Appendix

A. Research Articles.

This section of the appendix contains selected abstracts and summaries of research articles that may useful to those who design and implement programs to reduce shelter overpopulation. It is organized according to each article's primary topic to facilitate access for those who are especially interested in a particular issue. Comments regarding possible uses of the research findings for program design and suggestions about future research that may prove to be of value are included as well as—when available—sources from which a copy of the article or survey can be obtained.

■ DYNAMICS OF CAT AND DOG POPULATIONS

1. Nassar R, Mosier JE, & Williams LW (1984). Study of the feline and canine populations in the Greater Las Vegas area. *Am. J. Vet. Research* **54** (2): 282-287.

Summary: *Analysis of household dogs and cats based on age-distribution data and on age-specific birth and survival rates, as well as on pet source, indicated that the dog and cat populations are stable and not increasing in size (lambda congruent to 1). Roaming dogs and cats euthanatized at the pound represented about 5.7% and 8.1% of the estimated dog and cat populations, respectively. The death at the pound seems to be effective in checking pet population growth.*

Among pets acquired, 84% were less than 1 year of age for dogs as compared with 88% for cats. Breeders and pet shops supplied about 7% of cats and 17% of dogs. About 10% of cats and 10% of dogs were acquired at the pound, while 6.4% of dogs and 14% of cats were acquired as stray. About 45% of dogs and 41% of cats were acquired from pet owners. Some dogs (12.46%) and cats (12%) were imported from outside the Las Vegas area. Of dogs and cats below 2 months of age, 33% and 19.5%, respectively, came from breeders or pet shops or were imported from outside the area.

Seventeen percent of unspayed female dogs and 16% of unspayed female cats reproduced. The percentages of spayed females were 77 for dogs and 86 for cats. Forty-five percent of the dogs and 48% of the cats were males. Among dogs at the shelter, 2% were neutered and 26% spayed. At the pound, 24% of dogs were small breeds, 24% medium size breeds, and 52% large breeds. In the population, on the other hand, 35% were small breeds, 30% were medium sized breeds, and 35% were large breeds. These figures indicate that the majority of dogs that roam may be large breeds.

Forty-six percent of households had dogs, while 22% had cats. For households with dogs, there was an average of 1.49 dogs/household. For households with cats, the average was 1.61 cats. The ratio of people to pets was 3.92:1 for dogs and 7.74:1 for cats. We estimate that the increases in dogs and cats in 1982 as a result of new pet ownership were 3.6% and 1.8% respectively. These should be considered as the upper limits. The deaths at the pound are likely to compensate for this increase.

The average age at death was 7.02 years for cats and 9.57 years for dogs. The average age in the dog population was 5.32 years. The average age in the cat population was 4.86 years. The average age (as estimated by pound personnel) for a pet entering the pound was 1.68 years for dogs and 1.16 years for cats. The average age (as given by owner claiming the pet) was 2.53 years for dogs and 1.66 years for cats.

Dogs acquired from breeders and pet shops were represented with considerably less frequency in the pound (significantly less than their representation in the population). This may imply that they did not roam as much as dogs from other sources. Dogs born at home or acquired from the pound were represented at the pound at a much higher frequency than their representation in the population, implying that these dogs were allowed to roam more often than others. Approximately 15% of the dog and cat population were handled at the pound per year. There is evidence that a majority of roaming dogs and cats are owned animals.

Comment: Though limited to the study of cat and dog populations in a single community, this comprehensive research first explored many significant issues that were to become the subjects of later research. One such topic was the age distribution of cat and dog acquisitions. In this community, 84% of dogs acquired from all sources were less than a year old when acquired, as were 88% of all cats. Pets entering the local shelter were frequently older than this. The average age of dogs entering the shelter was 1.68 years; for cats it was 1.16 years. People appeared to adopt dogs and cats from the shelter when their age was in the same range as that of the pets that were acquired from other sources. Eighty percent of dogs that were adopted from the shelter were less than a year old, as were 90% of adopted cats. The shelter ac-

counted for only 10.35% of all cat acquisitions in the area and 9.67% of dog acquisitions, perhaps because many pets in the shelter were older than the public's apparent preference for juvenile animals. These age-based acquisition data were consistent with those found in a subsequent study of cat and dog populations in St. Joseph County, Indiana **(Appendix A2)** and suggest that to maximize their impact, shelter adoption programs may need to incorporate a public education component regarding the benefits of adopting adolescent and adult pets.

The reproductivity of cats and dogs of different age ranges was another significant issue examined in this study. In the area studied, the litter production rate of female cats in their reproductive years was strongly skewed toward younger cohorts. The most prolific age group of female cats was those between six months of age and one year old. Cats between the ages of two and three were only half as prolific. Some of this difference is likely due to the frequency with which owners delayed sterilizing female cats. Fifty-two percent of cats between the age of weaning and one year old had been sterilized, while 94% of those between two and three years old had been sterilized. The same trend held true for dogs. Dogs between the ages of one and two years were the most prolific and almost twice as prolific as those between three and four years old.

These data make clear that increasing the timeliness of sterilizations and reducing the frequency of pre-sterilization litters are critical to effectively managing pet populations through sterilization. More than 85% of female cats and 79.22% of female dogs in the area had been sterilized. Based on the local age-dependent birth and death rates, the authors of this study determined that the overall sterilization rate should have stabilized dog and cat populations in the area, but it had not. Population control euthanasia was needed to maintain a relatively stable pet population. This highlights the need for pet sterilization programs to take effective measures to reduce the frequency of pre-sterilization litters.

The source of pet acquisitions was another significant issue examined in this study. The acquisition of strays made up 14.5% of all cat acquisitions, even outstripping the rate at which cats were adopted from the shelter (10.35% of all acquisitions). Later research found that more stray and homeless cats were taken into homes than those adopted from shelters in an Indiana county **(Appendix A2)** and nationally **(Appendix A4)**. These data raise a concern that the beneficial impact of shelter adoption programs in reducing overall feline homelessness will be offset by the extent to which increased shelter adoptions result in fewer non-sheltered homeless

cats acquiring homes. To avoid that, adoption programs may need to be augmented with effective pet sterilization subsidy programs to reduce the frequency with which intact cats roam away from home and public information and awareness campaigns about the benefits of keeping cats indoors.

