Cat and dog ownership and management patterns in central Italy

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Abstract

Three hundred and ninety-seven randomly selected households were interviewed by telephone to determine the numbers and management of owned cats and dogs in the Teramo Province of Italy. The households were selected using stratified random sampling for each municipality; municipalities were combined into coastal, central hills and mountain regions for analysis. The interviews were completed during May and June of 2004 with a response rate of 74% (397/536). Forty-six percent of households ($n = 181$) owned pets; 15% of all households ($n = 60$) owned cats and 33% ($n = 130$) owned dogs. Twenty-seven of these households (7%) owned both cats and dogs. Data were provided on 91 cats evenly divided between males and females. The median age was 3 years (range 0.2–10 years). Forty-one percent of cats (36/87) entered the household as strays. Nearly half lived entirely outside. Seventy percent (62/88) had visited a veterinarian at least once; 43% (39/91) were sterilized. About 1/3 had had a litter and all litters were considered accidental rather than planned. Age, indoor/outdoor status, veterinarian visit and region were all associated with sterilization. Age, confined to a yard, veterinary visit and region were associated with allowing the cat to roam freely. Data were provided on 182 dogs. Sixty-two percent (113/181) were male, with a median age of 4 years (range newborn to 17 years) and 40% (72/181) were purebred. Almost half were acquired as a gift. Sixty-two percent (112/180) were kept entirely outside despite the fact that 82% (147/180) were considered companions rather than working dogs. Almost all of the dogs had been to a veterinarian at least once; only 20% ($n = 29$) were sterilized. Male dogs were significantly less likely to be sterilized than females. Almost half the dogs had had at least one litter. Seventy-six percent (137/180) of dogs knew some basic commands. Sex, source and training to sit/stay/

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come were significantly associated with whether the dog was sterilized. Dog size, confinement to a yard, trained to leash walk, veterinary visit and region were predictors of roaming freely. Source and trained to leash walk were associated with dog registration. For cats and dogs, education about sterilization seemed to be critically important. For dogs, factors relating to training, which may reflect the strength of the human–animal bond, were also important.

1. Introduction

In 2002, the number of pets owned by Italians was estimated to be 60 million (International Business Strategies, 2003). About one household in four owned at least one dog or cat. The free-roaming cats and dogs population is a result of owned animals allowed to wander, pets that have been lost or abandoned and feral dogs and cats. In order to gain insight into the problems related to free-roaming pets, an understanding of the owned population is required. Information about reproduction, disposition of offspring, management and sources of pets will provide a baseline for designing and implementing interventions to control the numbers of free-roaming dogs and cats.

In 1991, the Italian Parliament approved National Law n. 281 ''Companion Animals and the Prevention of Strays'' (Legge 14 Agosto 1991, n.281. Legge quadro in materia di affezione e prevenzione del randagism. Gazzetta Ufficiale 30 Agosto, 1991, n. 203) which addresses animal shelter regulations, provides for government protection and assistance with free-roaming dogs and cats and a national dog registry (certified translation at www.comune.firenze.it/servizi_pubblici/animali/law281.htm, accessed 30 September 2003). This law made it illegal to euthanize dogs and cats unless they were seriously or incurably ill, changing the face of animal sheltering in Italy. The law also specifically addressed feral cats, forbidding mistreatment and encouraging the Public Health Service Veterinarians to sterilize and return feral cats.

The Istituto Zooprofilattico Sperimentale dell'Abruzzo e del Molise (IZSA&M) is located in the Province of Teramo within the Abruzzo region of Italy. It 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, knowledge-based, innovative services in veterinary public health and environment protection, to national and international markets to protect animal and human health. The IZSA&M manages the municipal shelter (on behalf of the City Council of Teramo). Since 2001, IZSA&M has been actively working on the prevention of dog and cat abandonment and providing care for injured and sick unowned animals. The Institute is also engaged in dog training and animal assisted activities/therapy. This telephone survey was undertaken to better accomplish the mission of the Institute. 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 (Slater et al., 2008) and (2) to document the owned pet population size and type including reproduction and dog registration. The second objective was 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. Stratified random sampling (using computer generated random numbers) within each of the 47 municipalities was performed. The primary purpose of the project was to estimate the extent of free-roaming dogs and cats in the Province (Slater et al., 2008). We estimated 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. Data from the 2001 census reported 292,102 residents in the Province and 145,418 households (http://dawinci.istat.it/daWinci/jsp/MD/dawinciMD.jsp?a1=m0GG0-c0I0&a2=mG0Y804, accessed June 2003). 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 and how many dogs or cats. Cat owners were then asked a series of questions about each of their cats including age, sex, source, who cared for the cat, where the cat was kept, veterinary care, number of litters and kittens in the first four litters and disposition of the litters. Dog owners were asked similar questions about each dog as well as the size of the dog, whether it was purebred, had any training and was registered. The section on free-roaming animals asked about their number, species and locations and problems associated with them (Slater et al., 2008). 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: pet ownership (yes/no), cat sterilized (yes/no), cat roams free (yes/no), dog sterilized (yes/no), dog roams free (yes/no) and dog registered (yes/no). Independent variables for "pet owner" were the

