



Free-roaming dogs and cats in central Italy: Public perceptions of the problem

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Abstract

A cross-sectional telephone survey of randomly selected households examined the extent and types of problems associated with free-roaming dogs and cats in the Teramo province of Italy. The households were sampled randomly within each municipality; municipalities were combined into coastal, central hills and mountain regions for analysis. The survey was conducted in May and June of 2004 with a response rate of 74% (397/536). Ninety percent of respondents ($N = 356$) believed that free-roaming dogs and cats were a problem. They were most commonly concerned about personal safety, followed by animal welfare, public health and environmental sanitation. Sixty-nine percent of respondents (274) actually saw free-roaming dogs or cats where they live. While dogs were most commonly seen, cats were seen in greater numbers. Overall, 10% (39/297) and 5% (21/397) of respondents cared for free-roaming cats and dogs, respectively. Two-thirds of the respondents (251/397) believed that animals were abandoned because the owners lost interest. About 2/3 of respondents (251/397) reported that the community government should have the responsibility for dealing with free-roaming dogs and cats. The respondents supported the idea of building more shelters and controlling the birth rate as control measures rather than euthanizing dogs and cats. The results suggest that free-roaming dogs and cats are a very common sight in this part of Italy with substantial concerns by the residents. However, concerns about the animals' welfare were clearly raised, supporting the laws that make it illegal to euthanize a healthy dog or cat in Italy. Using the information from this study, research on the underlying causes of abandonment of dogs and cats or failing to sterilize them should be undertaken to begin to address this problem. Further, national and regional funding must be provided to

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support existing laws which should help protect and eventually decrease the numbers of free-roaming and homeless dogs and cats.

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1. Introduction

Free-roaming dogs and cats are a common problem in many countries. In Italy, they are often seen in urban and rural areas and are of increasing concern (Boitani et al., 1995; Macdonald and Carr, 1995; Slater, 2005). Problems associated with free-roaming dogs and cats include public health issues, nuisance complaints, predation on wildlife or livestock and, increasingly, the welfare of the animals themselves (Matter and Daniels, 2000; Slater, 2002). Commonly expressed public health concerns include zoonotic diseases such as rabies, echinococcosis, toxocariasis, leishmaniasis, toxoplasmosis and bartonellosis as well as bites, and urine and feces in the environment (Fico, 1994; Matter and Daniels, 2000; Slater, 2005). Welfare issues relate to adequacy of food, water and shelter, injuries from cars, other animals and humans, illnesses and a suitable level of interaction and attention from humans (WHO, 1996; Matter and Daniels, 2000; Slater, 2005).

Free-roaming dogs and cats are defined as any dog or cat that is not confined to its owner's house or property and is not under direct supervision (Slater, 2005). These animals can be owned and allowed to roam unsupervised or be unowned. Between these two extremes are loosely owned animals which have some interaction with humans but do not belong to one particular home (neighborhood or community owned dogs/cats) (Wandeler, 1985; Slater, 2002). A subgroup of free-roaming dogs and cats are stray: recently owned but lost, escaped or abandoned animals and their offspring (Rubin and Beck, 1982; Slater, 2002). An additional important classification is socialization status. Dogs and cats can range from highly socialized to poorly socialized to unsocialized and afraid of humans (feral). Further complicating our understanding of these subpopulations is the fact that dogs and cats may move within these subpopulations during their lives, becoming more or less socialized or going from a pet to a stray to a new pet again. Free-roaming dogs are most commonly socialized to some degree and they have contact with human beings who provide the food and shelter needed for survival. While feral dogs do exist, they are rather rare (less than 10% of the free-roaming dogs population in Italy) and elusive (Boitani et al., 1995). Feral cats are found more commonly than feral dogs in Italy and, while frightened of humans, may live in close proximity, accepting food and shelter (Natoli, 1994; Hart, 2003). It is important to understand the distinctions between these subgroups because many different terms are used by different researchers and because the types of possible interventions will vary between them (Slater, 2002).

In Italy, it was estimated in 2001 that there were 816,610 free-roaming dogs and 1,290,692 free-roaming cats (<http://www.waycasa.net/root/animali>, accessed 1 July 2005). In 2002, there were 6.9 million owned dogs and 7.4 million owned cats, showing a steady increase over the previous 4 years (International Business Strategies, 2003). During 2001, Eurispes (Istituto di Studi Politici Economici e Sociali) reported that, in Italy, the number of abandoned animals was about 350,000, of which 200,000 were cats and 150,000 were dogs (http://www.oltrelaspecie.org/download/animalisti_randagismo_dati.pdf, accessed 1 July 2005). In the same year, car accidents due to free-roaming animals were reported to have caused 400 human injuries and 20 casualties.

As of the beginning of 2005 in the Abruzzo region where Teramo is located, the number of microchipped, registered dogs in the Italian national dog registry, Anagrafe Canina Centralizzata della Regione Abruzzo, was 75,437 of which 6048 were owned by the municipalities (both in shelters and living in communities). Prior to microchipping, dogs were tattooed. These tattooed dogs add an estimated 50,000 additional dogs (“Il Centro” newspaper, 22 January 2005, p. 15). Therefore the total number of owned, registered dogs in the Abruzzo region is estimated to be about 125,000. However, the number of owned dogs which were not registered is unknown.

Because of growing concerns about free-roaming dogs and cats, on 14 August 1991, the Italian Parliament approved Law n. 281 “Companion Animals and the Prevention of Strays” which described the problems and laid the foundation for actions to solve them, emphasizing the welfare of the animals (certified translation at www.comune.firenze.it/servizi_publici/animali/law281.htm, accessed 30 September 2003). This law made a dramatic change by making it illegal to euthanize dogs and cats unless they were seriously or incurably ill and by promoting dog registration and sterilization as well as protection and assistance for free-roaming dogs and cats.

Additional regional laws continue to emphasize animal protection, education and collaboration among the various constituencies. However, several important obstacles to implementation have included: a shortage of funding (national funding was only provided briefly); the high cost of managing a shelter; lack of oversight regarding implementation of the laws; and varied regional dedication to the principles involved. Because animals in shelters cannot be euthanized unless seriously ill and because many dogs and cat in shelters are not well socialized, if dogs and cats enter shelters, they may spend the remainder of their lives there. This is both economically challenging as well as having serious ethical and animal welfare implications.