The breakdown of sterilization rates by species and gender was a fourth topic examined in this study. While cats of both genders were sterilized at about the same rate, 77% of female dogs, but only 26% of male dogs, were sterilized in this community. This gender sterilization disparity was consistent with studies of dog sterilization rates in an Indiana county **(Appendix A2)** and four towns in Massachusetts **(Appendix A12)**. Because sexually intact dogs tend to be relinquished by their owners at twice the rate of their sterilized counterparts (Page 28), pet sterilization education programs may need to include material that specifically addresses the benefits of sterilizing male dogs.

2. Patronek GJ, Beck AM, & Glickman LT (1997). Dynamics of cat and dog populations in a community. *J. Am. Vet. Med. Assoc.* **210** (5): 637-642.

Abstract: *OBJECTIVE—To describe dynamics of the pet dog and cat populations in a single community in terms of reproductive patterns and turnover.*
DESIGN—Cross-sectional, random-digit dial telephone survey. SAMPLE POPULATION—Information gathered from 1,272 households in St. Joseph County, Ind. that owned a dog or cat between Dec 1, 1993 and Nov 30, 1994 was compared with data on 9,571 dogs and cats received by the Humane Society of St. Joseph County during the same period. RESULTS—Prevalence of pet ownership was lower than expected, compared with consumer panel surveys. Eight hundred forty-three of 1,335 (63.1%) dogs were neutered, compared with 816 of 1,023 (79.8%) cats. Cost was cited as a reason that 35 of 441 (7.9%) dogs and 34 of 132 (25.8%) cats were not neutered. Only 33 of 968 (3.4%) dog-owning households reported that their dog had had a litter during the past year, whereas 52 of 662 (7.9%) cat-owning households reported that their cat had had a litter of kittens. Most cat litters were planned. Annual turnover in owned pets was 191 of 1,354 (14.1%) dogs and 184 of 1,056 (18.4%) cats. Pet owners underreported relinquishing pets to a shelter in the telephone survey. CLINICAL IMPLICATIONS—A combination of animal shelter and human population-based data are needed to describe pet population dynamics in a community. Information about species-specific reproductive patterns is essential in designing population control programs.

Comment: This was the first published study to consider the possible association between household income levels and pet sterilization rates. Households with annual incomes of less than $20,000 were more likely to have an intact dog at least 6 months old (34/27.9%) but that difference was not statistically significant. Data from a more recent national survey showed that households with annual incomes of less than $12,500 a year were significantly more likely to have an intact dog than households with higher incomes (data collected in 2008 for 2009/2010 American Pet Products Association [APPA] National Pet Owners Survey—Figure 5, Page 12).

In the St. Joseph County survey, low-income households were also more likely to have an intact adult cat than other all households (23.1/10.1%), a difference that was highly statistically significant. Subsequent national research found that household income level was strongly predictive of cat sterilization rates **(Appendix A16)**. Data collected for the 2009/2010 APPA National Pet Owners Survey also showed that people living in low-income households were significantly more likely to have an intact cat than those in other households (Figure 5, Page 12). These data suggest that pet sterilization programs which include subsidies to make neutering affordable for low-income owners will be more effective in increasing the pet sterilization rate than those that do not.

A second issue examined in this study was the reason owners of intact pets gave for not having had an animal sterilized. In the county studied, cat owners cited cost as a reason much more frequently than dog owners (25.8/7.9%). This pattern was consistent with that of a 1991 random telephone survey of Massachusetts pet-owning households, in which 22% of owners of intact cats, but not a single dog owner, cited cost as a reason for not having had the pet sterilized [Dorr Research Corporation (1991) Massachusetts Public Opinion Study on Spaying and Neutering of Pets, Boston, MA: Massachusetts Society for the Prevention of Cruelty to Animals, 8]. In a subsequent national survey, cost was the most frequent reason given by owners of a cat that had an unplanned litter for not having had the cat sterilized **(Appendix A4**). These data support the use by pet sterilization programs of a two-tiered co-payment structure in which the cost paid by cat owners to have their pet sterilized is less than that paid by dog owners.

As in the Las Vegas study **(Appendix A1)**, age distribution data showed that pet owners in this county frequently delayed having a female dog sterilized until the animal was well into her reproductive years. Sixty-three and nine-tenth percent of the female dogs between six months and three years old had been sterilized; the

sterilization rate for female dogs between the ages of three and seven years old was 73.8%; for those over than seven years old, it was 86.4%.

Sterilization of a female cat well after first estrus was common, too. The sterilization rate for female cats between six months and three years old was 76.5%; for those between three and seven years old, it was 90.7%; and 96.2% of those older than seven years old had been sterilized. Recent data from a high-volume pet sterilization program in Tennessee showed a similar pattern, in which the sterilization of both female dogs and cats was commonly delayed beyond first estrus (Figure 20, Page 93). These age-specific sterilization data suggest that increasing the number of sterilizations that are performed before an animal's first estrus can be of significant value in the management of cat and dog populations through sterilization.

As with the Las Vegas study **(Appendix A1)** and a study of dog and cat populations in four Massachusetts towns **(Appendix A12**), there was a gender disparity in the sterilization rate of dogs, but not cats. Slightly over half (52.9%) of male dogs had been sterilized compared to 72.7% of females.

Consistent with the Las Vegas data **(Appendix A1)**, this survey found that 84% of all dogs and cats had been acquired when less than a year old.

Another significant issue examined in this study was the extent to which the breeding of owned cats and dogs was intentional. Almost nine of ten (88.9%) feline litters were unplanned compared to less than two-fifths of canine litters (38.5%). A subsequent national survey found similar results **(Appendix A4)**. This suggests that programs to reduce the rate of unplanned or accidental litters can have significant impact in reducing feline reproductive rates.

Source: A copy of this article can be purchased from the cat.inist website at http://cat.inist.fr/?aModele=afficheN&cpsidt=10739381.

