Social bonds necessary for group formation and maintenance may not develop readily among unrelated individuals.

Secondly, Liberg and Sandell (1988) concluded that the food resource must be both predictable and clumped for group living to occur. Before the TTVAR program was initiated, the food resources for cats living on campus may not have been predictable enough for group living to be advantageous. However, a library staff member fed the cats in site 1 for at least 2 years prior to the TTVAR program. She claimed to have fed the cats daily and asked other staff members to feed the cats when she was on vacation. Cats in this site would be predicted to exhibit a high degree of association. However, the coefficients of association for cats from site 1 were low.

The findings of this study suggest that most cats living on the Texas A&M University campus do not exhibit the same spatial dynamics as expected from colonies of individuals sharing a common food source. Behaviors common to cats living in cohesive groups were observed in this population of cats only occasionally. Consequently, the assumption of resource defense by individuals sharing a common feeding area may not fully apply for this population of stray cats. Future studies examining groups of cats sharing a common food sources should determine if the social interactions and spatial dynamics change relative to the genetic relatedness.

REFERENCES

Dards, J.L. 1978. Home ranges of feral cats in Portsmouth Dockyard. Carnivore Genetic Newsletter 3:242-255.

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

Liberg, O. 1980. Spacing patterns in a population of rural free roaming domestic cats. Oikos 35:336-349.

Liberg, O. and M. Sandell. 1988. Spatial organization and reproductive tactics in the domestic cat and other felids. Pages 83-98 *in* D.C. Turner and P. Bateson, eds. The domestic cat: the biology of its behavior. Cambridge Univ. Press.

Macdonald, D.W., and P.J. Apps. 1978. The social behavior of a group of semi-dependent farm cats, *Felis catus*: a progress report. Carnivore Genetic Newsletter 3:256-268.

Natoli, E. 1985. Spacing patterns in a colony of urban stray cats (*Felis catus*, L.) in the historic centre of Rome. Applied Animal Ethology 14:289-304.

Patronek, G.J. 1998. Free-roaming and feral cats - their impacts on wildlife and human beings. Journal of American Veterinary Medical Association 212(2):218-226.

Remfry, J. 1996. Feral cats in the United Kingdom. Journal of American Veterinary Medical Association 208(4):520-523.

White, G.C., and R.A. Garrott. 1990. Analysis of wildlife radio-tracking data. Academic Press, Inc., San Diego. 383pp

Table 1. Mean home range size (hectares) of male and female cats tracked on the Texas A&M University campus from September to December 1998 and from January to March 1999.

Sex	N	Mean[a]	SD	SE
Male	14	15.180	15.680	4.191
Female	11	12.772	16.586	5.001

[a] No significant difference between male and female home range size (P<0.3244, Mann Whitney U test)

Table 2. Percentage of individual home ranges overlapped by adjacent cats on site 1 on the Texas A&M University campus from September to December 1998.

Cat ID (Sex)	Percent overlap	Adjacent cat ID (Sex)
297 (F)	65.22, 17.39, 20.65	357 (F), 660 (F), 879 (M)
357 (F)	18.99, 31.01, 27.85	297 (F), 660 (F), 879 (M)
660 (F)	5.80, 35.51, 71.74	297 (F), 357 (F), 879(M)
879 (M)	9.31, 43.14, 97.06	297 (F), 357 (F), 660 (F)

Table 3. Percentage of individual home ranges overlapped by adjacent cats on site 5 on the Texas A&M University campus from January to March 1998.

Cat ID (Sex)	Percent overlap	Adjacent cat ID (Sex)
156 (M)	9.76, 15.09	208 (M), 539 (M)
208 (M)	63.63, 100.00	539 (M), 156 (M)
539 (M)	41.18, 100.00	208 (M), 156 (M)

Table 4. Percentage of individual home ranges overlapped by adjacent cats on site 6 on the Texas A&M University campus from September to December 1999.

Cat ID (Sex)	Percent overlap	Adjacent cat ID (Sex)
068 (F)	100.00	178 (F)
186 (M)	81.81	178 (F)
178 (F)	9.62, 6.50	186 (M), 068 (F)

Table 5. Percentage of individual home ranges overlapped by adjacent cats on site 7 on the Texas A&M University campus from September to December 1998.

Cat ID (Sex)	Percent overlap	Adjacent cat ID (Sex)
787 (M)	34.38, 40.63	525 (M), 727 (F)
247 (F)	34.78, 100.00	525 (M), 727 (F)
525 (M)	7.55, 43.40, 10.38	247 (F), 727 (F), 787 (M)
727 (F)	59.95, 27.38, 7.73	247 (F), 525 (M), 787 (M)

Table 6. Percentage of individual home ranges overlapped by adjacent cats on site 8 on the Texas A&M University campus from January to March 1998.

Cat ID (Sex)	Percent overlap	Adjacent cat ID (Sex)
347		987
987		347

Table 7. Percentage of individual home ranges overlapped by adjacent cats on site 9 on the Texas A&M University campus from September to December 1998.

Cat ID (Sex)	Percent overlap	Adjacent cat ID (Sex)
417 (F)	33.33, 100.00	677 (F), 856 (M)
677 (F)	60.00, 100.00	417 (F), 856 (M)
856 (M)	9.86, 12.70	417 (F), 677 (F)

Table 8. Coefficients of association (CA) between pairs of cats from 6 sites tracked on the Texas A&M University campus from September to December 1998 and from January 1999 to March 1999.

Cat IDs	Sex	Age Class[a]	Site	CA
297, 879	F, M	Adult, Adult	1	0.022
660, 001	F, M	Adult, Adult	1	0.040
560, 002	M, F	Adult, Juvenile	2	0.583
560, 003	M, F	Adult, Adult	2	0.130
539, 208	M, M	Adult, Adult	3	0.217
178, 186	F, M	Adult, Juvenile	4	0.158
918, 787	M, M	Subadult, Subadult	5	0.777
727, 247	F, F	Adult, Adult	5	0.150
417, 677	F, F	Adult, Adult	6	0.293
417, 856	F, M	Adult, Adult	6	0.190
677, 856	F, M	Adult, Adult	6	0.148

[a] < 6 months = juveniles, 6 -12 months = subadult, > 1 year = adult