The Istituto Zooprofilattico Sperimentale dell’Abruzzo e del Molise (IZSA&M) is a government public health institution engaged in research. It provides cutting-edge technical and scientific services, documentation and continuing education and training. Its mission is to provide high quality, data driven, innovative services in veterinary public health and environment protection, to national, European and international markets to protect animal and human health. The IZSA&M has been managing the municipal shelter on behalf of the City Council of Teramo. Since 2001, the IZSA&M has been actively working on the prevention of dog and cat abandonment and providing care for injured and sick, unowned animals. The IZSA&M is also engaged in dog training and animal assisted activities/therapy. The continued problems with free-roaming dogs and cats in the Abruzzo region where the IZSA&M is located and the need to develop data driven interventions led to this project.

This study was conducted in the province of Teramo within the Abruzzo region of Italy. Two major objectives of the telephone questionnaire were (1) to learn more about the extent, types and potential solutions for problems associated with free-roaming dogs and cats in the province and (2) obtain information on owned cat and dog ownership patterns (see the companion paper, Slater et al., in revision). The first objective is the focus of this paper.

2. Materials and methods

2.1. Sample selection

The province of Teramo is located on the Adriatic side of Italy in the central part of the country. The altitude varies from sea level to 2912 m. The distance from the coast to the mountains (farthest inland) is approximately 120 km as is the north-south distance. Stratified

random sampling (using computer generated random numbers) within each the 47 municipalities was performed since the province of Teramo also has a varied population density. Because the primary purpose of the project was to estimate the extent of free-roaming dogs and cats in the province, we elected to estimate the sample size for a proportion of 0.5 using a 95% confidence level and 0.05 error rate. A sample size of 384 was calculated. For the purpose of analysis, these municipalities were combined using the official classification (Istituto Nazionale di Statistica, <http://www.istat.it>) into three regions: central hill municipalities, eastern coastal municipalities and western (inland) mountain municipalities. The planned sampling proportions were 52% for the central hills, 41% for the coastal area and 7% for the mountain area based on the number of human residences.

For the sampling frame of telephone numbers, the data from the residential telephone network management firm (Pagine Gialle SpA) were used. In order to provide anonymity for the interviewees, data were requested without names.

2.2. Questionnaire design

An anonymous telephone questionnaire in Italian was designed with input from social scientists, animal behaviorist, veterinarians, experts in pedagogy and epidemiologists (available from MR Slater in Italian). The questionnaire was pre-tested by calling 20 households in the area and revised accordingly (question sequence, word choices, etc.) with input from the above experts. It was entered into an Access (Microsoft Access 2000) database for direct data entry during the interview. Interviewers were trained and monitored periodically during the study.

The questionnaire consisted of an introduction explaining the purpose of this study, the role of the IZSA&M and assurance that the survey would be anonymous. Initial questions asked if the respondents owned pets and, if so, could the interviewer speak with someone in the household who could tell us about the pet(s). Questions included what species, how many and how they were kept (Slater et al, in revision). The section on free-roaming animals asked about their number, species and location and whether anyone was caring for them. Respondents were also asked if they considered free-roaming animals to be a problem and whether that problem was related to public health, personal safety, environmental sanitation and animal welfare (all yes, no, do not know questions). We also asked the respondents why they believed owners abandoned animals and what might be done about it (with specific answer choices listed). The final section of the questionnaire included demographic information about the respondent and household.

2.3. Data analysis

Data were exported into Microsoft Excel (version 2002, Redmond, WA). Statistix (version 8.0, Tallahassee, FL) and Intercooled Stata (version 8.2, College Station, TX) statistical analysis packages were used. Descriptive data analyses were performed. Dependent variables were the questions: “were free-roaming animals a problem?” (yes/no), and which type of problem were these animals: public health, personal safety, environmental sanitation and animal welfare (all yes/no). Independent variables were the respondent’s: gender, age, marital status, education level, household size, pet owner (yes/no), region (central hills, coast, mountains) and interviewer. Bivariate analysis was performed using logistic regression, Chi-square or Mann–Whitney rank sum tests (age). Chi-square analyses were used to evaluate collinearity among the independent variables. Only the relationship among the types of problems caused by free-roaming animals and the relationship between pet ownership and reasons not to keep pets were of specific

interested (Chi-square analyses) and, therefore, included in the results. Multivariable logistic regression models were developed to look at factors which predicted whether free-roaming dogs and cats were considered to be a problem and for each of the four possible types of problems. For model building, variables with bivariate p -value less than 0.25 were included in the initial logistic regression model (Hosmer and Lemeshow, 2000). Stepwise backwards selection including all possible variables was performed using likelihood ratio tests to determine final predictive models with $p < 0.05$ considered to be significant. Even if the independent variables had significant associations among them, they were included in the logistic regression modeling if $p < 0.25$. No problems with convergence were found. Age and household size were initially treated as continuous variables. To evaluate linearity, categories were created and the log odds of created category were plotted against the midpoint of the category (Dohoo et al., 2003). Cutpoints were based on logical age groupings and on categories which reflected the changes in log odds. Odds ratios and 95% confidence intervals were calculated from the final models. Baseline categories were selected based on logical choices (e.g., “no” was coded as zero), or where there were a large number of responses in that category (e.g., “married” rather than “other” for marital status). Final models were checked against the initial full models using likelihood ratio tests. Interactions were examined for statistical significance. Goodness of fit was also examined for each final model using the Hosmer and Lemeshow goodness-of-fit test.

3. Results

The interviews were completed between 17 May 2004 and 23 June 2004. Five interviewers performed between 33 and 171 interviews each. Five hundred and thirty-six households were contacted. Three hundred and ninety-seven respondents agreed to participate in the interview (74% response rate). The response rate for the coastal area was 70%, for the central hill area, 79% and for the mountain area, 83%. The sampling proportions for completed interviews for each of the three regions were less than 0.3% different from the planned proportions.

Tables 1–5 include demographic information and bivariate analyses for each of the five dependent variables. Table 6 summarizes the final logistic regression models for each dependent variable. No interaction terms were significant. All models fit well according to Hosmer–Lemeshow goodness-of-fit tests.

Ninety percent of respondents (357/397) felt free-roaming dogs and cats were a problem. Thirty-one respondents indicated that all four types of problems listed were true, while 35 respondents thought three of the four problems were true. One respondent thought there was a problem but did not specify what type. Respondents who indicated personal safety was a problem were significantly less likely to also consider animal health a problem (OR = 0.7, 95% CI = 0.4–0.9, $\chi^2 = 3.89$, $p = 0.05$) and were significantly more likely to also list public health (OR = 2.3, 95% CI = 1.5–3.1, $\chi^2 = 14.4$, $p < 0.0001$). There was no association between personal safety and environmental sanitation ($\chi^2 = 0.2$, $p = 0.7$). Respondents who selected public health as a problem were also more likely to select environmental sanitation (OR = 5.6, 95% CI = 3.4–9.2, $\chi^2 = 50.5$, $p < 0.0001$). There was no association between respondents who selected animal health and their selection of either public health ($\chi^2 = 0.01$, $p = 0.9$) or environmental sanitation ($\chi^2 = 0.5$, $p = 0.5$).

