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Trap–Neuter–Return and Return-to-Field Programs for Managing Community Cats at Florida Animal Shelters

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Abstract

***Introduction*:** The purpose of this study was to determine the extent to which Florida shelters utilize community cat programs for traditional trap–neuter–return (TNR), in which the original intent was to return the cat to its neighborhood following spay/neuter and return-to-field (RTF), in which return to the neighborhood was deemed the most appropriate outcome after a cat's admission to the shelter as a free-roaming stray.

***Methods*:** Florida animal shelters admitting 200 or more cats in 2019 were surveyed on practices related to the management of community cats. Results were correlated with cat admission and outcome data and rural versus urban locations.

***Results*:** Surveys were received from 110 of the 116 animal shelters admitting 200 or more cats in 2019 (95% response rate), of which 58 shelters (53%) performed TNR (55 shelters; 50%) and/or RTF (33; 30%). Shelter-based programs were available in 31 of 35 (89%) urban counties surveyed compared to only seven of 21 (33%) rural counties where cat shelter admissions and euthanasia rates were higher ($P < 0.0001$). TNR/RTF programs were more common in shelters admitting higher numbers of cats and reporting higher live outcome rates for cats. Shelters commonly collaborated with other organizations and volunteers to carry out the programs, including for transporting cats to and from the field, performing spay/neuter surgery, and funding surgery costs. TNR/RTF programs provided rabies vaccination (100% of TNR and RTF programs), feline panleukopenia virus, herpesvirus and calicivirus vaccination (80% TNR; 88% RTF), FeLV testing (44% TNR; 41% RTF), FIV testing (43% TNR; 41% RTF), internal parasite control (56% TNR; 84% RTF), external parasite control (76% TNR; 88% RTF), treatment of illnesses/injuries (91% TNR; 97% RTF), and humane euthanasia (85% TNR; 88% RTF).

***Conclusion*:** Shelters using the option of TNR and/or RTF programs for community cats had higher live outcome rates for cats than shelters without such programs. Expansion of shelter-based TNR/RTF programs in conjunction with community-based programs to support pet retention and to increase access to veterinary care are opportunities to reduce unnecessary admission and euthanasia of cats in shelters and deaths of kittens born in the wild. Regional collaborations between urban organizations where programs are well established and supported by community engagement could be expanded to support neighboring rural communities where resources are scarce, thereby creating a statewide safety net, not only for community cats but for all cats and dogs.

Keywords: *spay*; *neuter*; *animal shelter*; *community cats*; *feline welfare*; *shelter medicine*; *animal shelter outcomes*; *trap–neuter–return*; *return-to-field*

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Supplementary material
Supplementary material for this article can be accessed here.

Approximately 3.3 million cats entered animal shelters in the US in 2023.[1] Free-roaming stray and feral cats, also called 'community cats', constitute two-thirds of cat admissions. Population control of the estimated 74 million owned pet cats is accomplished largely by a spay and neuter rate of 85%.[2] In contrast, the sterilization rate of the estimated 30–80 million free-roaming community cats is less than 10%, making this population the main source of new kitten births.[3–5]

Historically, shelter management of community cats has been influenced by cat factors, such as socialization level to humans; shelter factors, such as cage capacity and funding; and community factors, such as the number of potential cat adopters and sterilization rates of cats, to prevent unwanted litters.[4] Cats determined to be unsocialized or 'feral' were often euthanized while 'friendly' cats could be adopted. The number of cats admitted to shelters often exceeds the number of

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available positive outcomes, such as adoptions, transfers to other organizations, and return to owners. As a result, many cats, often more than half, were euthanized or died at shelters following admission.[3,4,6] In shelters lacking alternatives to shelter admission, the prolific reproduction of community cats during the spring and summer 'kitten season' commonly exceeds the capacity of shelters to provide adequate care and positive outcomes. Overcrowding, shelter-acquired disease, and neonatal mortality contribute to kittens having the highest mortality rate of any subset of shelter animals.

Community cats often have caregivers who feed and look after them, even if they do not consider themselves to be owners of the cats in a traditional sense.[7–10] Since the 1980s, trap–neuter–return (TNR) programs have gained popularity in the US as a viable alternative to shelter admission for managing unowned free-roaming community cats. TNR involves capturing community cats specifically for the purpose of sterilization, followed by return to their original neighborhood location.[4,5] Many TNR programs involve the cooperation of multiple organizations, volunteer trappers, and cat caregivers. Following the success of TNR was the emergence of a variation called return-to-field (RTF), in which cats admitted to a shelter that appeared to be thriving in their neighborhood are selected for sterilization and returned to their original location[3,4,11–17] In either case, cats deemed suitable for neuter and return are provided with spay/neuter, vaccination, and identification by ear-tipping.[18–20] Other services, such as parasite control, treatment of illness and injuries, retroviral testing, tatooing, and microchipping, may also be included. Multiple studies have demonstrated that TNR/RTF programs, when performed at sufficient intensity, can quickly reduce shelter cat intake and euthanasia and can lead to sustained population reduction of community cats in the long term.[12–14,21–29]

Similar trends impact animal shelters in Florida, where more than 200,000 cats were admitted during 2024 (58% of total statewide shelter intake) and more cats were euthanized than dogs.[30]

The purpose of this study was to evaluate the extent to which Florida shelters utilize TNR and RTF programs for community cat management and their relationship with shelter cat admissions and outcomes.