Table 1
Descriptive and bivariate chi-square analyses for respondents who did or did not own pets ($N = 397$, yes = 181, 46%) and final logistic regression model for pet ownership

Variables	Own Pet		Total, N	P-Value (chi-square)
	No, N (%)	Yes, N (%)		
Gender				0.23
Female	152 (53)	137 (47)	289	
Male	63 (59)	43 (41)	106	
Total	215 (54)	180 (46)	395	
Missing			2	
Age (years)				0.006[*]
Mean	50	43	47	
Median	48	42	45	
Min–max	13–90	13–82		
Total	204 (54)	171 (46)	375	
Missing			22	
Marital status				0.002
Single	36 (41)	52 (59)	87	
Married	137 (56)	110 (44)	247	
Widowed	28 (78)	8 (22)	36	
Other	5 (56)	4 (44)	9	
Total	206 (54)	174 (46)	380	
Missing			17	
Education level				0.25
Elementary school	48 (60)	32 (40)	80	
Middle school	43 (46)	51 (54)	94	
High school	86 (56)	69 (44)	155	
University	24 (57)	18 (43)	42	
Total	201 (54)	170 (46)	371	
Missing			26	
Occupation				0.06
Laborer	6 (40)	9 (60)	15	
Housewife/husband	47 (49)	48 (51)	95	
Clerk	34 (62)	21 (38)	55	
Unemployed	10 (66)	5 (33)	15	
Professional	26 (70)	11 (30)	37	
Factory Worker	21 (58)	15 (42)	36	
Student	12 (34)	23 (66)	35	
Other	13 (54)	11 (46)	24	
Total	202 (55)	164 (45)	366	
Missing			31	
Household size				0.002
Number of persons				
1	16 (84)	3 (16)	19	
2	52 (64)	29 (36)	81	
3	50 (55)	41 (45)	91	
4	58 (53)	52 (47)	110	
5	24 (43)	32 (57)	56	
6–8	7 (29)	17 (71)	24	
Total	207	174	381	
Missing			16	

Table 1 (*Continued*)

Variables	Own Pet		Total, *N*	*P*-Value (chi-square)
	No, *N* (%)	Yes, *N* (%)		
Region				0.1
Central hills	116 (51)	112 (49)	228	
Coast	90 (61)	57 (39)	147	
Mountains	10 (46)	12 (54)	22	
Total	216 (54)	181 (46)	397	
Interviewer				0.22
Alessandra	35 (57)	26 (43)	61	
Giorgia	21 (66)	11 (33)	32	
Massimo	57 (50)	58 (50)	115	
Maura	31 (46)	36 (54)	67	
Valerio	72 (59)	50 (41)	122	
Total	216 (54)	181 (46)	397	

Logistic regression model	OR	95% CI	*P*-Value
Household size			
1	1.0 (reference)		
2	2.9	0.75–10.8	0.1
3	3.9	1.1–14.7	0.04
4	4.4	1.2–16.1	0.03
≥5	8.2	2.2–31.1	0.002
Region			
Central hills	1.0 (reference)		
Mountains	1.1	0.4–2.7	0.8
Coastal	0.6	0.4–0.9	0.02

N = 381 observations, likelihood ratio chi-square = 24.10, *p* = 0.001; Hosmer–Lemeshow goodness-of-fit *p* = 0.6.

[*] *P* value for age as a continuous variable, Mann–Whitney rank sum test.

respondent's: gender, age, marital status, education level, household (HH) size, region (central hills, coast, mountains) and interviewer. Independent variables for cat models were: sex, age, source, indoor/outdoor status, confined to a yard, visited a veterinarian, region, roam free or sterilization and interviewer. For dog models, variable included similar data to cats with the addition of: size of dog, purebred (yes/no), use (companion or working dog), trained to sit stay or come, trained to walk on a leash and registration. Bivariate analysis was performed using chi-square or Mann–Whitney rank sum tests (owner, dog and cat ages). Chi-square analyses were used to evaluate collinearity among the independent variables. Multivariable logistic regression models were developed to look at factors which predicted each of the independent variables. For model building, variables with bivariate *p*-values 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. 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

Table 2
Descriptive and bivariate chi-square analyses for cats who were sterilized or not ($N = 87$, yes = 39, 45%)