Table 7 describes the location, numbers and care of the free-roaming cats and dogs seen by respondents. Appendix A provides detailed data on the perception of the causes and solutions for free-roaming dogs and cats. Pet owners were less likely to respond that it was impossible to keep the pet than non-pet owners and somewhat more likely to respond that the owners lost interest in the pet ($\chi^2 = 10.8$, $p = 0.01$).

Table 1

Descriptive data and bivariate Chi-square analyses for respondents who indicated that free-roaming dogs and/or cats were or were not a problem ($N = 394$, yes = 357, 91%)

Variables	Are free-roaming dogs/cats a problem			P-Value (χ^2)
	No, N (%)	Yes, N (%)	Total, N	
Gender				0.24
Women	24 (8)	263 (92)	287	
Men	13 (13)	93 (88)	106	
Total	37 (9)	356 (91)	393	
Missing			1	
Age (years)				0.002*
Median (years)	58	46	46	
Mean (years)	56	45	47	
14–34	5 (5)	98 (95)	103	
35–44	6 (8)	67 (92)	73	
45–64	10 (8)	112 (92)	122	
65–90	15 (20)	61 (80)	76	
Total	36 (10)	338 (90)	374	
Missing			20	
Marital status				0.5
Other	0 (0)	9 (100)	9	
Single	6 (7)	82 (93)	88	
Married	23 (9)	223 (91)	246	
Widowed	5 (14)	31 (86)	36	
Total	34 (9)	345 (91)	379	
Missing			15	
Education level				0.5
Elementary School	10 (13)	70 (87)	80	
Middle School	6 (6)	88 (94)	94	
High School	11 (7)	143 (93)	154	
University	3 (7)	39 (93)	42	
Total	30 (8)	340 (92)	370	
Missing			24	
Occupation				0.6
Housewife/husband	10 (11)	85 (89)	95	
Clerk	2 (4)	52 (96)	54	
Retired	6 (11)	48 (89)	54	
Professional	2 (5)	35 (95)	37	
Factory worker	5 (14)	31 (86)	36	
Student	1 (3)	34 (97)	35	
Laborer	2 (13)	13 (87)	15	
Seeking job	2 (13)	13 (87)	15	
Other	2 (8)	22 (92)	24	
Total	32 (9)	333 (91)	365	
Missing			29	

Table 1 (Continued)

Variables	Are free-roaming dogs/cats a problem			P-Value (χ^2)
	No, N (%)	Yes, N (%)	Total, N	
Household size				0.007
Number of persons				
1	5 (26)	14 (74)	19	
2	10 (12)	71 (88)	81	
3	2 (2)	88 (98)	90	
4	12 (11)	98 (89)	110	
5	5 (9)	51 (91)	56	
6–8	0 (0)	24 (100)	24	
Total	34 (9)	346 (91)	380	
Missing			14	
Pet owner				0.09
No	25 (12)	190 (88)	215	
Yes	12 (7)	167 (93)	179	
Total	37 (9)	357 (91)	394	
Region				0.28
Central hills	18 (8)	209 (92)	227	
Coast	15 (10)	131 (90)	146	
Mountains	4 (19)	17 (81)	21	
Total	37 (9)	357 (91)	394	
Interviewer				0.006
Alessandra	2 (3)	58 (97)	60	
Giorgia	2 (6)	30 (94)	32	
Massimo	5 (4)	110 (96)	115	
Maura	8 (12)	58 (88)	66	
Valerio	20 (17)	101 (83)	121	
Total	37 (9)	357 (91)	394	

* P-Value for age as a continuous variable, Mann–Whitney rank sum test.

4. Discussion

The population of free-roaming dogs and cats (FRDC) is a direct result of how owned animals are kept. Therefore, there are some countries in which FRDC are not a substantial problem. However, where they are a problem, potential causes and solutions must be conceptualized into two components: (1) how to prevent dogs and cats from becoming free-roaming and (2) what to do about dogs and cats that are currently free-roaming. For owned animals, preventing abandonment or discouraging animals from being allowed to roam unsupervised are obvious avenues. Methods could be developed to decrease the numbers by encouraging owners to keep their animals confined or on a leash or at least identify them so they can be returned if they become lost and sterilize them so they cannot reproduce. Fournier and Geller (2004) outline approaches which include influencing the media and animal industry as well as animal caretakers and animal welfare professionals. They suggest both education and enforcement approaches.

For unowned or loosely owned animals, the approaches to directly influence their lives are less obvious. These populations originally came from the owned pet population and steps should be

Table 2

Descriptive data and bivariate Chi-square analyses for respondents who indicated that personal safety was or was not a problem related to free-roaming dogs and/or cats ($N = 394$, yes = 239, 61%)

Variables	Personal safety as a problem			P-Value (χ^2)
	No, N (%)	Yes, N (%)	Total, N	
Gender				0.9
Women	113 (39)	174 (61)	287	
Men	41 (39)	65 (61)	106	
Total	154 (39)	239 (61)	393	
Missing			1	
Age (years)				0.02*
Mean (years)	50	45	47	
Median (years)	49	42	46	
13–34 years	34 (33)	69 (67)	103	
35–44 years	26 (36)	47 (64)	73	
45–64 years	52 (43)	70 (57)	122	
65–90 years	38 (50)	38 (50)	76	
Total	150 (40)	224 (60)	374	
Missing			20	
Marital status				0.15
Single	29 (33)	59 (67)	88	
Married	97 (39)	149 (61)	246	
Widowed	17 (47)	19 (52)	36	
Other	6 (67)	3 (33)	9	
Total	149 (39)	230 (61)	379	
Missing			15	
Education level				0.9
Elementary School	30 (38)	50 (62)	80	
Middle School	38 (40)	56 (60)	94	
High School	57 (37)	97 (63)	154	
University	19 (45)	23 (56)	42	
Total	144 (39)	226 (61)	370	
Missing			24	
Occupation				0.6
Housewife/husband	40 (42)	55 (58)	95	
Clerk	17 (32)	37 (68)	54	
Retired	24 (44)	30 (56)	54	
Professional	20 (54)	17 (46)	37	
Factory worker	14 (39)	22 (61)	36	
Student	12 (34)	23 (66)	35	
Laborer	4 (27)	11 (73)	15	
Seeking job	6 (40)	9 (60)	15	
Other	9 (38)	15 (62)	24	
Total	146 (40)	219 (60)	365	
Missing			29	

Table 2 (Continued)