3. Wenstrup J & Dowidchuk A (1999). Pet overpopulation: Data and measurement issues in shelters. *J. Appl. Animal Welfare Sci.* **2** (4): 303-319.

Abstract: *Data collection and analysis within animal shelters are critical to developing effective programs that reduce the number of dogs and cats euthanized each year. However, current data collection efforts are insufficient to identify the magnitude, dynamics,*

or root causes of euthanasia in animal shelters across the United States. The purpose of this study was to examine potential solutions to the underlying root causes of pet overpopulation, with 2 elements. The first, more explicit goal was to establish a baseline of shelter data, policies, and viewpoints through a detailed survey of 186 shelters, 12 site visits, and numerous interviews. The findings suggest large variation in local issues faced by shelters, as well as a nearly universal focus on sterilization as a solution. The greater objective, however, was to use this information as an impetus to improve the process by which shelters amalgamate information and effectively use it to target the most pressing needs within their communities. We believe the essential step is to provide shelters with an analytical tool that would yield informational benefits exceeding the cost of data collection. Such an improvement would have a positive spillover effect on researchers, donors, and others attempting to collect standardized, geographically scalable data. This article presents an overview of the survey findings, as well as a prototype of a tool to help improve data amalgamation and analysis efforts within shelters.

Comment: This 1998 study was based on survey data provided by 186 public and private shelters in the United States. The quantitative data were supplemented by personal interviews and site visits to 12 shelters in five states.

A great deal of variation was found in the demographics of the animals that entered shelters in different localities. This suggests that shelter data from national surveys and from shelters located in other jurisdictions may be of limited value in the design of programs for a particular locality.

Data were collected about sheltering expenses and shelter population levels from which a unit cost per animal handled ($176) was derived. Such data are needed to better understand the economics of animal sheltering operations. More complete data about animal control expenditures could be of significant value, especially if they were broken down between fixed costs (i.e., costs that do not vary with the volume of animals handled) and variable costs. This could provide a sound basis for cost-benefit analyses to determine the appropriate level of funding for various animal sheltering policies and programs.

Data were also collected regarding the period of time before an animal exited the surveyed shelters through adoption, redemption, or euthanasia (an average of 9.5 days). Collecting similar data in future studies could help determine whether increased holding periods affect adoption rates or the incidence of disease and medical euthanasia rates in a shelter.

Source: A copy of this article can be purchased from the informaworld website at http://www.informaworld.com/smpp/ftinterface?content=a783708082&rt=0&format=pdf

4. New, Jr. JC, Kelch WJ, Hutchinson JM, Salman MD, King M, Scarlett JM, & Kass PH (2004). Birth and death rate estimates of cats and dogs in U.S. households and related factors. *J. Appl. Animal Welfare Sci.* **7** (4): 229-241.

Abstract: *Studies report variable factors associated with dog and cat surpluses in the United States. Estimates of cat and dog birth and death rates help understand the problem. This study collected data through a commercial survey company, distributing questionnaires to 7,399 cat- and dog-owning households (HHs) in 1996. The study used an unequal probability sampling plan and reported estimates of means and variances as weighted averages. The study used estimates of HHs and companion animals for national projections. More than 9 million owned cats and dogs died during 1996-yielding crude death rates of 8.3 cat deaths/100 cats in HHs and 7.9 dog deaths/100 dogs in HHs. The study reported twice as many kitten as puppy litters, with an average litter size of 5.73 and 7.57, respectively. The study reported data on planned versus unplanned litters, reasons caregivers did not spay females, disposition of litters, and sources of animals added to HHs. These first national estimates indicate the magnitude of, and reasons for, animals leaving HHs. The crude birth rate was estimated to be 11.2 kittens/100 cats in HHs and 11.4 puppies/100 dogs in HHs.*

Comment: Many findings of this national survey were consistent with those of several local studies. Data about the frequency with which stray and abandoned cats acquired homes were consistent with those from the Las Vegas study **(Appendix A1)** and the St. Joseph County study **(Appendix A2)**. In 1996, stray cats were taken into U.S. households about two and a half times more often than cats were adopted from shelters (2.07/.82 million).

Cost was the reason most frequent reason given for not having had a pet sterilized by owners of female cats that had given birth to an unplanned litter during the survey period; it was much less frequently given by dog owners whose pets had an unplanned litter (.49 million cat-owning households/.17 million dog-owning households). Cat owners also more frequently cited cost as a reason for not having had a pet sterilized than dog owners in a 2007 telephone survey of pet-owning households in Louisiana

and Mississippi [Cammisa H (2009). Messaging spay/neuter: lessons from the Gulf Coast spay/neuter campaign. http://hsus.org/web-files/PDF/messaging-spay-neuter-report-_-final.pdf.]. These findings are consistent with those first reported in the St. Joseph County study **(Appendix A2)**.

This survey included information from owners whose pets had litters about whether the litters were planned or unplanned. As with the St. Joseph County, Indiana survey **(Appendix A2)**, more than four-fifths of all litters of kittens were unplanned (81%) compared to less than half of all litters of puppies (47.4%).

Source: A copy of this article can be obtained at no cost from the National Council on Pet Population Study and Policy website at http://www.petpopulation.org/BirthandDeathRateEstimatesJAAWS7_4.pdf.

5. Di Nardo A, Candeloro L, Budke CM, & Slater MR (2007). Modeling the effect of sterilization rate on owned dog population size in central Italy. *Prev. Vet Med.* **82**: 308-313.