Variables	Cat sterilized		Total, N	P-Value (chi-square)
	No, N (%)	Yes, N (%)		
Sex				0.4
Male	25 (60)	17 (40)	42	
Female	23 (51)	22 (49)	45	
Total	48 (55)	39 (45)	87	
Missing			4	
Age (years)				0.002[*]
Mean	2.8	2.4		
Median	2.5	4		
0.2–1	13 (76)	4 (24)	17	
2	11 (61)	7 (39)	18	
3–4	17 (65)	9 (35)	26	
5–8	7 (27)	19 (73)	26	
Total	48 (55)	39 (45)	87	
Missing			4	
Source				0.16
Purchased	1 (50)	1 (50)	2	
Adopted from shelter	2 (100)	0 (0)	2	
Born in house	15 (75)	5 (25)	20	
Gift	11 (42)	15 (58)	26	
Found	19 (53)	17 (47)	36	
Total	48 (56)	38 (44)	86	
Missing			5	
Where do they live				<0.001
Outside	36 (82)	8 (18)	44	
Indoor/outdoor	6 (35)	11 (65)	17	
Inside	6 (23)	20 (77)	26	
Total	48 (55)	39 (45)	87	
Missing			4	
Confined to yard				0.4
No	30 (52)	28 (48)	58	
Yes	18 (62)	11 (38)	29	
Total	48 (55)	39 (45)	87	
Missing			4	
Allowed to roam free				0.18
No	32 (67)	31 (33)	63	
Yes	16 (80)	8 (20)	24	
Total	48 (55)	39 (45)	87	
Missing			4	
Ever visited a veterinarian				<0.001
No	25 (96)	1 (4)	26	
Yes	23 (38)	38 (62)	61	
Total	48 (55)	39 (45)	87	
Missing			4	
Region				<0.001
Central hills	42 (79)	11 (21)	53	
Coast	5 (19)	21 (81)	26	
Mountain	1 (13)	7 (87)	8	

Table 2 (*Continued*)

Variables	Cat sterilized		Total, N	P-Value (chi-square)
	No, N (%)	Yes, N (%)		
Total	48 (74)	39 (26)	87	
Missing			4	
Interviewer				0.1
Alessandra	3 (43)	4 (57)	7	
Giorgia	0 (0)	4 (100)	4	
Massimo	26 (67)	13 (33)	39	
Maura	10 (56)	8 (44)	18	
Valerio	9 (47)	10 (53)	19	
Total	48 (5)	39 (26)	87	
Missing			4	

[*] *P* value for age as a continuous variable, Mann–Whitney rank sum test.

(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 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 which resulted in a response rate of 74%. The response rate for the central hill area was 79%, for the coastal area 70% 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.

3.1. Pet ownership and household demographic data

Of the 397 respondents, 181 HH had pets (46%). Fifteen percent of HH (60/397) had cats while 33% of HH (130/397) had dogs. Twenty-seven HH (7%) had both dogs and cats and two of these HH (0.05%) had other kinds of pets. Of HH with both dogs and cats, five had two or more dogs and two or more cats. Thirty-three of 397 HH (8%) had only cats and 104/297 (26%) had only dogs. Six dog only HH also had other pets. Nineteen of 397 households (5%) had only ''other'' pets such as fish, birds or small mammals. For cats, 81% (46/55 HH) of the respondents were the primary caretaker; for dogs 62% (80/128 HH) were the primary caretaker with another 11 HH (9%) where the whole family (including the respondent) was the primary caretaker. Table 1 includes owner demographic data, bivariate analyses and the final logistic regression model for pet ownership (yes/no).

3.2. Cat demographic, reproductive and health data

Sixty HH owned 97 cats (1.7 cats/HH). Using the average of 1.7 cats per household, 15% cat ownership and the 2001 HH numbers in the Province (145,418), there were 37,081 owned cats

Table 3
Descriptive and bivariate chi-square analyses for cats who were allowed to roam free part of the time ($N = 91$, yes = 24, 26%)

Variables	Cat roams free		Total, N	P-Value (chi-square)
	No, N (%)	Yes, N (%)		
Sex				0.7
Male	33 (76)	13 (24)	46	
Female	34 (72)	11 (28)	45	
Total	67 (74)	24 (36)	91	
Age (years)				0.07[*]
Mean	3.1	4.3		
Median	3	4		
0.2–1	17 (94)	1 (6)	18	
2	15 (79)	4 (21)	19	
3–4	17 (61)	11 (39)	28	
5–10	18 (69)	8 (31)	26	
Total	67 (74)	24 (36)	91	
Source				0.8
Purchased	2 (100)	0 (0)	2	
Adopted from shelter	1 (50)	1 (50)	2	
Born in house	15 (75)	5 (25)	20	
Gift	20 (74)	7 (26)	27	
Found	25 (69)	11 (31)	36	
Total	63 (69)	24 (31)	87	
Missing			4	
Where do they live				<0.001
Outside	28 (64)	16 (36)	44	
Indoor/outdoor	9 (53)	8 (47)	17	
Inside	27 (100)	0 (0)	27	
Total	64 (70)	24 (30)	88	
Missing			3	
Confined to yard				<0.001
No	36 (61)	23 (39)	59	
Yes	28 (97)	1 (3)	29	
Total	64 (73)	24 (27)	88	
Missing			3	
Ever visited a veterinarian				0.13
No	16 (62)	10 (38)	26	
Yes	48 (77)	14 (13)	62	
Total	64 (73)	24 (27)	88	
Missing			3	
Region				<0.001
Central hills	39 (70)	17 (30)	56	
Coast	26 (96)	1 (4)	27	
Mountain	2 (25)	6 (75)	8	
Total	67 (74)	24 (26)	91	
Sterilized				0.18
No	32 (67)	16 (33)	48	
Yes	31 (80)	8 (20)	39	
Total	63 (69)	24 (31)	87	
Missing			4	