Methods

Sample population

The Shelter Medicine Program at the University of Florida has maintained an annually updated directory and state-wide shelter-level census of cat and dog admissions and outcomes since 2013. For the purpose of this study, an animal shelter was defined as a continuously occupied 'brick and mortar' physical facility that housed cats and/or dogs temporarily for the purposes of animal control and protection. Home-based animal rescue organizations and sanctuaries with a permanent population were not included in the study. Shelter types included municipal (operated by a town or county), private (operated by a non-profit or business entity), or private with a municipal contract (holding a contract to provide animal control and/or sheltering services for a municipality). Counties of shelter location were defined as rural (<100 residents per square mile) or urban (≥100 residents per square mile), as defined by the Florida Department of Health Office of Rural Health. The Shelter Medicine Program's animal census figures were used to provide cat intake and outcome data. Shelters admitting a minimum of 200 cats in the study year were selected to be surveyed. A total of 116 shelters in 57 counties met these criteria. Four additional rural counties had no animal shelters, and six rural counties had shelters admitting <200 cats in the study year.

Survey development

An online survey study was developed to collect data from Florida animal shelters on practices related to the management of unowned free-roaming community cats. A prototype survey was administered to a focus group of personnel from 10 shelters in seven counties to assess clarity and ease of use. Six members of the focus group completed sample surveys and made no recommendations for changes, and four made suggestions for clarifying language in standardized categorical replies. Their feedback was used to create the final version of the survey (see Supplementary material). The final survey had 14 questions regarding the selection of cats for shelter intake, TNR, RTF, the involvement of animal control/shelter personnel in community cat management procedures, and the scope of veterinary care provided to cats in TNR/RTF programs. Contact information of respondents was collected to enable follow-up clarification of any incomplete or internally inconsistent responses. Therefore, the survey was not anonymous. No individual cat-level or person-level data were collected. The survey was loaded into an internet-based response tool (Google Forms) using a secure university-owned account.

Standardized definitions of important terms were provided in the survey instructions as follows to ensure consistency of responses:

- **'Community cat'** means any unowned free-roaming cat living outdoors. It might be a single cat or associated with a colony of cats. It might also be fed by someone who does not self-identify as the cat's owner. Community cats can span the behavior spectrum from socialized and friendly to people to

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unsocialized, feral, and fearful of people. Community cats are sometimes referred to as 'stray cats' or 'feral cats'.

- **'Trap–neuter–return'** (TNR) means capturing a community cat specifically for the purpose of spaying/neutering followed by returning to the neighborhood it came from.
- **'Return-to-field'** (RTF) means that a cat was originally admitted to the shelter and then, after assessment, was designated for spay/neuter and return to the neighborhood it came from. RTF is sometimes known as 'Shelter–Neuter–Return' (SNR) or 'Feral Freedom'.
- **TNR** and **RTF** are very similar in that community cats have spay/neuter followed by return to their neighborhood. The only difference is the original intention by the person who wanted the cat captured – whether it was for the purpose of sterilization and return to the neighborhood (TNR) or the purpose of admitting to the shelter (RTF).

Survey administration

The survey was conducted between June and September, 2020. Due to the disruption and lingering effects of the COVID-19 pandemic on normal shelter operations, respondents were instructed to report practices related to the management of community cats in place during 2019, prior to the impact of lockdowns and staffing shortages. Initial distribution was to shelter directors by email, with options to reply via multiple methods to account for variability in shelter communication policies and access. The survey could be completed by the recipient or their delegate via an online Google Forms link, email, fax, phone interview, or postal mail. Respondents were instructed to provide the most common protocols that were routinely followed, not exceptions or unusual circumstances. Research staff assisted with the collection of data from respondents without internet access and from those indicating a preference for telephone communication by reading the survey to them. Reminders were emailed to non-responders every 3 weeks beginning at Week 2. Telephone calls were attempted to non-responders every 3 weeks beginning at Week 3. A paper copy of the survey with a return stamped envelope was sent by postal mail to non-responders at Week 4. Study personnel contacted respondents to resolve missing or internally inconsistent responses. No responses were excluded, and missing information is noted in the data tables.

Statistical analysis

Survey responses were audited for completeness and internal consistency as they were received. Live outcome rates were calculated for each shelter by dividing total live cat outcomes by total live cat intakes for the study year. Standard descriptive statistics were used to examine frequencies of specific community cat management practices. Percentages were calculated for categorical variables, using appropriate denominators (e.g. the number of complete responses for each question with missing values reported separately). Chi-squared tests (or Fisher's exact tests for frequencies <5) were used to assess differences between categorical variables. Chi-square tests for trend were used to assess association with ordered categories. Medians calculated for non-normally distributed data were compared with the Wilcoxon rank sum test. $P < 0.05$ was defined as statistical significance.