Abstract: *A spreadsheet population dynamics model was constructed to evaluate the impact of female dog sterilization on the domestic dog population for the province of Teramo, Italy. Baseline owned dog population structure as well as the annual number of births, adoptions, abandonments, and purchases were estimated based on regional managed kennel data in addition to a telephone questionnaire administered to members of the local population. Age- and gender-dependent death rates were based on domestic dog life tables. The model predicts that at the current female dog sterilization rate of 30%, the owned dog population will most probably continue to increase. After 20 years, a mean annual increase of 2.6% (median: 2.5%, 95% CI: –3.2% to 8.8%) is projected assuming that the average age at sterilization is 3 years. A sterilization rate of at least 55% is estimated to be needed to halt population growth if the current age structure for female dog sterilization is maintained. However, if the province of Teramo were to focus on sterilizing female dogs less than 1 year of age, the required sterilization rate to arrest population growth could be reduced to as low as 26%.*

Comment: The authors of this study constructed a statistical model to evaluate the impact of different female dog sterilization rates and average ages of sterilization on the domestic dog population in an Italian province. According to the model, if the current female sterilization rate (30%) and average age of sterilization (3 years)

were maintained, the annual mean domestic dog population in the province would increase by 2.6% after 20 years. The sterilization rate would have to increase to 55% to halt population growth if the current age structure for the sterilization of female dogs was maintained. If the average age at which female dogs were sterilized was reduced to less than one year old, however, the sterilization rate needed to arrest population growth would be reduced to as low as 26%. This model demonstrates the enormous impact that pre-sterilization litters can have on the reproductive rate of domestic dogs.

Source: A copy of this article can be purchased at the website of Science Direct: http://www.sciencedirect.com/science

■ RESOURCE ALLOCATION

6. Frank J (2004). An interactive model of human and companion animal dynamics: The ecology and economics of dog overpopulation and the human costs of addressing the problem. *Human Ecology* **32** (1): 107-130.

Abstract: *Companion animal overpopulation is a problem of human creation with significant human costs that can only be addressed through human action. A model was constructed to understand the dynamics of canine overpopulation and the effectiveness of various policy options for reducing euthanasia. The model includes economic and ecological factors in human and dog populations. According to the model, a "no-kill" society is an achievable goal at an acceptable human cost. Spay/neuter programs were generally found to be the most effective, with increasing adoptions also being an effective option. However, spay/neuter policies need to be evaluated over a very long time horizon since full impact may not be achieved for 30 years or more. Spay/neuter efforts can have a large impact even if they only effect (sic) a small portion of the human population. Adoption and spay/neuter programs were found to work well in combination, and to continue being effective as society approaches "no-kill" dynamics.*

Comment: In this study, various policy options to reduce canine shelter overpopulation were analyzed to determine their relative cost efficiency and compatibility with other strategies. Data from a survey of the human and dog populations in the Capital Region of New York State were used to construct a mathematical model. Many policy options were studied: increasing shelter capacity, providing financial incentives to

adopt dogs from shelters, imposing taxes on the acquisition of dogs from sources other than a shelter, and establishing low-cost spay/neuter programs, educational programs promoting pet sterilization, educational programs promoting the adoption of dogs from shelters, and educational programs to reduce pet abandonment rates.

Low-cost pet sterilization programs and educational programs promoting pet sterilization were found to be the most effective methods of addressing canine shelter overpopulation, especially when long-term impacts were considered.

Adoption programs were found to be less cost efficient than pet sterilization programs, but still quite effective, especially if they resulted in switching dog acquisitions from other sources to shelters instead of increasing the total number of dog owners.

Programs to reduce dog abandonment rates were found to be less efficient in reducing shelter euthanasia rates than either pet sterilization or adoption programs.

Source: A copy of this article can be purchased from the Springer Science & Business Media website at http://www.springerlink.com/content/wr3604327413804r.

■ RELINQUISHMENT OF PETS TO SHELTERS

7. Patronek GJ, Glickman LT, Beck AM, McCabe GP, & Ecker C (1996). Risk factors for relinquishment of dogs to an animal shelter. *J. Am. Vet. Med. Assoc.* **209** (3): 572-581.

Abstract: *OBJECTIVE–To identify canine and household characteristics associated with relinquishment of a pet dog to an animal shelter. DESIGN–Case-control study. SAMPLE POPULATION–Households that relinquished dogs for adoption (case households) and a random sample of current dog-owning households in the same community (control households). RESULTS–Potentially modifiable factors that explained the highest proportion of relinquishment were owners not participating in dog obedience classes after acquisition, lack of veterinary care, owning a sexually intact dog, inappropriate care expectations, and dogs having daily or weekly inappropriate elimination. Dogs obtained from shelters, kept in crates, or acquired at > or = 6 months of age were at increased risk of relinquishment. Greater purchase price was associated with decreased*

risk of relinquishment, but relinquishment was not associated with the degree of planning to acquire the dog. Dogs with behavioral problems and little veterinary care were at greater risk of relinquishment than were dogs with regular veterinary care, and behavioral problems were associated with inappropriate care expectations. CLINICAL IMPLICATIONS–Risk factors identified in this study can be modified by dog owners and veterinarians to decrease the estimated 2 million dogs euthanatized annually in animal shelters. Veterinarians should educate owners about typical dog behavior, routine care requirements and training, and the importance of regular veterinary visits; should incorporate wellness concepts in their practice; and should focus on preventive medicine and behavioral consultation.

Comment: This study examined factors that were associated with an increased risk of relinquishment of dogs to an Indiana shelter and first explored many issues that became subjects of the Regional Shelter Relinquishment Survey undertaken by the National Council on Pet Population Study and Policy. **(Appendix A9)**. Sexually intact dogs were three times more likely to be relinquished to the shelter studied, perhaps because they were also significantly more likely to engage in problematic behaviors, such as inappropriate elimination or unwanted chewing. Nearly one-third of all relinquishments to the shelter were attributed to a dog's intact status. This suggests that the impact of pet sterilization programs in reducing shelter overpopulation extends beyond managing the size of the pet population to reducing relinquishment rates. It also suggests that by adopting a pre-release sterilization policy instead of placing intact dogs with a neutering deposit, a shelter will increase the rate at which dogs adopted from the shelter will be successfully retained in an adoptive home.

It was also found that participation in a dog training class after acquisition significantly reduced the risk that a dog would subsequently be relinquished. Public information and awareness programs that promote the benefits of training programs and subsidized classes for low-income dog owners would likely be of significant value if they increase the rate at which new dog owners participate in training classes. In addition, by offering dog training classes to adopters and offering a subsidy to those unable to pay the full cost, shelters would likely benefit by increasing participation in training classes and subsequent adoptive retention rates.