Table 3 (*Continued*)

Variables	Cat roams free		Total, N	P-Value (chi-square)
	No, N (%)	Yes, N (%)		
Interviewer				0.5
Alessandra	8 (89)	1 (11)	9	
Giorgia	2 (50)	2 (50)	4	
Massimo	29 (73)	11 (27)	40	
Maura	12 (67)	6 (33)	18	
Valerio	16 (80)	4 (20)	20	
Total	67 (74)	24 (26)	91	

[*] *P* value for age as a continuous variable, Mann–Whitney rank sum test.

living in the Province. Forty-three of 60 HH (72%) had one cat, 9/60 HH (15%) had two cats, 4/60 HH (7%) had three cats and 3/60 HH (5%) had six cats. One HH did not provide any additional data on the six cats owned. Therefore, all of the following analyses were performed on 91 cats. See Tables 2 and 3 for cat data and bivariate analyses. In addition, among cats outside at least part of the time, respondents indicated that one spent time both in a yard and also was free-roaming and one cat was allowed outside under supervision only.

Twenty-two households owned the 29 cats who had had a litter (20 females, 9 males). Respondents were significantly more likely to report that they did not know if a male cat was bred then if a female had been bred (chi-square test, $p = 0.004$). Data on litter size were provided for 27/33 litters reported from female cats. The median litter size was three kittens (range one to five). The total number of kittens reported for female cats was 82. If the median of 3 kittens was applied to each litter of unknown size, another 18 kittens were produced by female cats (total 100 kittens). Using the ages of the female cats in the study, an estimated 1.3 kittens were produced for each cat year of life. The disposition of kittens in shown in Appendix A.

3.3. Dog demographic, reproductive and health data

There were 130 HH that had dogs; one did not provide any data on their three dogs. With a mean of 1.4 dogs/HH (184/130) and 33% dog ownership among the 145,418 HH, there were 67,183 owned dogs living in the Province. We had detailed data on 182 dogs in 129 HH. Ninety-four of 129 HH (73%) owned one dog, 24 HH (19%) owned two dogs, five HH (4%) owned three dogs, four HH (3%) owned four dogs and one HH (1%) each owned five and six dogs. See Tables 4–6 for details on dog ownership.

Of the 129 HH with dogs, 78/129 (60%) kept at least one outside-only dogs, 22/129 (17%) kept at least one indoor/outdoor dog and 29/129 (22%) kept at least one indoor-only dog. See Fig. 1 for more details. One hundred and thirty-seven dogs of 188 (76%) knew basic commands (sit, stay or come) and/or how to walk on a leash. Of these, 59% (81/137 dogs) knew both and 24% (43 dogs) had no training. Of the 137 dogs with some training, 91% (125/137) were trained by the owner.

Twenty-one female dogs, 21 male dogs and one dog of unknown sex were reported to have had at least one litter. Of the 29 dogs who were sterilized, 7 (24%) were known to have had a litter beforehand. There were data on litter size for 23/38 litters born to females. The median litter size for females was three (mean 2.6 puppies/litter) (range one to six). The total number of puppies reported for females was 61. The estimated numbers of puppies born was 106 (assuming the median size for the 15 litters of unknown size). Using the sum of the female dog ages, there were

Table 4
Descriptive and bivariate chi-square analyses for dogs who were sterilized or not ($N = 177$, yes = 29, 16%)

Variables	Dog sterilized		Total, N	P-Value (chi-square)
	No, N (%)	Yes, N (%)		
Sex				<0.001
Male	100 (92)	9 (8)	109	
Female	47 (70)	20 (30)	67	
Total	147 (84)	29 (16)	176	
Missing			6	
Age (years)				0.15[*]
Mean	4.5	6		
Median	4	5		
Min–max	0.1–14	0.4–17		
Total	146 (87)	29 (13)	175	
Missing			7	
Size				0.7
Large ≥16 kg	42 (84)	8 (16)	50	
Medium 6–15 kg	49 (86)	8 (14)	57	
Small ≤5 kg	55 (81)	13 (19)	69	
Total	146 (83)	29 (17)	175	
Missing			7	
Purebred				0.3
No	87 (81)	20 (19)	107	
Yes	66 (87)	9 (13)	70	
Total	148 (84)	29 (13)	177	
Missing			5	
Source				0.08
Gift	72 (86)	12 (14)	84	
Found	25 (76)	8 (24)	33	
Purchased	25 (93)	2 (7)	27	
Born in house	20 (91)	2 (9)	22	
Adopted from shelter	6 (60)	4 (40)	10	
Total	148 (84)	28 (16)	176	
Missing			6	
Where do they live				0.7
Outside	92 (84)	17 (16)	109	
Indoor/outdoor	13 (76)	4 (24)	17	
Inside	42 (84)	8 (16)	50	
Total	147 (84)	29 (16)	176	
Missing			6	
Confined to yard				0.4
No	63 (81)	15 (19)	78	
Yes	85 (86)	14 (14)	99	
Total	148 (84)	29 (16)	177	
Missing			5	
Outside under supervision				0.07
No	146 (84)	27 (16)	173	
Yes	2 (50)	2 (50)	4	
Total	148 (84)	29 (16)	177	
Missing			5	