Results

Characteristics of responding animal shelters

Surveys were received from 110 of the 116 Florida animal shelters admitting a minimum of 200 cats each in 2019 (95% response rate). The responding shelters collectively admitted 206,924 cats in 2019, the majority of which were classified as free-roaming strays (137,720; 67%). The shelters reported live outcomes for 147,176 (71%) of cats through adoptions (98,453; 48% of all admitted cats), transfers to other organizations (26,315; 13%), return to owner (4,002; 2%), and other means (18,406; 9%). A total of 48,918 cats did not have live outcomes (24%), including shelter euthanasia (20% of all admitted cats), died in care (3%), and missing (<1%). Cats undergoing TNR were not included in shelter admission and outcome statistics because they were not transferred into shelter ownership in the same way as cats undergoing RTF were. In comparison, the 110 responding shelters took in 173,484 dogs in 2019, of which 148,330 (86%) had live outcomes.

Surveys were received from 49 municipal shelters, 48 private shelters, and 13 private shelters with government contracts. The shelters collectively reported more TNR programs (55) than RTF programs (33) (Table 1). There were no differences in types of shelters performing TNR ($P = 0.6$), but private shelters with municipal contracts were less likely than other types of shelters to perform RTF ($P = 0.0004$). The proportion of shelters performing TNR or RTF significantly increased as their shelter cat admission numbers increased for both TNR ($P = 0.0001$) and RTF ($P < 0.0001$) and as their live outcome rates increased for TNR ($P = 0.03$) but not for RTF ($P = 0.3$).

Rural versus urban shelters

Shelters in rural counties were significantly less likely than urban counties to perform TNR (rural 25%, urban 57%; $P = 0.0006$) or RTF (rural 13%, urban 35%; $P = 0.04$). Shelter-based TNR and/or RTF programs were available in 31 of 35 (89%) urban counties surveyed compared to only seven of 21 (33%) rural counties surveyed ($P < 0.0001$) (Fig. 1). Rural shelters admitted a median of 17

Table 1. Characteristics of Florida animal shelters offering trap–neuter–return or return-to-field programs for managing community cats

Category	No. shelters	TNR		RTF	
		Number	Percent	Number	Percent
Shelter type		*P* = 0.6		***P* = 0.0004**	
Municipal shelter	49	23	47	22	45
Private shelter with municipal contract(s)	48	24	50	5	10
Private shelter without contract(s)	13	8	62	6	46
Total	110	55	50	33	30
Shelter region		***P* = 0.006**		***P* = 0.04**	
Rural county	24	6	25	3	13
Urban county	86	49	57	30	35
Total	110	55	50	33	30
Shelter cat admissions*		***P* = 0.0001**		***P* < 0.0001**	
200–499	30	8	27	2	7
500–1,499	33	16	48	4	12
1,500–2,999	26	15	58	14	54
3,000 and above	19	16	84	13	68
Total	108	55	51	33	31
Shelter live outcome rate*†		***P* = 0.03**		*P* = 0.3	
0–69	28	9	32	5	18
70–89	33	18	55	13	39
90–100	47	28	60	15	32
Total	108	55	51	33	31

*The intake and live outcome rates were not available for one private shelter with municipal contracts and one private shelter without contracts.
†Live outcome rates were calculated for each shelter by dividing total live cat outcomes by total live cat intakes for the study year.
P values refer to comparisons within columns. *P* values in bold indicate statistically significant differences at $P < 0.05$. There was no difference in types of shelters performing TNR, but private shelters with contracts were less likely than other types of shelters to perform RTF. Rural counties were significantly less likely than urban counties to perform TNR or RTF. The proportion of shelters performing TNR or RTF significantly increased as their shelter cat admission numbers increased for both TNR and RTF and as their live outcome rates increased for TNR, but not for RTF.

cats per 1,000 residents compared to only four in urban counties ($P < 0.0001$) (Fig. 2). This was accompanied by a median live outcome rate for cats of 59% in rural shelters compared to 90% in urban shelters ($P < 0.0001$). However, rural shelters with TNR and/or RTF programs had lower cat admission rates and higher live outcome rates intermediate between rural shelters without such programs and urban shelters.

Role of shelters in management of free-roaming community cats

Approximately half of surveyed shelters provided cat traps to the public and accepted cats at the shelter that were trapped by the public, whether intended for permanent removal or for TNR (Table 2). Shelters were more likely to pick up cats trapped by residents for permanent removal (45%) than for TNR (23%) ($P = 0.0006$).

Most shelters participating in TNR and RTF programs reported collaborations with other organizations and volunteers to piece together necessary logistics for the programs, including transporting cats to and from the field, performing spay/neuter surgery, and funding surgery costs (Table 3). More shelters relied on their own shelter personnel to transport cats back to their original location for RTF (82%) than for TNR (54%) ($P = 0.008$). Most shelters had TNR (78%) and RTF (85%) surgery performed in-house by their own personnel. Shelters also utilized outside partners for at least some of their TNR (47%) and RTF (33%) surgeries of cats while under shelter care or permanently transferred cats to other organizations for TNR (31%) and RTF (24%) surgeries. Shelters

Table 2. Role of 110 Florida animal shelters in trapping community cats for admission to shelters or for TNR programs

Category	Trapping for removal	Trapping for TNR	*P*
Shelter provided traps for the public's use	54 (49%)	51 (46%)	0.7
Cats trapped and brought by the public accepted at the shelter	66 (60%)	52 (47%)	0.06
Shelter personnel picked up cats trapped by the public	49 (45%)	25 (23%)	**0.0006**
Shelter personnel trapped cats in the field	38 (35%)	30 (27%)	0.2

P values in bold indicate statistically significant differences at $P < 0.05$.