Another modifiable risk factor associated with an increased risk of relinquishment was an owner's expectation that the care of a dog would be less work than it turned out to be. Nearly one-third of all relinquishments were attributed to an owner's underestimate of the amount of work that would be required to care for the dog. In

addition, owners who adopted dogs from shelters were significantly more likely to report that the dog required more care than expected. The authors of the study suggested that subsequent research would be helpful to evaluate the efficacy of various pre-adoption counseling programs.

Source: A copy of this article can be purchased from the cat.inist website at http://cat.inist.fr/?aModele=afficheN&cpsidt=10977491

8. Patronek GJ, Glickman LT, Beck AM, McCabe GP, & Ecker C (1996). Risk factors for relinquishment of cats to an animal shelter. *J. Am. Vet. Med. Assoc*. **209** (3): 582-588.

Abstract: *OBJECTIVE–To identify feline and household characteristics associated with relinquishment of a pet cat to an animal shelter. DESIGN–Case-control study. SAMPLE POPULATION–Households that relinquished cats for adoption (case households) and a random sample of current cat-owning households in the same community (control households). RESULTS–Potentially modifiable risk factors with the highest population attributable risk for relinquishment were owners having specific expectations about the cat's role in the household, allowing the cat outdoors, owning a sexually intact cat, never having read a book about cat behavior, cats having daily or weekly inappropriate elimination, and inappropriate care expectations. Frequency of inappropriate elimination and aggression toward people were not associated with declaw status, but these behaviors were more common among sexually intact cats, compared with sterilized cats. Owners of cats in case households were more likely than owners in control households to cite cost of sterilization as a reason a cat was sexually intact. Cats found as strays and cats acquired with minimal planning were at decreased risk of relinquishment. CLINICAL IMPLICATIONS–The identified risk factors can be modified by cat owners and veterinarians to decrease the estimated 4 million cats euthanatized annually in animal shelters. Owner education programs are needed as well as increased awareness on the part of cat owners and veterinarians of the importance of resolving feline inappropriate elimination problems.*

Comment: This study was the companion to the authors' research regarding risk factors for the relinquishment of dogs to an Indiana shelter **(Appendix A7)**. Among the modifiable risk factors that were associated with an increased risk of feline relinquishment was being sexually intact. Unsterilized cats were four times more likely to be relinquished, perhaps because such problematic behaviors as inappropriate elimination and aggression toward people were also associated with being sexually

intact. Nearly one-third of all feline relinquishments to the shelter were attributed to a cat's intact status. Programs that increase the local sterilization rates of owned cats may not only help better manage the size of the cat population, they also may help reduce the rate at which owned cats are relinquished to local shelters. In addition, shelters that adopt a pre-release sterilization policy in the place of a neutering deposit may increase the retention rate of adopted cats.

Having unrealistic expectations about a cat's role in the family or the amount of work required to care for the animal was also associated with an increased risk of relinquishment. A shelter may be able to increase the rate at which cats are successfully retained in their adoptive homes by insuring that prospective adopters are well informed about these matters prior to adoption. Not having owned another cat as an adult was also associated with a heightened relinquishment risk, so adoption counselors may want to take special care that this group of prospective adopters receive thorough pre-adoption counseling.

Source: A copy of this article can be purchased from the cat.inist website at http://cat.inist.fr/?aModele=afficheN&cpsidt=10977492

9. New Jr. JC, Salman MD, King M, Scarlett JM, Kass PH, & Hutchinson JM (2000). Characteristics of shelter-relinquished animals and their owners compared with animals and their owners in U.S. pet-owning households. *J. Appl. Animal Welfare Sci.* **3** (3): 179-201.

Abstract: *Animal shelters in the United States annually receive millions of relinquished dogs and cats, and risk factors for relinquishment are not fully understood. Investigators sponsored by the National Council on Pet Population Study and Policy interviewed people who relinquished dogs and cats at 12 shelters in four regions. We collected similar data from a sample of U.S. households with companion animal. Data collected included nonhuman animal characteristics such as age, sex, and frequency of selected behaviors. We also obtained data on keepers' (owners') age, sex, and level of education as well as their general knowledge of pet care and behavior. We found that relinquishment was associated with physical and behavioral characteristics of the animals and owner characteristics and knowledge. Relinquished animals were more likely to be intact, younger, and mixed bred. People relinquishing animals were significantly more likely to be men and younger than 35 years. Duration of ownership was significantly shorter for relinquished animals..*

Comment: This was the first study to report the widespread nature of the knowledge deficit among pet owners about whether a female pet would benefit from having a litter before being sterilized. Half of all owners in this national mail survey of pet-owning households (51.2% of the dog owners and 49.3% of cat owners) either mistakenly believed that a female animal would benefit from having a litter or did not know whether she would benefit or not. This knowledge deficit may have a significant practical impact: In a 2007 national survey, 40.7% of those who had an intact cat in their household cited their belief that a cat would benefit from having a litter before being sterilized as the reason they had not had the cat sterilized, the most common reason given **(Appendix A16)**. Remediating this knowledge deficit through public information and awareness campaigns would likely be of great benefit in the effective management of dog and cat populations and the reduction of shelter relinquishment rates.

Consistent with findings of earlier studies that intact cats and dogs were more likely to be relinquished to an Indiana shelter **(Appendix A7 and A8)**, intact status was associated with an increased risk of relinquishment to the 12 shelters included in this study. Intact dogs were found to have twice the risk of being relinquished to these shelters, and intact cats had more than three times the risk. In addition to other benefits, programs that increase local pet sterilization rates may also help reduce the frequency with which pets are relinquished to local shelters.

This study extended the findings of earlier local relinquishment studies **(Appendix A7 and A8)** in other respects, too. As in the Indiana studies, several factors were associated with an increased risk of canine and feline relinquishment to the 12 shelters studied (e.g., increased frequency of inappropriate elimination and an owner's unrealistic expectations about the amount of work that would be needed to care for the pet). To derive the full benefit from this research, it will be necessary to design interventions to reduce these risks and evaluate the effectiveness of each.