Table 4 (*Continued*)

Variables	Dog sterilized		Total, N	P-Value (chi-square)
	No, N (%)	Yes, N (%)		
Tied up outside				0.20
No	140 (83)	29 (17)	169	
Yes	8 (100)	0 (0)	8	
Total	148 (84)	29 (16)	177	
Missing			5	
Allowed to roam free				0.9
No	129 (84)	25 (16)	154	
Yes	19 (83)	4 (17)	23	
Total	148 (84)	29 (16)	177	
Missing			5	
Use				0.02
Companion	115 (80)	28 (20)	143	
Working dog	1 (3)	32 (97)	33	
Total	147 (84)	29 (16)	176	
Missing			2	
Trained to sit, stay, or come				0.04
No	65 (90)	7 (10)	72	
Yes	82 (79)	22 (21)	104	
Total	147 (84)	29 (16)	176	
Missing			6	
Walks on leash				0.25
No	57 (88)	8 (12)	65	
Yes	90 (81)	21 (19)	111	
Total	147 (84)	29 (16)	176	
Missing			6	
Veterinary visits				0.9
No	6 (86)	1 (14)	7	
Yes	140 (83)	28 (17)	168	
Total	146 (83)	29 (17)	175	
Missing			7	
Region				0.22
Central hills	87 (88)	12 (12)	99	
Coast	46 (78)	13 (22)	59	
Mountain	15 (79)	4 (21)	19	
Total	148 (84)	29 (16)	177	
Missing			5	
Registered				0.9
Yes	72 (84)	14 (16)	86	
No	72 (84)	14 (16)	86	
Total	144 (88)	28 (12)	172	
Missing			10	
Interviewer				0.22
Alessandra	25 (86)	4 (14)	29	
Giorgia	9 (75)	3 (25)	12	
Massimo	44 (83)	9 (17)	53	
Maura	28 (97)	1 (3)	29	
Valerio	42 (78)	12 (22)	54	

Table 4 (*Continued*)

Variables	Dog sterilized		Total, N	P-Value (chi-square)
	No, N (%)	Yes, N (%)		
Total	148 (84)	29 (16)	177	
Missing			5	

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

0.7 puppies/dog year for female dogs. Owners of purebred dogs were significantly more likely to have bred their dogs on purpose than owners of mixed breed dogs ($p = 0.004$, odds ratio = 8). The one respondent who had sold puppies, had deliberately bred a purebred dog. The disposition of puppies is shown in Appendix A. Two percent of dogs were reported to have leishmaniasis, a serious zoonotic disease in this area of Italy.

Seventy-two percent of respondents (91/127) who owned dogs knew there was a registration for dogs in Italy. Twenty-four respondents of 87 (3 HH did not provide dog registration data) (28%) knew about the registry but had at least one dog not registered. And 5 of 36 respondents indicated they did not know about the registry but said their dog was registered (14%) (assumed to be a data entry error). Among HH with only one dog, 53/88 (60%) had the dog registered. Among households with two or three dogs, 12/30 (40%) had all dogs registered. Among all households with more than one dog, 17/35 (49%) did not have any dogs registered.

Table 5
Descriptive and bivariate chi-square analyses for dogs who were allowed to roam free or not (N = 181, yes = 23, 13%)

Variables	Dog roams free		Total, N	P-Value (chi-square)
	No, N (%)	Yes, N (%)		
Sex				0.4
Male	97 (86)	16 (14)	113	
Female	61 (90)	7 (10)	68	
Total	158 (87)	23 (13)	181	
Missing			1	
Age (years)				0.7
Mean	4.9	4.3	4.8	
Median	4	4	4	
Min–max	0.1–17	0.1–10		
Total	157 (87)	23 (13)	180	
Missing			2	
Size				0.02
Large ≥16 kg	44 (83)	9 (17)	53	
Medium 6–15 kg	46 (81)	11 (19)	57	
Small ≤5 kg	67 (96)	3 (4)	70	
Total	157 (87)	23 (13)	180	
Missing			2	
Purebred				0.3
No	94 (85)	16 (15)	110	
Yes	65 (90)	7 (10)	72	
Total	159 (87)	23 (13)	182	
Source				0.5
Gift	73 (86)	12 (14)	85	

Table 5 (*Continued*)