Variables	Personal safety as a problem			P-Value (χ^2)
	No, N (%)	Yes, N (%)	Total, N	
Household size				0.03
Number of persons				
1	10 (53)	9 (47)	19	
2	38 (47)	43 (53)	81	
3	28 (32)	62 (68)	91	
4	50 (45)	60 (55)	110	
5	21 (38)	35 (62)	56	
6	2 (8)	22 (92)	24	
Total	149 (39)	231 (61)	381	
Missing			13	
Pet owner				0.5
No	88 (41)	127 (59)	215	
Yes	67 (37)	112 (62)	179	
Total	155 (39)	239 (61)	394	
Region				0.09
Central hills	80 (35)	147 (65)	227	
Coast	64 (44)	82 (56)	146	
Mountains	11 (52)	10 (48)	21	
Total	155 (39)	239 (61)	394	
Interviewer				0.003
Alessandra	27 (45)	33 (55)	60	
Giorgia	7 (22)	25 (78)	32	
Massimo	39 (34)	76 (66)	115	
Maura	20 (30)	46 (70)	66	
Valerio	62 (51)	59 (49)	121	
Total	155 (39)	239 (61)	394	

* P-Value for age as a continuous variable, Mann–Whitney rank sum test.

taken at that level to try and decrease recruitment. However, only a limited number of these animals can be adopted; in Italy, the rest either remain on their own or are taken into shelters. Neuter and return has been used widely in Italy for feral cats (Natoli et al., 1999; Hart, 2003). This approach has also been reported on a small scale in dogs in a small town in southern Italy (Leney and Remfry, 2000). In this town, a plan which combined sterilization, identification, education, adoption and cooperation between local authorities, veterinarian and dog owners was implemented by a dedicated veterinarian in 1995. They reported that by 1998, it was rare to see a sick dog in the streets and have a problem associated with packs of dogs. While there can be problems that need to be addressed, programs of neuter and return for dogs and cats are one option to consider in controlling existing unowned or loosely owned animals.

Nearly all of the respondents (91%) felt that FRDC were a problem even if all of them did not actually see these animals. Seventy-six percent of the respondents did see dogs and 61% saw free-roaming cats. They believed about a third of these animals were owned. Groups of 5–15 cats were relatively common while smaller groups of dogs were generally seen. These figures support the belief that there are many FRDC in the province of Teramo. Free-roaming dogs and cats were most commonly seen on public property followed by abandoned buildings and private property.

Table 3

Descriptive data and bivariate Chi-square analyses for respondents who indicated that animal welfare were or were not a problem related to free-roaming dogs and/or cats ($N = 394$, yes = 176, 45%)

Variables	Animal Welfare as a Problem			P-Value (χ^2)
	No, N (%)	Yes, N (%)	Total, N (%)	
Gender				0.008
Women	147 (51)	140 (49)	287	
Men	70 (66)	36 (34)	106	
Total	218 (55)	177 (45)	393	
Missing			1	
Age (years)				0.0009*
Mean (years)	50	43		
Median (years)	49	42		
13–34 years	44 (43)	60 (57)	103	
35–44 years	40 (55)	33 (45)	73	
45–64 years	66 (54)	56 (46)	122	
65–90 years	54 (71)	22 (29)	76	
Total	204 (54)	171 (46)	374	
Missing			20	
Marital status				0.1
Single	40 (45)	48 (55)	88	
Married	139 (56)	107 (44)	246	
Widowed	23 (64)	13 (36)	36	
Other	3 (33)	6 (67)	9	
Total	205 (54)	175 (46)	379	
Missing			15	
Education level				<0.0001
Elementary School	59 (74)	21 (26)	80	
Middle School	41 (44)	53 (56)	94	
High School	77 (50)	77 (50)	154	
University	20 (48)	22 (52)	42	
Total	197 (53)	173 (47)	370	
Missing			24	
Occupation				0.5
Housewife/husband	57 (60)	38 (40)	95	
Clerk	26 (47)	28 (53)	54	
Retired	31 (57)	23 (43)	54	
Professional	17 (46)	20 (54)	37	
Factory worker	23 (64)	13 (36)	36	
Student	14 (40)	21 (60)	35	
Laborer	8 (53)	7 (47)	15	
Seeking job	8 (53)	7 (47)	15	
Other	13 (54)	11 (46)	24	
Total	197 (54)	169 (46)	365	
Missing			29	

Table 3 (Continued)

Variables	Animal Welfare as a Problem			P-Value (χ^2)
	No, N (%)	Yes, N (%)	Total, N (%)	
Household size				0.69
Number of persons				
1	12 (63)	7 (37)	19	
2	47 (58)	34 (42)	81	
3	49 (54)	41 (46)	90	
4	54 (49)	56 (51)	110	
5	29 (52)	27 (48)	56	
6–8	14 (58)	10 (42)	24	
Total	205 (54)	176 (46)	380	
Missing			14	
Pet owner				0.002
No	134 (62)	84 (38)	218	
Yes	81 (47)	95 (53)	176	
Total	215 (55)	179 (45)	394	
Region				0.9
Central hills	126 (56)	101 (44)	227	
Mountains	12 (57)	9 (43)	21	
Coast	80 (55)	66 (45)	146	
Total	218 (55)	176 (45)	394	
Interviewer				<0.0001
Alessandra	36 (60)	24 (40)	60	
Giorgia	12 (38)	20 (62)	32	
Massimo	84 (73)	31 (27)	115	
Maura	32 (49)	34 (51)	66	
Valerio	54 (45)	67 (55)	121	
Total	218 (55)	176 (45)	394	

* P-Value for age as a continuous variable, Mann–Whitney rank sum test.

In a Canadian survey, 28% of households complained about animals roaming around their property (www.legermarketing.com, accessed 12 November 2004). This lower rate of perceived problems compared to our study could be due to the question asking only about personal property or, more likely, to a lower number or frequency of free-roaming animals in Canada compared to Italy. In a study in the Bahamas, 88% of respondents felt there was a stray dog problem with 52% reporting personal nuisance and 52% reporting concerns about catching a disease (Fielding and Mather, 2001). Similarly in a small, Hispanic town near El Paso TX, 97% of residents indicated a free-roaming dog problem and 84% were concerned for their personal safety (Poss and Bader, 2007). Survey data from Roseau, Dominica in the Caribbean indicated 90% of respondents believed there was a free-roaming dog problem and 71% saw free-roaming animals in their neighborhoods. Clearly FRDC can be a substantial community concern in various countries.