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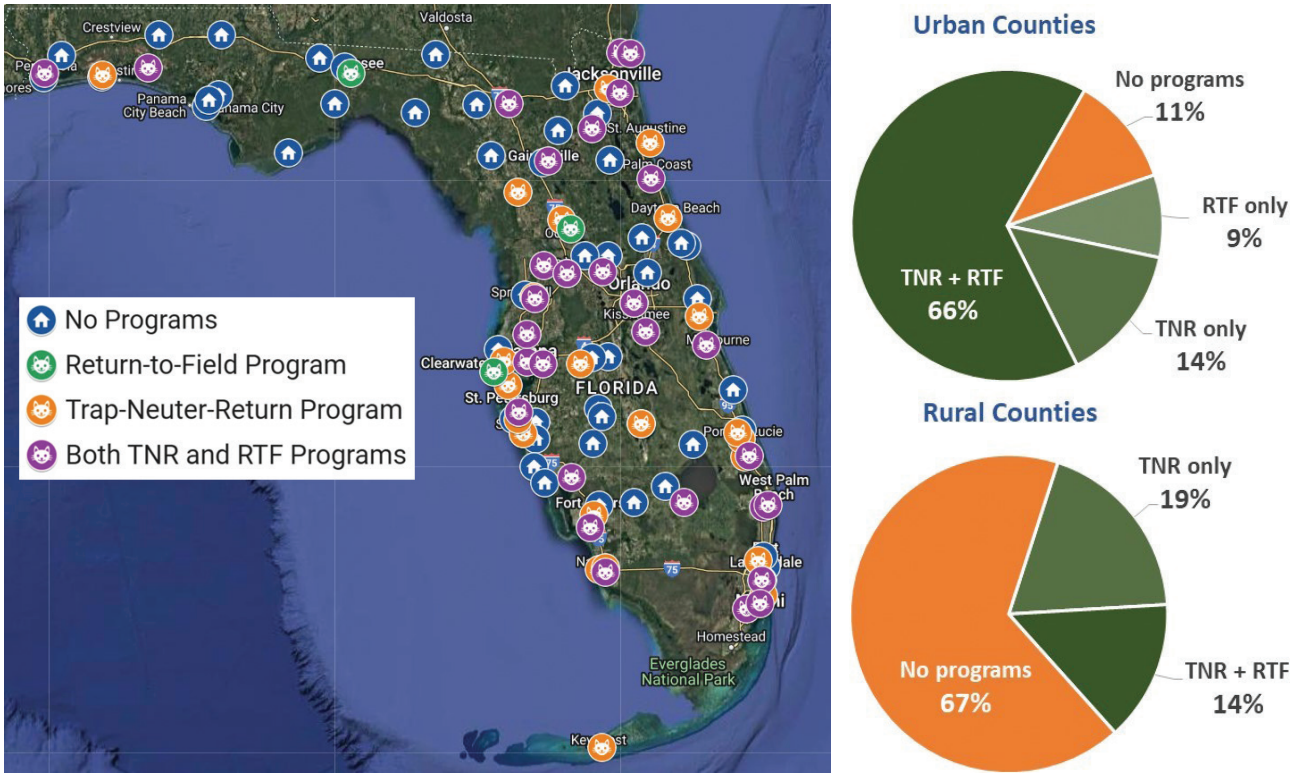

Fig. 1. Distribution of trap–neuter–return and return-to-field programs in 110 Florida animal shelters. Shelter-based TNR and/or RTF programs were available in 31 of 35 (89%) urban counties surveyed compared to only seven of 21 (33%) rural counties surveyed ($P < 0.0001$).

Table 3. Role of Florida animal shelters in logistical support and funding for TNR and RTF programs

Logistical support category	TNR (n = 55)	RTF (n = 33)	P
Transportation of cats to and from the field*			
Shelter personnel transported cats from the field for surgery	39 (72%)	N/A	N/A
Another organization transported cats from the field for surgery	13 (24%)	N/A	N/A
The public or volunteers transported cats from the field for surgery	43 (80%)	N/A	N/A
Shelter personnel transported cats back to the field after surgery	29 (54%)	27 (82%)	**0.008**
Another organization transported cats back to the field after surgery	20 (37%)	8 (24%)	0.2
The public or volunteers transported cats back to the field after surgery	45 (83%)	22 (67%)	0.09
Providing spay/neuter surgery			
Shelter personnel performed the surgery	43 (78%)	28 (85%)	0.4
Another organization performed the surgery	26 (47%)	11 (33%)	0.2
Shelter funded another organization to perform the surgery	25 (45%)	7 (21%)	**0.02**
Shelter transferred cats to another organization for the surgery	17 (31%)	8 (24%)	0.5
Alternative outcome options in addition to return to original location*			
Adoption into a home	48 (89%)	N/A	N/A
Transfer to another organization	21 (30%)	N/A	N/A
Relocation to a new site	20 (37%)	N/A	N/A
All cats were returned to their neighborhoods	6 (11%)	N/A	N/A

*One shelter did not report transportation or outcome alternatives.
P values in bold indicate statistically significant differences at $P < 0.05$.
Percentages in each category come to more than 100% because more than one answer could be selected.