Source: A copy of this article can be obtained at no cost from the website of the National Council on Pet Population Study and Policy: http://www.petpopulation.org/characteristicsofshelter.pdf.

■ FERAL CAT MANAGEMENT PROGRAMS

10. Natoli E, Maraliano L, Cariola G, Faini A, Bonanni R, Cafazzo S, & Fantini C (2006). Management of feral domestic cats in the urban environment of Rome (Italy) *Prev Vet Med* **77** (3-4): 180-185.

Abstract: *In Italy, which is rabies-free, the national Law No. 281 [Legge Nazionale 14 agosto 1991. No. 281: Legge Quadro in materia di animali di affezione e prevenzione del randagismo. Gazz. Uff. Rep. Ital. no 203 del 30 agosto 1991: p. 3] on the management of pets and on the control of feral cats has introduced the no-kill policy for this species. Thus, "trap-neuter-release" (TNR) programs have been carried out for >10 years. In this paper we present data on registered colonies and censused cats in Rome from 1991 to 2000; the results of the neutering campaign from 1991 to 2000; and a survey, on 103 cat colonies, on the effects of demographic control of urban feral-cat colonies in the city of Rome, carried out by the local Veterinary Public Services (VPS) in collaboration with the associations of cat care-takers. In 10 years almost 8000 were neutered and reintroduced in their original colony. The spay/neuter campaigns brought about a general decrease in cat number but the percentage of cat immigration (due to abandonment and spontaneous arrival) is around 21%. This suggests that all these efforts without an effective education of people to control the reproduction of house cats (as a prevention for abandonment) are a waste of money, time and energy.*

Comment: This was the first published study about the impact of long-term Trap/Neuter/Release (TNR) programs on a large population of urban feral cats. While colonies that had been managed through TNR programs for two years or less showed a 13% increase in the total population, those that had been managed for 3, 4, 5, or 6 years showed decreases of 16, 29, 28, and 32% respectively. These data suggest that TNR programs can produce a significant decrease in urban feral cat populations, but only if sustained for several years.

The impact of TNR programs on the size of feral cat populations in the 103 colonies studied was greatly affected by the arrival of pet cats that had migrated from households or had been abandoned. Between 16% and 21% of each colony's population was made up of pets that had been abandoned by owners or migrated from households during the two- to six-year period after a colony first began to be studied. The authors concluded that controlling the reproduction of owned pet cats is crucial to achieve control of urban feral cat populations. They suggested that to effectively manage feral populations, TNR programs need to be combined with public information and

awareness campaigns to reduce the abandonment of owned cats and subsidized sterilization programs for household cats.

Source: A copy of this article can be purchased at the website of Science Direct : http://www.sciencedirect.com/science

11. Wallace JL & Levy JK (2006). Population characteristics of feral cats admitted to seven trap-neuter- return programs in the United States. *J. Fel. Med. & Surgery* **8**: 279-284.

Abstract: *Internationally, large populations of feral cats constitute an important and controversial issue due to their impact on cat overpopulation, animal welfare, public health, and the environment, and to disagreement about what are the best methods for their control. Trap-neuter-return (TNR) programs are an increasingly popular alternative to mass euthanasia. The objective of this study was to determine the population characteristics of feral cats admitted to large-scale TNR programs from geographically diverse locations in the United States. Data from 103,643 feral cats admitted to TNR programs from 1993 to 2004 were evaluated. All groups reported more intact females (53.4%) than intact males (44.3%); only 2.3% of the cats were found to be previously sterilized. Overall, 15.9% of female cats were pregnant at the time of surgery. Pregnancy was highly seasonal and peaked between March and April for all of the groups. The average prenatal litter size was 4.1 ± 0.1 fetuses per litter. Cryptorchidism was observed in 1.3% of male cats admitted for sterilization. A total of 0.4% of cats was euthanased because of the presence of debilitating conditions, and 0.4% died during the TNR clinics. Remarkably similar populations of cats with comparable seasonal variability were seen at each program, despite their wide geographical distribution. These results suggest that it is feasible to safely sterilize large numbers of feral cats and that the experiences of existing programs are a consistent source of information upon which to model new TNR programs*

Comment: This study of 103,643 unowned free-roaming cats in the southern, southwestern, and northwestern United States found that only 2.3% had previously been sterilized. This suggests that sterilized pet cats do not commonly migrate from households to become free-roaming. As a result, programs that increase the sterilization rate of owned cats may reduce the rate they migrate to free-roaming status and increase the capacity of TNR programs to effectively manage feral populations.

Even though the cats studied were homeless and had variable access to food and shelter, only .4% were euthanized for debilitating conditions, such as neoplasia, chronic health conditions, trauma and infectious diseases. These data suggest that there is no animal welfare justification for the widespread trapping and euthanization of feral and free-roaming cats.

Source: A copy of this article can be purchased at the website of Science Direct: http://www.sciencedirect.com

■ PET STERILIZATION PROGRAMS

12. Manning MM & Rowan AN (1992). Companion animal demographics and sterilization status: Results from a survey in four Massachusetts towns. *Anthrozoos* 5 (3): 192-201.

Abstract: *A survey was conducted in four Massachusetts communities to determine levels of pet ownership and the sterilization status of those pets, to analyze the impact of sterilization on pet overpopulation, to identify major reasons owners do or do not sterilize their animal, and to assess the impact of cost on an owner's decision to sterilize, among other factors. The survey was conducted by telephone using randomly generated telephone numbers. Interviews were conducted with 343 households of which 42% owned pets and 58% owned no pets. The percentages of households owning dogs (22%) and cats (21%) were lower than those reported in national surveys, as were the numbers of dogs (1.17) and cats (1.66) per owning household. Information was collected on 209 animals of which 42% were dogs and 52% were cats. Of the animals in the survey, 18.6% were intact and 81.3% were sterilized. Female dogs were sterilized at a significantly higher rate (87.8%) than were male dogs (45%). There was no difference in the sterilization rates for male and female cats. The rate of lifetime litter production by intact (0.4 litters per female) and sterilized females (0.31 litters per female) did not differ significantly. Owners obtaining their animals from pet stores and breeders were more likely to own intact animals than owners obtaining their pets from any other source. The most frequently cited reason for having a pet sterilized was to decrease the number of unwanted offspring. Owners of male animals were more likely to have their animals sterilized for behavior problems than owners of female animals. The major reasons for not sterilizing animals were: unnecessary because the animal was confined*

(31.6%), wanted to breed the animal (23.6%), animal was too young (18.4%), and it was inconvenient (10.5%). Less than 6 percent of owners cited cost as a factor in the decision to sterilize. A relationship also exists between owners' religious affiliation and ethnic background and sterilization status of their pets.