In the logistic regression models we deliberately did not choose specific variables to enter into the model even when there were independent variables that were significantly associated with one another. Since none of the independent variables were the type that could be influenced or changed, we did not have any rationale for selecting one over another. We were also interested in

Table 4

Descriptive data and bivariate Chi-square analyses for respondents who indicated that public health concerns were or were not a problem related to free-roaming dogs and/or cats ($N = 394$, yes = 129, 33%)

Variables	Public health as a problem			P-Value (χ^2)
	No, N (%)	Yes, N (%)	Total, N	
Gender				0.07
Women	201 (70)	86 (30)	287	
Men	64 (60)	42 (40)	106	
Total	265 (67)	128 (33)	393	
Missing			1	
Age (years)				0.9*
Mean (years)	47	47	47	
Median (years)	46	44	46	
13–34 years	73 (71)	30 (29)	103	
35–44 years	41 (56)	32 (44)	73	
45–64 years	85 (70)	37 (30)	122	
65–90 years	52 (68)	24 (32)	76	
Total	251 (67)	123 (33)	374	
Missing (N)			20	
Marital status				0.04
Single	64 (25)	24 (19)	88	
Married	154 (73)	93 (27)	247	
Widowed	30 (83)	6 (17)	36	
Other	6 (67)	3 (30)	9	
Total	254 (67)	126 (33)	380	
Missing			14	
Education level				0.6
Elementary School	50 (63)	30 (37)	80	
Middle School	67 (71)	27 (29)	94	
High School	99 (64)	55 (36)	154	
University	29 (69)	13 (31)	42	
Total	245 (66)	125 (34)	370	
Missing			24	
Occupation				0.8
Housewife/husband	65 (68)	30 (32)	95	
Clerk	31 (57)	23 (43)	54	
Retired	36 (67)	18 (33)	54	
Professional	24 (65)	13 (35)	37	
Factory worker	26 (72)	10 (28)	36	
Student	26 (74)	9 (26)	35	
Laborer	10 (67)	5 (33)	15	
Seeking job	9 (60)	6 (40)	15	
Other	14 (58)	10 (42)	24	
Total	241 (66)	124 (34)	365	
Missing			29	

Table 4 (Continued)

Variables	Public health as a problem			P-Value (χ^2)
	No, <i>N</i> (%)	Yes, <i>N</i> (%)	Total, <i>N</i>	
Household size				0.9
Number of persons				
1	14 (74)	5 (26)	19	
2	54 (67)	27 (33)	81	
3	58 (64)	32 (36)	90	
4	74 (67)	36 (33)	110	
5	40 (71)	16 (29)	56	
6–8	13 (54)	11 (46)	24	
Total	253 (67)	127 (33)	380	
Missing			14	
Pet owner				0.7
No	143 (67)	72 (33)	216	
Yes	122 (68)	57 (32)	181	
Total	265 (67)	129 (33)	394	
Region				0.15
Central hills	144 (63)	83 (37)	227	
Coast	106 (71)	40 (29)	146	
Mountains	15 (73)	6 (27)	21	
Total	265 (68)	129 (32)	394	
Interviewer				0.001
Alessandra	43 (72)	17 (28)	60	
Giorgia	21 (66)	11 (34)	32	
Massimo	62 (54)	53 (46)	115	
Maura	55 (83)	11 (17)	66	
Valerio	84 (70)	37 (30)	121	
Total	265 (67)	129 (31)	394	

* P-Value for age as a continuous variable, Mann–Whitney rank sum test.

hypothesis generation and believed that letting the modeling process select the final variables was be a valid approach.

The interviewer was also included as a potential fixed effect to see if there was any pattern or influence of the interviewer's gender or number of completed interviews on the outcome. Only in one model (whether FRDC were a problem or not) was a variable dropped (age) when interviewer was added (data not shown). Since marital status was also associated with age, this could have been the reason for the change. All but two models had different patterns of which interviewer was associated with the outcome demonstrating no obvious effect of individual interviewer. Interviewer as a variable was significantly associated with marital status ($\chi^2 = 25.0$, $p = 0.02$) but not with any other independent variables. Alessandra had more respondents in the "other" category (separated, living together or divorced) while Valerio had fewer than expected. Massimo had fewer widowed respondents and Valerio more than expected. Valerio also had fewer single respondents than the other interviewers. However, interviewer did not substantially change the odds ratios of any of the other variables in any models, indicating it was not a confounder or effect modifier in this study. We did not force interviewer into any models.

Table 5

Descriptive data and bivariate Chi-square analyses for respondents who indicated that environmental sanitation was or was not a problem related to free-roaming dogs and/or cats ($N = 394$, yes = 90, 23%)

Variables	Environmental sanitation a problem			P-Value (χ^2)
	No, N (%)	Yes, N (%)	Total, N	
Gender				0.4
Women	225 (78)	62 (22)	287	
Men	79 (75)	27 (25)	106	
Total	304 (77)	89 (23)	393	
Missing			1	
Age (years)				0.3*
Mean (years)	46	48	47	
Median (years)	46	47	46	
13–34 years	83 (81)	20 (19)	103	
35–44 years	54 (75)	18 (25)	73	
45–64 years	93 (76)	29 (24)	122	
65–90 years	56 (74)	20 (26)	76	
Total	287 (77)	87 (23)	374	
Missing			20	
Marital status				0.5
Single	72 (82)	16 (18)	88	
Married	184 (75)	62 (25)	246	
Widowed	28 (78)	8 (22)	36	
Other	6 (67)	3 (33)	9	
Total	290 (77)	89 (23)	379	
Missing			15	
Education level				0.8
Elementary School	61 (76)	19 (24)	80	
Middle School	74 (79)	20 (21)	94	
High School	116 (75)	38 (25)	154	
University	30 (71)	12 (29)	42	
Total	281 (76)	89 (24)	370	
Missing			24	
Occupation				0.8
Housewife/husband	73 (77)	22 (23)	95	
Clerk	43 (80)	11 (20)	54	
Retired	41 (76)	13 (24)	54	
Professional	24 (65)	13 (35)	37	
Factory worker	30 (83)	6 (17)	36	
Student	30 (86)	5 (14)	35	
Laborer	10 (67)	5 (33)	15	
Seeking job	10 (67)	5 (33)	15	
Other	16 (67)	8 (33)	24	
Total	277 (76)	88 (24)	365	
Missing			29	

Table 5 (Continued)

Variables	Environmental sanitation a problem			P-Value (χ^2)
	No, N (%)	Yes, N (%)	Total, N	
Household size				0.5
Number of persons				
1	13 (68)	6 (32)	19	
2	58 (72)	23 (28)	81	
3	68 (76)	22 (24)	90	
4	90 (82)	20 (18)	110	
5	44 (79)	12 (21)	56	
6–8	18 (75)	6 (25)	24	
Total	291 (77)	89 (23)	380	
Missing			14	
Pet owner				0.05
No	158 (74)	57 (26)	215	
Yes	146 (82)	33 (18)	171	
Total	307 (77)	90 (23)	394	
Region				0.49
Central hills	179 (79)	48 (21)	227	
Mountains	17 (81)	4 (19)	21	
Coast	108 (74)	38 (26)	146	
Total	304 (77)	90 (23)	394	
Interviewer				<0.0001
Alessandra	47 (78)	13 (22)	60	
Giorgia	25 (78)	7 (22)	32	
Massimo	72 (63)	43 (37)	115	
Maura	57 (86)	9 (14)	66	
Valerio	103 (85)	18 (15)	121	
Total	304 (77)	90 (23)	394	

* P-Value for age as a continuous variable, Mann–Whitney rank sum test.