Variables	Dog roams free		Total, N	P-Value (chi-square)
	No, N (%)	Yes, N (%)		
Found	28 (82)	6 (18)	34	
Purchased	27 (96)	1 (4)	28	
Born in house	21 (88)	3 (12)	24	
Adopted from shelter	9 (90)	1 (10)	10	
Total	158 (87)	23 (13)	181	
Missing			1	
Where do they live				0.002
Outside	90 (80)	22 (20)	112	
Indoor/outdoor	17 (94)	1 (6)	18	
Inside	50 (100)	0 (0)	50	
Total	157 (87)	23 (13)	180	
Missing			2	
Confined to yard				<0.001
No	97 (95)	5 (5)	80	
Yes	62 (78)	18 (22)	102	
Total	159 (87)	23 (13)	182	
Outside under supervision				0.02
No	157 (88)	21 (12)	178	
Yes	2 (50)	2 (50)	4	
Total	159 (87)	23 (13)	182	
Tied up outside				0.9
No	152 (87)	22 (13)	174	
Yes	7 (88)	1 (12)	8	
Total	159 (87)	23 (13)	182	
Use				0.9
Companion	128 (87)	19 (13)	147	
Working dog	29 (88)	4 (12)	33	
Total	157 (87)	23 (13)	180	
Missing			2	
Trained to sit, stay or come				0.25
No	62 (84)	12 (16)	74	
Yes	95 (90)	11 (10)	106	
Total	157 (87)	23 (13)	180	
Missing			2	
Walks on leash				0.001
No	52 (77)	16 (24)	68	
Yes	105 (94)	7 (6)	112	
Total	157 (87)	23 (13)	180	
Missing			2	
Veterinary visits				<0.001
No	2 (29)	5 (71)	7	
Yes	154 (90)	17 (10)	171	
Total	156 (88)	22 (12)	178	
Missing			4	
Sterilized				1.0
No	129 (87)	19 (13)	148	
Yes	25 (86)	4 (14)	29	

Table 5 (*Continued*)

Variables	Dog roams free		Total, N	P-Value (chi-square)
	No, N (%)	Yes, N (%)		
Total	154 (87)	23 (13)	177	
Missing			5	
Region				0.03
Central hills	88 (85)	15 (15)	103	
Coast	57 (95)	3 (5)	60	
Mountain	14 (74)	5 (26)	19	
Total	159 (87)	23 (13)	182	
Registered				0.12
No	72 (84)	14 (16)	86	
Yes	82 (91)	8 (9)	90	
Total	154 (88)	22 (12)	176	
Missing			6	
Interviewer				0.5
Alessandra	26 (90)	3 (10)	29	
Giorgia	10 (77)	3 (23)	13	
Massimo	46 (82)	10 (18)	56	
Maura	28 (93)	2 (7)	30	
Valerio	49 (91)	5 (9)	54	
Total	159 (87)	23 (13)	182	

3.4. Logistic regression analyses

Tables 1–6 show the bivariate analyses for each independent variable. Tables 7 and 8 include the final logistic regression models for cat- and dog-dependent variables, respectively. No interaction terms were significant. All models fit well according to Hosmer–Lemeshow goodness-of-fit tests.

Table 6
Descriptive and bivariate chi-square analyses for dogs who were registered or not (N = 176, yes = 90, 51%)

Variables	Dog registered		Total, N	P-Value (chi-square)
	No, N (%)	Yes, N (%)		
Sex				0.4
Male	52 (47)	59 53)	111	
Female	34 (53)	30 (47)	64	
Total	86 (49)	89 (51)	175	
Missing			7	
Current age (years)				0.7*
Mean	4.8	4.8		
Median	4	4		
Min–max	0.1–17	0.3–15		
Total	86 (87)	88 (13)	174	
Missing			6	
Size				0.14
Large ≥16 kg	21 (41)	30 (59)	51	
Medium 6–15 kg	25 (45)	31 (55)	56	

Table 6 (*Continued*)

Variables	Dog registered		Total, N	P-Value (chi-square)
	No, N (%)	Yes, N (%)		
Small ≤5 kg	39 (58)	28 (42)	67	
Total	85 (49)	89 (51)	174	
Missing			6	
Purebred				0.11
Yes	28 (41)	40 (59)	68	
No	58 (54)	50 (46)	108	
Total	86 (49)	29 (51)	176	
Missing			6	
Source				0.001
Gift	39 (48)	43 (52)	84	
Found	22 (65)	12 (35)	33	
Purchased	6 (23)	20 (77)	27	
Born in house	16 (70)	7 (30)	22	
Adopted from shelter	2 (20)	8 (80)	10	
Total	85 (49)	85 (51)	175	
Missing			7	
Where do they live				0.3
Outside	54 (50)	54 (50)	108	
Indoor/outdoor	6 (33)	12 (67)	18	
Inside	26 (53)	23 (47)	49	
Total	86 (49)	89 (51)	175	
Missing			7	
Confined to yard				0.7
No	39 (51)	38 (49)	77	
Yes	47 (48)	52 (53)	99	
Total	86 (49)	90 (51)	176	
Missing			6	
Outside under supervision				0.6
No	85 (49)	88 (51)	173	
Yes	1 (33)	2 (67)	3	
Total	86 (49)	90 (51)	176	
Missing			6	
Tied up outside				0.4
No	81 (48)	87 (52)	168	
Yes	5 (63)	3 (37)	8	
Total	86 (49)	90 (51)	176	
Missing			6	
Allowed to roam free				0.14
No	72 (47)	82 (53)	154	
Yes	14 (64)	8 (36)	22	
Total	86 (49)	90 (51)	176	
Missing			6	
Use				0.8
Companion	71 (50)	72 (50)	143	
Working dog	15 (47)	17 (53)	32	
Total	86 (49)	89 (51)	175	
Missing			7	