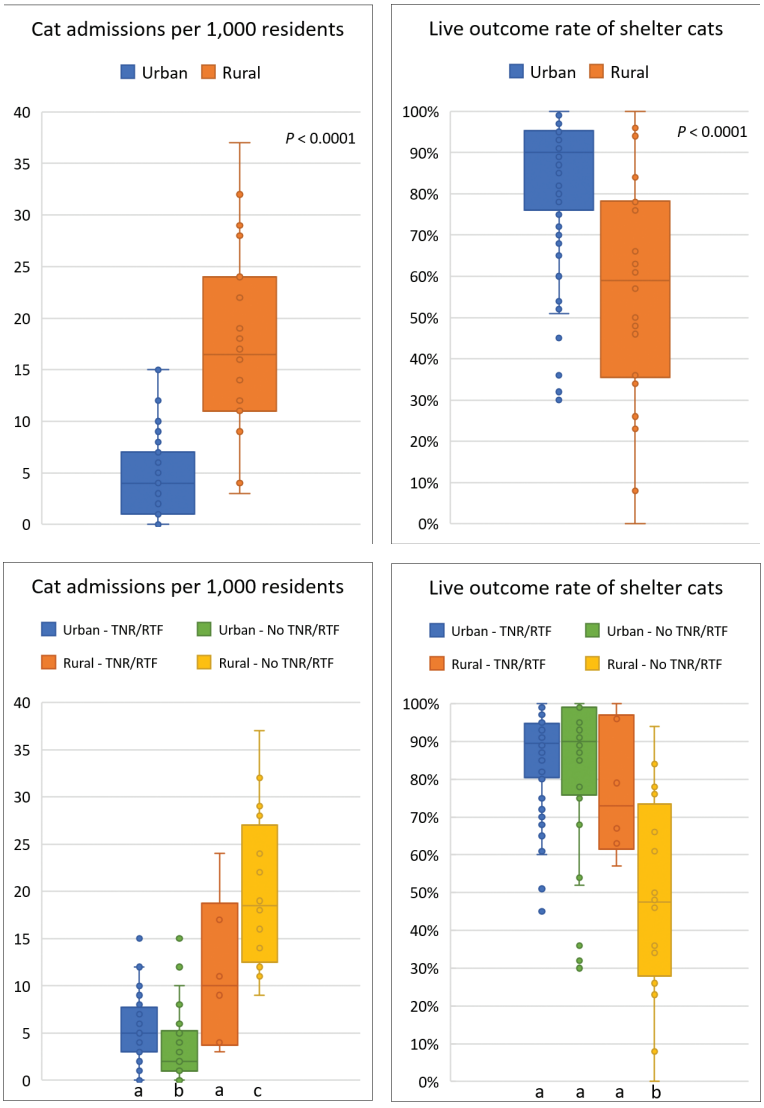

Fig. 2. In 110 Florida animal shelters, cat admissions were lower, and live outcome rates were higher in urban counties (median cat admissions 4/1,000 residents; 90% live outcomes) than in rural counties (median cat admissions 17/1,000 residents; 59% live outcomes). Rural shelters offering TNR and/or RTF had cat admission rates intermediate between urban shelters and rural shelters without such programs and live outcome rates approaching those of urban shelters. Different letters indicate significant differences ($P > 0.05$).

funded some, but not all, outside surgeries. Most shelters also offered alternatives to returning cats presented for TNR to their original location following surgery. Adoption into a home was offered by most shelters (89%) for at least some cats presented for TNR, followed by transfer to other organizations (30%) or relocation to a new site (37%).

Clinical care provided for cats in shelter-based TNR and RTF programs

Rabies vaccines were administered by 100% of programs, followed closely by programs that administered against feline panleukopenia virus, herpesvirus and calicivirus vaccines (80% for TNR; 88% for RTF) (Table 4). Ear-tipping to identify sterilized community cats was used in all TNR and all but 1 RTF program. Sterilization tattoos were used additionally by most programs (81% for TNR; 91% for RTF). Nearly half of shelters offered FeLV and/or FIV testing, and more than half provided internal and/or external parasite treatment. Treatment of injuries and illnesses (91% for TNR; 97% for RTF) and humane euthanasia for debilitating conditions (85% for TNR; 88% for RTF) were also offered by nearly all programs.