Household (HH) size and interviewer were significantly associated with whether or not the respondents felt FRDC were a problem. Households with three or more people in them were significantly more likely to consider FRDC a problem than HH with only one person. Three person HH were 20 times more likely to believe this was a problem. This might reflect the fact that three-person HH tend to have a married person and perhaps a young child. Household size was also associated with age and pet ownership (1 person HH respondents tended to be >65, widowed and have fewer pets) and the largest households were more likely to have pets than the 1 person HH. Two interviewers (Maura and Valerio) had fewer respondents who indicated FRDC were a problem than Alessandra.

Personal safety was the most commonly cited problem (60% of respondents) followed by animal welfare, public health and environmental sanitation. Perhaps the more common sightings of free-roaming dogs accounts for personal safety as the most commonly reported problem. Household size and interviewer were significant predictors of this type of problem. Households of six or more were significantly more likely to consider personal safety a problem than one-person HH. As HH size is associated with age, marital status, education and occupation, it may be

Table 6

Final logistic regression models for responses about whether and what type of problems were a result of free-roaming dogs/cats

Variables	Free-roaming ^a OR (95% CI)	Personal safety ^b OR (95% CI)	Animal welfare ^c OR (95% CI)	Public health ^d OR (95% CI)	Environment ^e OR (95% CI)
Household size					
Number of persons					
1	1.0 (reference)	1.0 (reference)	–	–	–
2	2.8 (0.7–11)	1.3 (5–4)	–	–	–
3	2 (3.5–14)	2.7 (0.9–8)	–	–	–
4	4.0 (1.1–15)	1.6 (0.6–4.5)	–	–	–
5	–	2.2 (0.7–7)	–	–	–
5–8	6.9 (1.6–30)	–	–	–	–
6–8	–	11.6 (2.0–67)	–	–	–
Gender					
Women	–	–	1.0 (reference)	1.0 (reference)	–
Men	–	–	0.5 (0.3–0.8)	1.7 (1.04–2.9)	–
Educational level					
High School	–	1.0 (reference)	–	–	–
Elementary School	–	0.4 (0.2–0.7)	–	–	–
Middle School	–	1.2 (0.7–2.2)	–	–	–
University	–	1.1 (0.5–2.3)	–	–	–
Marital status					
Married	–	–	1.0 (reference)	–	–
Single	–	–	0.5 (0.3–0.9)	–	–
Widowed	–	–	0.4 (0.2–0.98)	–	–
Other	–	–	1.1 (0.3–4.7)	–	–
Pet owner					
No	–	–	1.0 (reference)	–	1.0 (reference)
Yes	–	–	2.3 (1.4–3.6)	–	0.6 (0.3–0.9)
Interviewer					
Alessandra	1.0 (reference)	1.0 (reference)	1.0 (reference)	1.0 (reference)	1.0 (reference)
Giorgia	0.2 (0.02–2.8)	2.7 (1.0–7.4)	2.9 (1.1–7.7)	1.2 (0.5–3.1)	1.0 (0.4–2.8)
Massimo	0.3 (0.03–3.1)	1.3 (0.7–2.6)	0.6 (0.3–1.1)	2.5 (1.2–5.1)	2.3 (1.1–4.8)
Maura	0.1 (0.01–0.9)	1.6 (0.7–3.4)	1.8 (0.8–4.0)	0.5 (0.2–1.3)	0.6 (0.2–1.6)
Valerio	0.1 (0.01–0.5)	0.7 (3–1.3)	1.8 (0.9–3.7)	1.2 (0.6–2.4)	0.6 (0.3–1.4)

^a Are free-roaming dogs/cats a problem? Yes or no. $N = 372$; likelihood ratio $\chi^2 = 34.30$, $p = 0.0001$; Hosmer–Lemeshow goodness-of-fit test, $p = 0.21$.

^b Is personal safety a problem from free-roaming dogs/cats? Yes or no. $N = 380$; likelihood ratio $\chi^2 = 32.55$, $p = 0.0002$; Hosmer–Lemeshow goodness-of-fit test, $p = 0.87$.

^c Is animal health a problem as a result of free-roaming dogs/cats? Yes or no. $N = 362$; likelihood ratio $\chi^2 = 59.78$, $p = 0.0001$; Hosmer–Lemeshow goodness-of-fit test, $p = 0.87$.

^d Is public health a problem as a result of free-roaming dogs/cats? Yes or no. $N = 379$; likelihood ratio $\chi^2 = 32.50$, $p = 0.0001$; Hosmer–Lemeshow goodness-of-fit test, $p = 0.42$.

^e Is environmental sanitation a problem as a result of free-roaming dogs/cats? Yes or no. $N = 397$; likelihood ratio $\chi^2 = 26.11$, $p = 0.0001$; Hosmer–Lemeshow goodness-of-fit test, $p = 0.94$.

representing a more complex pattern of younger, singles in one and two-person HH, married people in three-person HH, and professionals (doctors, lawyers, etc.) in HH with <five people. Since larger household were also more likely to own pets, this could be due to negative interactions between owned pets in the household and unowned free-roaming animals.