Comment: This is the first published study to point out the high rate at which sterilized female cats and dogs had one or more litters before having been sterilized. The rate of lifetime litter production of the intact cats and dogs included in this study (.4 litters per female) was not significantly different from that of those that had been sterilized (.31 litters).

The authors' estimate that 20% of sterilized female cats and dogs had at least one litter before having been sterilized [derived from a survey of Massachusetts pet-owning households sponsored by the Massachusetts Society for the Prevention of Cruelty to Animals—Dorr Research Corporation (1991): Massachusetts Public Opinion Study on Spaying and Neutering of Pets] was similar to the percentage of female cats and dogs that had one or more litters before being sterilized through a Tennessee pet sterilization program (24.7 % of female cats and 22.3% of female dogs; Figure 21, Page 94) and the finding of a 2007 national telephone survey of cat-owning households that 18.3% of sterilized female cats that had at least one litter before having been sterilized [Chu K, Anderson WM, & Rieser MY (2009). Population characteristics and neuter status of cats living in households in the United States. *J. Am.Vet. Med. Assoc.* **234** (8): 1025; **Appendix A16**].

In the four towns studied, female cats and dogs that remained intact had given birth to only 13% of all litters while those that were ultimately sterilized accounted for the remaining 87%. The high volume of pre-sterilization litters points to the need for pet sterilization education programs to emphasize the importance of timeliness in maximizing the benefits of pet sterilization. In addition, because timely sterilizations more effectively manage pet population levels than those that have been delayed, sterilization programs should consider offering discounts or other financial incentives for the sterilizations that are performed before an animal's first estrus.

This study found that female dogs in the four towns surveyed were sterilized at a much higher rate than males (87.8/45%) which was consistent with the findings of surveys in Las Vegas **(Appendix A1)** and Indiana **(Appendix A2)**. The second most common reason given by pet owners surveyed in this study for having male pets sterilized was to address behavior problems, suggesting that education programs may

want to include information about the behavioral benefits that are associated with pet sterilization in an attempt to increase the sterilization rate of male dogs.

Source: A copy of this article can be purchased from the IngentaConnect website: http://www.ingentaconnect.com/content/berg /anthroz/1992/00000005/00000003/art00006

13. Alexander SA & Shane SM (1994). Characteristics of animals adopted from an animal control shelter whose owners complied with a spaying/neutering program. *J. Am.Vet. Med. Assoc.* 205 (3): 472-476.

Summary: *A study of 137 cats and 567 dogs received by and subsequently adopted from an animal control center was performed to determine characteristics of animals whose new owners subsequently complied with a prepaid spaying/neutering program. Four times as many dogs as cats were adopted. Females were adopted more frequently than males. Owners who adopted female cats were most likely to comply with the prepaid spaying/neutering program, followed, in order, by owners of male cats, owners of female dogs, and owners of male dogs. Most animals returned to the shelter were < 4 months old. Dogs suspected to be of mixed breeding that were > 4 months old were most likely to be adopted. Owners who adopted a female dog suspected to be of mixed breeding were more likely to have the dog spayed than were owners who adopted a female dog that appeared purebred.*

Comment: This study included data about the rate at which adopters from a Louisiana animal control shelter had intact pets sterilized after paying a $25 neutering deposit that entitled them to have the adopted cat or dog sterilized at a participating veterinary clinic at no additional cost. Only 53.8% of those who adopted an intact cat and 38.3% of those who adopted an intact dog had the pet sterilized. These data suggest that pre-release sterilization programs can be of substantial value to manage pet populations and to increase the rate at which shelter pets are successfully retained in their adoptive homes.

Source: A copy of this article can be purchased from the cat.inist website at http://cat.inist.fr/?aModele=afficheN&cpsidt=11243282.

14. Mahlow JC (1999). Estimation of the proportions of dogs and cats that are surgically sterilized. *J. Am. Vet. Med. Assoc.* 215 (5): 640-643.

Abstract: *OBJECTIVE: To determine an estimate of the proportions of dogs and cats in Texas that are surgically sterilized and whether those proportions differed according to species and sex of the animal, level of responsibility of the owner, or geographic location. DESIGN: Cross-sectional study. ANIMALS: 43,831 dogs and cats > or = 6 months old. PROCEDURE: Information on sterilization rates was provided by 14 licensing agencies and 16 animal shelters in diverse regions of Texas. Univariate and multivariate analyses were used to compare sterilization rates among subpopulations of animals (dogs vs cats, males vs females, sheltered vs licensed, rural vs urban location). RESULTS: Overall, 12,893 (29.4%) of the animals (26.9% of dogs and 32.6% of cats) were sterilized. Proportions of animals sterilized were significantly different among subpopulations. CONCLUSIONS AND CLINICAL RELEVANCE: Although the cause of pet overpopulation is multifaceted, failure of owners to spay and castrate their animals is a major contributing factor. Significant differences in sterilization rates among subpopulations of dogs and cats suggest that organizations encouraging spaying and castration should use motivational techniques specific for the pet owners they are targeting.*

Comment: In this comprehensive survey of sterilization rates of canine and feline subpopulations in Texas, it was found that less than one-fifth of all dogs (17.7%) and cats (19.7%) admitted to surveyed shelters had been sterilized. This percentage was very similar to that of adult dogs (19.6%) and cats (20.2%) admitted to Michigan shelters in 2003 [Bartlett PC, Bartlett A, Walshaw S, & Halstead S (2005). Rates of euthanasia and adoption for dogs and cats in Michigan animal shelters, *J. Appl. Animal Welfare Sci.* **8** (2): 100]. Licensed dogs and cats in the surveyed jurisdictions were 4.4 times more likely to have been sterilized than those that entered shelters, suggesting that sterilization may have a strong protective effect.