Table 6 (*Continued*)

Variables	Dog registered		Total, N	P-Value (chi-square)
	No, N (%)	Yes, N (%)		
Trained to sit, stay, or come				0.27
No	39 (54)	33 (46)	72	
Yes	47 (46)	56 (54)	103	
Total	86 (49)	89 (51)	175	
Missing			7	
Walks on leash				0.008
No	41 (62)	25 (38)	66	
Yes	45 (41)	64 (59)	109	
Total	86 (49)	89 (51)	175	
Missing				
Veterinary visits				0.05
No	6 (86)	1 (14)	7	
Yes	80 (48)	86 (52)	166	
Total	86 (49)	87 (51)	173	
Missing			9	
Region				0.5
Central hills	47 (47)	52 (53)	99	
Coast	28 (47)	31 (53)	59	
Mountain	11 (61)	7 (39)	18	
Total	86 (49)	90 (51)	176	
Missing			8	
Sterilized				1.0
No	72 (50)	72 (50)	144	
Yes	14 (50)	14 (50)	28	
Total	86 (50)	86 (50)	172	
Missing			10	
Interviewer				0.4
Alessandra	13 (46)	15 (54)	27	
Giorgia	6 (50)	6 (50)	12	
Massimo	25 (45)	31 (55)	56	
Maura	16 (57)	12 (43)	28	
Valerio	26 (50)	26 (50)	52	
Total	86 (49)	90 (51)	176	
Missing			6	

Colinearity was present among the independent variables for each of the three data sets (pet ownership, cats and dogs). However, only use of the dog was initially excluded from the backwards stepwise regression due to sparse data. For cats roaming free, indoor/outdoor status was excluded during the modeling process because it was associated with both roaming free and confined to a yard and caused too many observations to be dropped; indoor/outdoor status was also excluded for dogs because all but one dog were free-roaming and outside-only dogs.

For pet ownership, HH size was significantly associated with age, marital status and education. Respondents <35 years old were more likely to live in a four person HH rather than one and two person HH. Age group was also associated with education level: respondents ≤45 years old had more education and respondents ≥65 had less. Single respondents were more likely to live in the largest HH sizes (more than four people). Married respondents were more likely to
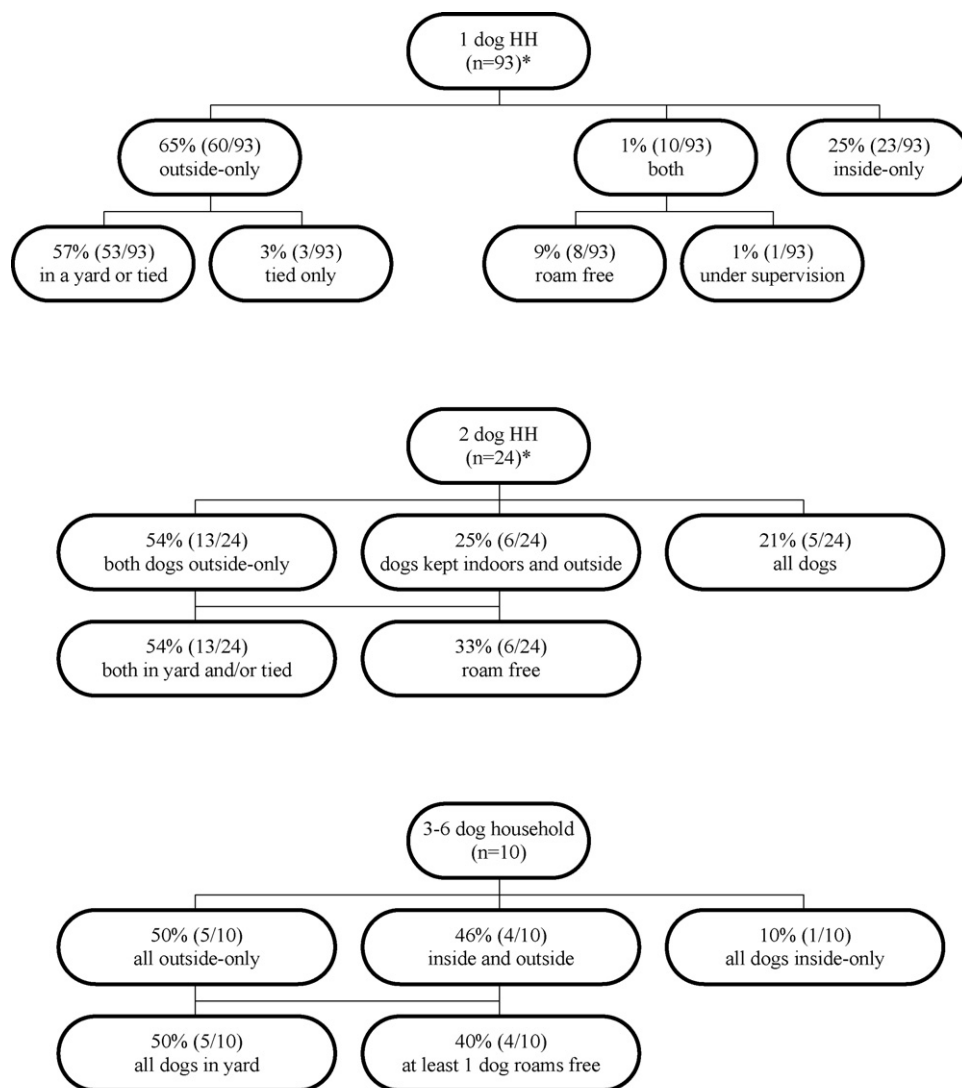
* 1 Household did not provide data.