Table 7

Respondents opinions about the causes of abandonment and possible solutions for free-roaming dogs and cats in the Teramo region ($N = 397$)

Variable	Number (%)
Why abandoned	
Lose interest	254 (65)
Impossible to keep	91 (23)
Animal behavior problem	2 (0.5)
Do not know/missing	50 (13)
What should they do instead	
Give to a trusted friend	169 (43)
Take to public shelter	199 (50)
Pay for a private kennel	8 (2)
Put to sleep	1 (0.3)
Other	7 (2)
Do not know/missing	13 (3)
Who should be responsible	
Community government	251 (63)
Volunteer organizations	28 (7)
Government veterinarians	40 (10)
Istituto zooprofilattico	36 (9)
Other	15 (4)
Do not know/missing	27 (7)
How should free-roaming animals be prevented	
Public education campaign	135 (34)
More personal responsibility	97 (24)
School education campaign	90 (23)
Other	11 (3)
Do not know/missing	64 (16)
How should free-roaming animals be controlled	
Control birthrate	149 (38)
Build new kennels	177 (45)
Euthanize them	9 (2)
Other	7 (2)
Do not know/missing	56 (14)

Animal welfare was the second most commonly cited problem demonstrating the high level of concern of the public for the well-being of these animals. Gender and education level of the respondent, pet ownership and interviewer were the important predictors for this response. Men were half as likely to give this answer as women. Only an elementary education decreased the likelihood of indicating animal welfare was a problem. Households which owned pets were about twice as likely to believe this was a problem as non-pet owners. Giorgia was more likely to have respondents give this answer than Alessandra. Since education and pet ownership are also associated with marital status and age, the significant variables could be surrogates for the non-significant ones.

Respondents who were concerned about public health and free-roaming animals were more likely to be men than women. Respondents who were single or widowed were about half as likely to be concerned about public health as those were married. This could reflect children in the household and concerns about disease transmission. Massimo was more likely to have this type of response than the other interviewers.

Environmental sanitation was the least common problem reported. The only predictor of this response was pet ownership and interviewer. Pet owners were about half as likely to give this answer as non-pet owners. This might be due to more realistic appreciation of the amount of mess created by pets or conversely by a desensitization to urine and feces in the environment. This might also be due to an effort to downplay the need to clean up after pets. Also, respondents <35 years old had more pets and were more likely to be single men who may not be very concerned about this problem. Again, Massimo has more respondents indicate this was a problem than the other interviewers. In Canada, a survey reported a higher percentage of HH (51%) complained about feces left in public places (www.legermarketing.com, accessed 12 November 2004).

Among free-roaming animals seen by the respondents, almost 40% of cats were cared for by the respondents compared to 22% of dogs. Overall, 10% of HH in this survey cared for free-roaming cats. Presumably, this activity primarily consists of feeding cats but could also include sterilizing them. This estimate is quite similar to estimates in the United States where eight to 12% of households feed cats they do not own (Johnson et al., 1993; Johnson and Lewellen, 1995; Patronek et al., 1997; Levy et al., 2003). In Victoria, Australia, 22% of 424 respondents to a survey cared for cats they did not own (Toukhsati et al., 2007). Ninety-three percent were feeding cats and 83% reported handling the cats as part of their care. Twenty percent reported neutering cats they did not own.

In our study, only 5% of total respondents cared for dogs they did not own. In the Bahamas, 54% of households fed unowned dogs (Fielding and Mather, 2001).

When respondents were asked why they believed pets were abandoned by their owners, about two-thirds (254/397) felt that people lost interest in keeping the pet and about 23% believe that it had become impossible to properly care for the pet. We did not specifically ask if the respondent has abandoned a pet because of the sensitive nature of that question. We believed we would get a more honest answer if the question was asked more hypothetically. Pet owners were less likely to respond that it was impossible to keep the pet than non-pet owners. These replies would tend to support the idea that a strong relationship between the pet and the owner had not developed, making it relatively easy for an owner to abandon the pet. In addition, a poor choice of pet for the household members' lifestyle may play an important role. Many researchers involved in pet overpopulation, indicate that the inadequacy of the human–animal relationship is a key element (Arkow, 1991; Miller et al., 1996; Fournier and Geller, 2004). Therefore, activities which might strengthen this relationship or which might provide a better match between owner and pet could decrease abandonment substantially.

In addition, abandonment may be perceived to be their best or only alternative. This perception could be due to too few animal shelters or to the belief that shelters were not good choices for pets. Therefore, leaving the animal homeless might result in someone adopting the animal. Forty-five percent of respondents believed more shelters were needed. Alternatively, people who abandon pets may believe that the dog or cat could look after itself.

Interestingly, problems with the behavior of the pet were not considered to be an important reason for abandonment. In the United States, studies have demonstrated that behavior problems are the number one reason for animals to be relinquished to an animal shelter (Salman et al., 1998).

When asked what people who could not keep the pet should do, responses were divided approximately in half between giving the pet to a reliable person and putting it in a public kennel. Obviously, is very difficult to find a reliable friend who will take a pet and public shelters rapidly

fill up. It is unknown whether respondents would be willing to pay more to expand the capacity of public kennels. Respondents clearly felt it was the community government's responsibility to deal with free-roaming dogs and cats. In the province of Teramo, there are few low cost or subsidized sterilization programs supported by the government for owned dogs. More research to define an optimal funding and delivery system for these programs is needed. Further work might focus on the relative priorities of both the community government and the residents for funding animal work versus other activities. In addition, the views of the local private practice veterinarians as well as the government veterinarians on sterilization, including prepubertal surgery, should be examined.

Only a small percentage felt that the government veterinary services, the IZSA&M or volunteer groups might take responsibility for free-roaming animals. In terms of preventing abandonment or free-roaming owned pets, respondents were divided. Most commonly, public education was listed followed by better responsibility by the owners and school education programs. However, 13% of respondents had no opinion indicating either that they had not thought much about this or that they recognized there was no easy solution. When asked what to do about the currently free-roaming animals, respondents primarily chose building new kennels and birth control. These are essentially the options which are currently being pursued. Only 2% felt that euthanasia of these animals was appropriate. This demonstrates support for the law which makes it illegal to euthanize animals except for serious or incurable illness. But again, 11% did not have an opinion. These results indicate that respondents do realize this is a community level problem. This recognition should improve the ability of the various organizations involved in solving the problem to get community support for new programs.

5. Conclusions

This cross-sectional survey demonstrated that free-roaming dogs and cats are a common problem in the province of Teramo, Italy. Personal safety was the most commonly reported concern, perhaps as a result of the visibility and numbers of free-roaming dogs. Animal welfare was the second most commonly reported problem. This underscores the public concern for animal well-being in this part of Italy and is consistent with nation and regional legislation designed to protect and reduce the numbers of free-roaming dogs and cats. The view of the respondents was that this problem should be handled primarily by the government and not by private organizations. While this type of study can only suggest hypotheses to be tested by more stringent study designs, the result indicate that abandonment is likely a result of lack of interest or difficulty in maintaining the pet. These results are probably due to a poor choice of pet for the situation, failure to bond with the pet or lack of infrastructure to help owners with problem situations.