There was significant local variation in sterilization rates within the state. Dogs and cats licensed in rural counties were significantly less likely to have been sterilized than those licensed in urban counties. This variation in sterilization rates highlights the value of using local data about dog and cat demographics and population dynamics when designing programs to reduce shelter overpopulation.

The variation in sterilization rates among subpopulations of dogs and cats may also be important in the design of strategies to increase pet sterilization rates. The author suggests that different motivational techniques, incentives, and disincentives may be

needed to influence dog owners than cat owners, for the owners of male and female pets, for those who live in urban and rural areas, and for responsible and irresponsible owners.

15. Frank J & Carlisle-Frank PL (2007). Analysis of programs to reduce overpopulation of companion animals: Do adoption and low-cost spay/neuter programs merely cause substitution of sources? *Ecological Economics* **62**: 740-746.

Abstract: *Overpopulation of companion animal results in millions of deaths each year at shelters and spending in the billions of dollars. Major efforts are underway to reduce this problem, with one of the largest efforts being spearheaded by Maddie's Fund. Maddie's Fund programs focus on encouraging spay/neuter and adoptions through economic incentives and marketing. However, aggressive spay/neuter and adoption programs present economic questions regarding how much they simply lead to substitution of sources for these good and services rather than increasing total community adoption and spay/neuter levels. In addition, spay/neuter also presents an ecological question as to how effective it is at reducing population sizes and therefore shelter intake. Analysis of Maddie's Fund program results show that low-cost spay/neuter programs are effective at raising total community spay/neuter levels (i.e. they do not merely cause substitution in source of spay/neuter procedures). Similar results were found for adoptions, with animal control adoptions not being reduced by new adoption programs initiated by other organizations. However, no clear results were found demonstrating the impacts of total spay/neuter procedures on shelter intake.*

Comment: This study of five separate low-cost pet sterilization programs found that the establishment of a subsidized program not only was not associated with a reduction in the number of unsubsidized sterilizations performed, but there was also an increase in the number of sterilizations performed by local veterinary clinics in the community at full price. The authors suggested that the publicity and social marketing campaigns used to promote the subsidy programs may have induced owners to have their pets sterilized even in the absence of a financial incentive. These findings suggest that economic incentives can increase a community's overall pet sterilization rate—especially if they are provided to financially needy pet owners—and that the effectiveness of subsidy programs can be augmented through social marketing campaigns that promote pet sterilization.

Source: A copy of this article can be purchased at the website of Science Direct: http://www.sciencedirect.com/science

16. Chu K, Anderson WM, & Rieser MY (2009). Population characteristics and neuter status of cats living in households in the United States. *J. Am.Vet. Med. Assoc.* **234** (8): 1023-1030.

Abstract: *OBJECTIVE: To gather data on cats living in US households, document their neuter status, and identify demographic characteristics associated with neuter status. DESIGN: Cross-sectional, random-digit-dial telephone survey. SAMPLE POPULATION: 1,205 adults in the continental United States contacted between April 24, 2007, and May 14, 2007. PROCEDURES: Information was gathered by means of computer-assisted telephone interviews. Multivariate logit analysis was used to identify demographic characteristics significantly associated with neuter status. RESULTS: 383 of 1,205 (31.8%) respondents reported having at least 1 cat at the time of the survey, yielding an estimated population of 82.4 million cats living in 36.8 million US households. Overall, 680 of 850 (80.0%) cats were reportedly neutered. Of the 371 neutered female cats, 303 (81.7%) had reportedly been neutered before having any litters. Proportion of cats that were neutered differed significantly across annual family income groups, with 96.2% (231/240) of cats in households with annual family incomes >or= $75,000 being neutered, 90.7% (231/254) of cats in households with annual family incomes between $35,000 and $74,999 being neutered, and only 51.4% (123/239) of cats in households with annual family incomes < $35,000 being neutered. CONCLUSIONS AND CLINICAL RELEVANCE: Findings suggested that a high percentage (80.0%) of cats living in households in the United States were neutered and that annual family income was the strongest predictor of whether cats in the household were neutered. The present study did not attempt to address stray and feral cats, which represent a substantial but unknown percentage of the total US cat population.*

Comment: This national survey found that annual household income was a better predictor of cat sterilization status than any other demographic factor examined. Only 51.4% of the cats living in households with annual incomes of less than $35,000 had been sterilized, compared to 90.7% of those living in households with incomes between $35,000 and $74,999 a year and 96.2% of those living in households with incomes of at least $75,000 a year. Cats living in the low-income households were 26 times more likely to be intact than those living in the upper-income households and 9 times more likely to be intact than those from the middle-income households.

This relationship between income level and the household cat sterilization rate was consistent with that found in a contemporaneous national survey completed for the American Pet Products Association (Figure 5, Page 12) and is strong evidence that attempts to significantly increase the U.S. household cat sterilization rate beyond its current level will depend on increasing the rate at which cats living in low-income households are sterilized.

Almost one-fifth (18.3%) of all the sterilized female cats included in the survey had at least one litter before having been sterilized. This rate was similar to that reported in an earlier Massachusetts survey **(Appendix A12)** and data from a Tennessee pet sterilization program (Figure 21, Page 94) and suggests that the high incidence of pre-sterilization litters may be a national phenomenon.

More than two-fifths (40.7%) of those who maintained at least one intact cat reported that they had not had the cat sterilized because they believed that a female cat would be better off by having a litter before being sterilized. This was the most common reason given for not having had a cat sterilized, more commonly cited than cost (38.8%) or an intention to breed the cat (20%). Public education campaigns to correct this mistaken belief would appear to have great potential as a strategy to reduce the incidence of pre-sterilization litters and more effectively manage household cat populations in the United States.

Source: A copy of this article can be purchased at the website of the American Veterinary Medical Association: http://avmajournal.avma.org/doi/abs/10.2460/javma.234.8.1023