Since the age of kittens can be estimated at approximately one pound of body weight per month of age, shelters used minimum age or weight limits in the selection

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Table 4. Clinical care provided for cats in shelter-based TNR and RTF programs in addition to spay/neuter surgery

Clinical care provided	TNR (*n* = 55)	RTF (*n* = 33)	*P*
FVRCP vaccination	44 (80%)	29 (88%)	0.3
Rabies vaccination	55 (100%)	33 (100%)	1.0
Ear-tipping	55 (100%)	32 (97%)	1.0
Sterilization tattoo*	44 (81%)	29 (91%)	0.2
FeLV testing*	24 (44%)	13 (41%)	0.7
FIV testing*	23 (43%)	10 (31%)	0.3
Internal parasite treatment*	30 (56%)	27 (84%)	**0.01**
External parasite treatment	42 (76%)	29 (88%)	0.3
Treatment of injuries/illnesses	50 (91%)	32 (97%)	0.4
Humane euthanasia for debilitating conditions	47 (85%)	29 (88%)	0.7

*One shelter did not report on use of tattoos, FeLV/FIV testing, and internal parasite control.
P values in bold indicate statistically significant differences at $P < 0.05$.

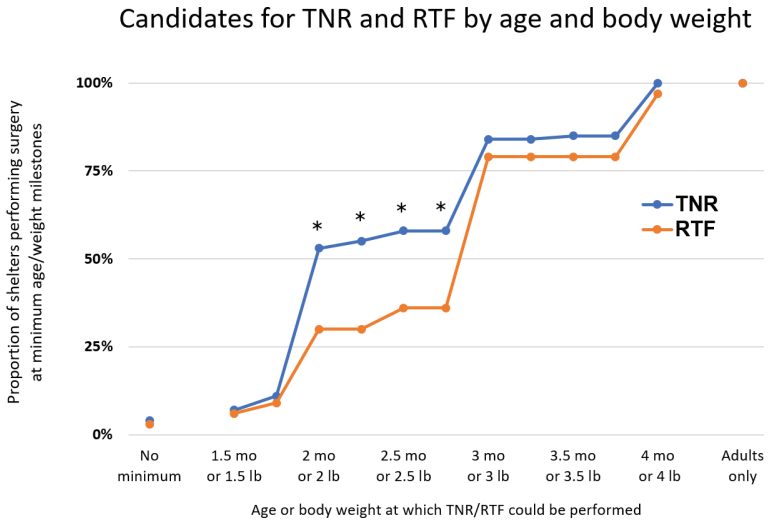

Fig. 3. Age and body weight minimums at which spay/neuter surgery could be performed for community cats at 55 shelter-based TNR programs and 33 shelter-based RTF programs. The proportion of shelters allowing surgery at 8–11 weeks of age (2.0–2.75 lb) was significantly higher for TNR than for RTF.

of cats for TNR or RTF (Fig. 3). Only two shelters had no minimum age policies or accepted kittens less than 2 months of age for TNR, and only one accepted them for RTF. More than half of shelters accepted kittens 2 months and older for TNR; however, acceptance for RTF remained significantly lower until 3 months of age. Cats 4 months and older were accepted by all programs for TNR and all but 1 for RTF. One shelter reserved RTF for adult cats only.

Discussion

More than half of surveyed animal shelters in Florida participated in community cat population management programs via traditional TNR, in which the original intent was to return the cat to its neighborhood following spay or neuter, or via RTF, in which return to the neighborhood was deemed the most appropriate outcome after a cat's admission to the shelter as a free-roaming stray. TNR and RTF were implemented in both municipal and private shelters and were more common in shelters with higher total cat admissions and higher cat live outcome rates.

TNR/RTF programs were more prevalent in urban communities than in rural ones. Rural shelters typically experience higher dog and cat shelter admissions on a per capita basis (often expressed as the number of animals per 1,000 residents) while also having lower per capita municipal budgets for services.[30] In this study, rural shelters admitted a median of 17 cats per 1,000 residents compared to only four in urban counties. This was accompanied by a median live outcome rate for cats of 59% in rural shelters compared to 90% in urban shelters. However, rural

shelters with TNR and/or RTF programs had more favorable cat admission and live outcome rates closer to those of urban shelters. Sparsely populated rural regions can have veterinary care deserts that impede access to preventive care and spay/neuter.[31,32] This frequently extends to shelters that lack their own staff veterinarian or access to outside veterinary services. Twenty Florida counties, all rural, have a veterinary accessibility score of ≤ 20 (on a scale of 0–100), defined as 'veterinary care is nearly inaccessible'.[33] Exacerbation of veterinary workforce shortages since the pandemic has left a large proportion of shelters and non-profit clinics understaffed, resulting in delays and reductions of spay/neuter and other essential veterinary care.

Florida shelter personnel frequently collaborated with residents, volunteers, and other animal welfare organizations to carry out TNR/RTF programs. This distribution of effort and cost facilitates the scale-up of programs for greater impact and sustainability. Such collaborations are less common when euthanasia is the primary outcome, as surveys report that the majority of the public is opposed to management protocols that rely on lethal methods.[10,34–37] In addition to meeting community demands to reduce euthanasia of cats for population control, TNR programs reduce neighborhood nuisances associated with unfettered reproduction, including the birth of kittens destined to perish before reaching adulthood, loud vocalization and fighting associated with cat breeding, and pungent urine spraying by male cats.[38] High-intensity TNR reduces both premature death of cats, a welfare issue, and neighborhood cat populations, a public health and environmental issue.[26]