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Appendix A

Descriptive data on location and human interaction of free-roaming dog and cat populations in the Teramo region for 275/396 (69%) respondents who indicated that free-roaming dogs and/or cats were present where they lived

Variable	Number (%)	
Which species present		
Cats	66 (24)	
Dogs	108 (39)	
Both	101 (37)	
Missing	1 (0.4)	
Are dogs/cats owned		
Yes	98 (36)	
No	92 (34)	
Do not know	77 (28)	
Missing	8 (3)	
	Number (%)	
	How many cats (<i>N</i> = 167)	How many dogs (<i>N</i> = 209)
1–2	5 (3)	19 (9)
3–5	77 (46)	136 (65)
6–14	61 (37)	42 (20)
More than 14	18 (11)	4 (2)
Missing	6 (4)	8 (4)
	Number (%)	
	Where cats seen	Where dogs seen
Abandoned buildings	47 (28)	51 (24)
Public property	52 (31)	91 (44)
Private property	30 (18)	24 (12)
Dumps	0 (0)	2 (1)
Other	16 (10)	16 (8)
Do not know/missing	21 (13)	22 (12)
	Number (%)	
	Is someone caring for the cats?	Is someone caring for the dogs?
Yes	95 (57)	89 (43)
No	45 (27)	65 (31)
Do not know/missing	27 (16)	55 (27)
	Number (%)	
	For cats	For dogs
Is that person yourself		
Yes	39 (41)	21 (24)
No	50 (53)	60 (67)
Missing	6 (6)	8 (9)

References

- Arkow, P., 1991. Animal control laws and enforcement. *J. Am. Vet. Med. Assoc.* 198, 1164–1172.
- Boitani, L., Francisci, F., Ciucci, P., Andreoli, G., 1995. Population biology and ecology of feral dogs in central Italy. In: Serpell, J.A. (Ed.), *The Domestic Dog: Its Evolution, Behaviour, and Interactions with People*. Cambridge University Press, pp. 217–244.
- Dohoo, I., Martin, W., Stryhn, H., 2003. *Veterinary Epidemiologic Research*. AVC Inc., Charlottetown, Prince Edward Island, Canada.
- Fico, R., 1994. Population dynamics in dogs and wild animals. In: Siemensis, A.M. (Ed.), *Information Circular*, vol. 35. WHO Mediterranean Zoonosis Control Centre, World Health Organization, Athens, Greece, pp. 3–4.
- Fielding, W.J., Mather, J., 2001. Dog ownership in the West Indies: a case study from the Bahamas. *Anthrozoos* 14 (2), 72–80.
- Fournier, A.K., Geller, E.S., 2004. Behavioral analysis of companion-animal overpopulation: a conceptualization of the problem and suggestions for intervention. *Behav. Social Issues* 13, 51–68.
- Hart, M., 2003. Gatti di Roma. *Cat Fancy* 38–41.
- Hosmer, D.W., Lemeshow, S., 2000. *Applied Logistic Regression*. John Wiley & Sons, New York.
- International Business Strategies, 2003. Pet products market in Italy. www.internationalbusinessstrategies.com, October 2003, pp. 1–22.
- Johnson, K., Lewellen, L., 1995. San Diego County: Survey and analysis of the pet population. San Diego Cat Fanciers Inc., San Diego, CA.
- Johnson, K., Lewellen, L., Lewellen, J., 1993. Santa Clara County's Pet Population. National Pet Alliance, San Jose, CA.
- Leney, J., Remfry, J., 2000. In: Macpherson, C.N.L. (Ed.), *Dog Population Management*.
- Levy, J.K., Woods, J.E., Turick, S.L., Etheridge, D.L., 2003. Number of unowned free-roaming cats in a college community in the southern United States and characteristics of community residents who feed them. *J. Am. Vet. Med. Assoc.* 223, 202–205.
- Macdonald, D.W., Carr, G.M., 1995. Variation in dog society: between resource dispersion and social flux. In: Serpell, J.A. (Ed.), *The Domestic Dog: Its Evolution, Behaviour, and Interactions with People*. Cambridge University Press, pp. 199–216.
- Matter, H.C., Daniels, T.J., 2000. Dog ecology and population biology. In: Macpherson, C.N.L., Meslin, F.X., Wandeler, A.I. (Eds.), *Dogs, Zoonoses, and Public Health*. CABI Publishing, New York, pp. 17–62.
- Miller, D.D., Staats, S.R., Partlo, C., Rada, K., 1996. Factors associated with the decision to surrender a pet to an animal shelter. *J. Am. Vet. Med. Assoc.* 209 (4), 738–742.
- Natoli, E., 1994. Urban feral cats (*Felis catus* L.): perspectives for a demographic control respecting the psycho-biological welfare of the species. *Ann. Ist Super Sanita* 30, 223–227.
- Natoli, E., Ferrari, M., Bolletti, E., Pontier, D., 1999. Relationship between cat lovers and feral cats in Rome. *Anthrozoos* 12, 16–23.
- Patronek, G.J., Beck, A.M., Glickman, L.T., 1997. Dynamics of a dog and cat populations in a community. *J. Am. Vet. Med. Assoc.* 201, 637–642.
- Poss, J.E., Bader, J.O., 2007. Attitudes toward companion animals among Hispanic residents of a Texas border community. *J. Appl. Anim. Welf. Sci.* 10, 243–253.
- Rubin, H.D., Beck, A.M., 1982. Ecological behavior of free-ranging urban pet dogs. *Appl. Anim. Ethol.* 8, 161–168.
- Salman, M.D., New Jr., J.G., Scarlett, J.M., Kass, P.H., Ruch-Gallie, R., Hetts, S., 1998. Human and animal factors related to the relinquishment of dogs and cats in 12 selected animal shelters in the United States. *J. Appl. Anim. Welf. Sci.* 1, 207–226.
- Slater, M.R., 2002. *Community Approaches to Feral Cats: Problems, Alternatives and Recommendations*. The Humane Society Press, Washington, DC.
- Slater, M.R., 2005. The welfare of feral cats. In: Rochlitz, I. (Ed.), *The Welfare of Cats*. Springer, Dordrecht, The Netherlands, pp. 141–175.
- Toukhsati, S.R., Bennett, P.C., Coleman, G.J., 2007. Behaviors and attitudes towards semi-owned cats. *Anthrozoos* 20, 131–142.
- Wandeler, A.I., 1985. Ecological and epidemiological data requirements for the planning of dog rabies control. In: Kuwert, E., Merieux, C., Koprowski, H., Bogel, K. (Eds.), *Rabies in the Tropics*. Springer-Verlag, New York, pp. 657–661.
- World Health Organization, 1996. Guidelines for veterinary urban hygiene, volume II. Management of feline and canine population in urban areas. ISS/WHO/FAO-CC/IZSTe/96.26(II). World Health Organization, Rome, Italy.