Community cats are loosely defined as cats that are not owned in the traditional sense and that roam freely within a neighborhood.[4] They may or may not have one or more people who provide food and shelter, sometimes without knowing about each other. The cats may be friendly towards people or may be feral and reluctant to approach even the people who feed them. They may live individually or in groups known as colonies, which often form around an abundant food source. It is usually not possible to distinguish an unowned or loosely owned community cat from an owned pet that is allowed to roam outdoors.[9] An additional benefit of neuter–return programs is that owned pet cats were reportedly 17 times more likely to find their way home if left in their neighborhood than if they were brought to a shelter.[39,40] Lost cats were most often found close to home, and returning home on their own was a more common way cats were reunited with their families (66%) versus being reunited via shelters (4%).[16]

The selection of cats for TNR/RTF programs is not without controversy. In the case of TNR, many cats are trapped by caregivers who are familiar with them and will provide ongoing care following return to the neighborhood.[7,8,41,42] However, in the case of RTF, cats are usually admitted to shelters without knowledge of the people involved in their care, if any. When the caregiver is unknown, the good condition of cats is taken as evidence they are thriving where they are, even if their source of support is not identified.[3] In an effort to investigate whether community cats have caregivers, researchers have performed neighborhood surveys or placed collars on free-roaming cats, asking any caregivers to check in with information about their care.[9] In these studies, upwards of 80% of cats were determined to have one or more caregivers or to be owned pets allowed outdoors. It is also possible that cats found in good condition could be recently lost or abandoned, in which case they are at risk for harm if they are not rescued. Although community cats often have their neighborhood advocates, conflict may also exist regarding their potential negative impacts on public health, wildlife, and nuisance. Regardless of the reasons residents become engaged in community cat issues, most are mitigated by fertility control and public–private collaboration.[3,4,28,35]

In this study, the most common minimum age for TNR programs was 2 months, and for RTF programs, it was 3 months, which is the minimum age for a valid rabies vaccine in Florida. The age of stray kittens can be estimated by body weight at approximately 1 pound per month of age. Therefore, many spay/neuter providers use weight as a proxy for age when the birthdate is unknown.[43] The minimum age at which to perform TNR or RTF is controversial. When shelters are overcrowded, highly stressful, and have high disease rates, the risk of a poor outcome in the shelter may be greater than that of being returned to the neighborhood. However, the normal expected mortality of free-roaming kittens is 50–75%, similar to other small carnivores.[26,44,45] Although such high rates of juvenile mortality are common in nature, they are considered to be a welfare concern in domesticated species. Ideally, decision-making about the fate of kittens found outside should be more nuanced and individualized, balancing the situation in which they are found, their condition, and the resources available to intervene. One recommended decision tree suggests that, in general, kittens should be on a path toward adoption into a home, since they are in a high-risk age range, are not yet integrated into the local cat community, and are at a life stage more amendable to socialization.[46] Exceptions can be made when local shelter capacity is overwhelmed, kittens are already feral, or a committed caregiver is available. In contrast, the decision tree suggests that adult cats should generally be on a pathway toward return to the neighborhood, since they likely have a territory in which they can thrive and are likely to have a caregiver or owner who shares a bond with them. This fills an environment niche with healthy, sterilized, and vaccinated cats and preserves shelter space and resources for cats in need of rescue. Exceptions can be

made for cats that show evidence of failure to thrive, those whose environment is being disrupted, those residing on conservation lands, or those in imminent danger.

The central feature of TNR/RTF programs is sterilization, but all shelters in this study offered additional medical procedures at the time of surgery. Identification of cats that have undergone TNR/RTF is essential to avoid re-trapping cats unnecessarily or overlooking cats that are still capable of reproducing. The universal identifier for a sterilized community cat is removal of the tip of one ear, which is easily recognized from a distance.[19,20,47] Eartipping was practiced in all shelters performing TNR and all but one shelter performing RTF. A green tattoo on the ventral abdomen should be used in addition to eartipping as a back-up to clarify sterilization status of cats that may sustain injury to the ears. All shelters vaccinated cats against rabies. This is important because free-roaming cats may encounter wildlife rabies reservoirs such as racoons and bats.[18] Nearly all shelters also provided core vaccines against feline panleukopenia, feline herpesvirus, and feline calicivirus. A majority of cats presented for TNR lack protection against FPV, outbreaks of which can result in mass fatality events in free-roaming cats. Vaccination at the time of TNR surgery provides immunity against FPV in more than 90% of cats within 2–3 months.[48] Less than half of shelters tested cats for FeLV or FIV, which is lower than the proportion of cats selected for adoption programs previously reported in Florida shelters.[49] National guidelines generally recommended against routine testing of cats in TNR/RTF programs as an unnecessary diversion of resources since sterilization reduces the primary sources of transmission, which are the birth of kittens from queens infected with FeLV and fighting among intact males infected with FIV.[50] Many shelters also provided internal and external parasite treatments. While these treatments may provide temporary relief at a time when cats are healing from surgery, some level of parasitism is likely to recur after cats are returned to their outdoor environments. It is not uncommon for a subset of cats coming into TNR/RTF programs to have injuries or illnesses, especially during the cat breeding season.[18,51,52] Most shelters performed care for such conditions or provided humane euthanasia for debilitated cats.

Although TNR programs are designed with return to the neighborhood in mind, most shelters also had other options available as appropriate for individual cats. Adoption was available at most shelters, which would be an ideal outcome for most kittens, abandoned cats, and cats that are not thriving. Other options included relocation to another site, which is ideal for cats whose current location is being disrupted or is too dangerous. This often occurs in the context of 'barn cat' or 'working cat' programs designed to provide new placements for cats not suitable for traditional adoptive homes.[53] Transfer to another organization was also used as a lifesaving option, which might be as part of an ongoing collaboration to complete TNR, adoption, or relocation. Return to the neighborhood was the only option listed for RTF programs, since any other outcome for cats following admission to the shelter, such as adoption or transfer, would be classified as such.

In many Florida jurisdictions, local municipal codes may define anyone providing food or shelter for free-roaming cats as their owner; 'leash laws' commonly require owned cats to remain on the owner's property; and owned cats may be required to be licensed and wear tags.[54] Local codes may require free-roaming strays to be reported to animal control authorities or brought to municipal shelters. These policies are not consistent with the practice of TNR/RTF, in which neighborhood cats often cannot be handled and are not candidates for adoption due to lack of socialization to people and are cared for by residents who are not their owners. In such situations, outdoor cats that are fed for a few days before shelter impoundment could be counted as owner surrenders, obscuring their true status as lost pets or neighborhood community cats. Commonly, TNR/RTF is not explicitly addressed in municipal codes regulating animal control, leading to ambiguity about what cat management options are allowed or how cats should be tracked. As a result, shelters often use more traditional intake categories such as stray or owner surrender and outcome categories such as transfer, adoption, or return to owner as alternatives to TNR or RTF language. Even Florida State Statute 823.15 blurs required shelter statistical reporting, with only one mention of such programs in an outcome category described as 'Released in field/Trapped, Neutered, Released (TNR)', but no parallel intake category. The national animal shelter data collection organization Shelter Animals Count developed a standardized definition that includes, 'While the programs function in similar ways, the key difference is that RTF cats are admitted for sheltering and are therefore part of the animal sheltering function. TNR cats are NOT admitted for sheltering, only for a service or services (sterilization and/or vaccination)'.[55]

Limitations

This study had several limitations, primarily related to a lack of standardized shelter record-keeping systems that used different admission and outcome categories. In addition, shelters apply flexibility in tailoring decisions depending on the circumstances of each cat, the cat's neighborhood, public opinion, and shelter capacity, which varies throughout the year. As a result, it can be difficult to define what practices are 'routine' and what would be considered uncommon exceptions. Finally, the distinction between TNR and RTF is a subtle one, primarily based on the original intent of the person

performing or requesting the intervention. Some shelters and even the state statute regulating shelter data reporting did not distinguish between TNR and RTF. As a result, it is not possible to determine the number of cats managed by TNR/RTF programs or any trends in their numbers over time. This study evaluated shelter-based TNR/RTF programs and their use in Florida animal shelters but did not survey programs operated by other entities. TNR in particular is often a major function of non-profit spay/neuter clinics, low-cost access to veterinary care practices, and private veterinary hospitals. Therefore, it cannot be assumed that counties lacking shelter-based community cat programs did not have local or regional access to TNR/RTF through other organizations. Another limitation is that shelters were asked to report on programs in place in 2019, prior to the pandemic disruption of services. Current shelter operations may not be reflected in those responses.

Conclusion

Approximately two-thirds of cats taken in by Florida shelters were classified as 'strays', and cats were euthanized at nearly twice the rate of dogs in the study year. Shelters using the option of TNR and/or RTF programs for community cats had higher live outcome rates for cats than shelters without such programs. The expansion of shelter-based TNR/RTF programs in conjunction with community-based programs to support pet retention and to increase access to veterinary care is an opportunity to reduce unnecessary admission and euthanasia of cats in shelters and deaths of kittens born in the wild. Ideally, each cat should be evaluated to determine its best outcome, including TNR/RTF for thriving adults, relocation to 'working cat' placements for community cats that cannot care be returned to their original location, adoption for kittens, rehoming for surrendered pets, and reserving shelter admission for cats in need of shelter care and protection. Regional collaborations between urban organizations where programs are well established and supported by community engagement could be expanded to support neighboring rural communities where resources are scarce, thereby creating a statewide safety net not only for community cats but for all cats and dogs.

Author contributions

Conceptualization: CAS, JKL; Investigation: CAS, JKL, PCC, KS; Data curation: CAS, KS, JKL; Formal analysis: JKL; Methodology: CAS, JKL; Supervision: JKL; Writing – original draft: CAS; Writing – review & editing: JKL, PCC.

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Ethical approval

Surveys compiled non-privileged open-access retrospective population-level animal intake and outcome information and shelter protocols for community cat management. No animal- or person-level data were collected, and no individuals or organizations are identifiable within this publication. Therefore, no IACUC or IRB ethical approval was required.

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Supplementary materials

Florida Animal Shelter Survey: Management of Unowned Free-Roaming Cats.

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