Fig. 1. Distribution of where dogs were kept and how they were confined by number of dogs per household (HH).

live in three person HH rather than alone. Widowed respondents were most likely to live alone. Respondents who had only completed elementary school level of education were most likely to live alone or with one other person. Those with a middle school education were more likely to live in the larger HH, with four or more other people. Therefore, HH size in the final model was likely representing a complex combination of stage of life.

Age category of the cat was not significantly associated with any other independent cat variables. Veterinary visits for cats were associated with both source of the cat and indoor/outdoor status. Cats were less likely to have ever visited a veterinarian if they were born in the house or received as a gift. Indoor-only cats were more likely to have visited a veterinarian than if they were outside only.

Table 7
Final logistic regression models for responses about how cats were kept

Variable	Sterilized[a] OR (95% CI)	Roam free[b] OR (95% CI)
Age of cat (years)		
0.2–1	1.0 (reference)	1.0 (reference)
2	5.0 (0.7–36)	6 (0.6–85)
3–4	4.0 (0.6–26)	16 (1.4 to >100)
5–8	20 (2.6 to >100)	14 (1.1 to >100)
Indoor/outdoor		
Outside only	1.0 (reference)	–
Both	2.4 (0.4–15)	–
Inside only	8.5 (1.6–46)	–
Confined to a yard		
No	–	1.0 (reference)
Yes	–	0.03 (0.003–0.3)
Visited a veterinarian		
No	1.0 (reference)	1.0 (reference)
Yes	12 (1.2 to >100)	0.2 (0.04–1.2)
Region		
Central hills	1.0 (reference)	1.0 (reference)
Mountains	18 (1.2 to >100)	6 (0.8–48)
Coast	6.6 (1.1–39)	0.1 (0.01–0.8)

[a] Was the cat sterilized? No or yes. $N = 87$ observations, likelihood ratio chi-square = 62.84, $p < 0.0001$; Hosmer–Lemeshow goodness-of-fit test, $p = 0.9$.

[b] Was the cat allowed to roam free? No or yes. $N = 88$ observations, likelihood ratio chi-square = 42.67, $p < 0.0001$; Hosmer–Lemeshow goodness-of-fit test, $p = 0.5$.

Size of the dog was associated with purebreds, indoor/outdoor status, being kept in a yard, and use. Purebred status was associated with source, use, and training. Purebred dogs were more likely to be large dogs and mixed breeds, small dogs. Small dogs were more likely to be indoor only and not allowed to roam. Large dogs were more likely to be kept in a yard and outside only. Purebred dogs were more likely to be purchased and mixed breeds were found. Purebred dogs were also more likely to be considered working dogs and kept outside only. Dogs who were purchased were more likely to received training.

4. Discussion

We were pleased with the response rates for randomly selected HH. However, it is possible that we had a bias towards pet owners since they might be most interested in completing the survey. This would be consistent with the somewhat higher ownership levels in this region compared to Italy as a whole. Missing data was usually in HH with more than one pet where the level of detail likely caused the respondent to become impatient and skip those questions. Because the sample size was selected to estimate problems related to free-roaming dogs and cats (Slater et al., 2008), it was somewhat small for certain variables in this study. It is possible that some of the interaction terms might have been significant with a larger sample size, based on bivariate patterns. We did not have any good data on pet ownership rates prior to this study making it impossible to accurately estimate samples sizes for this component of the entire project.

Table 8
Final logistic regression models for responses about how dogs were kept

Variable	Sterilized[a] OR (95% CI)	Roam free[b] OR (95% CI)	Registered[c] OR (95% CI)	Registered[d] OR (95% CI)
Sex of dog				
Female	1.0 (reference)	–	–	–
Male	0.2 (0.1–0.5)	–	–	–
Size of dog				
Large ≥16 kg	–	1.0 (reference)	–	–
Medium 6–15 kg	–	1.2 (0.3–5)	–	–
Small ≤5 kg	–	0.1 (0.01–0.4)	–	–
Source				
Gift	1.0 (reference)	–	1.0 (reference)	1.0 (reference)
Bought	0.3 (0.1–1.5)	–	2.8 (1.0–8)	2.7 (1.0–7.7)
Adopted	5.5 (1.1–26)	–	3.9 (0.8–20)	2.0 (0.8–21)
Born in house	0.6 (0.1–3)	–	0.4 (0.2–1.2)	0.5 (0.2–1.4)
Found	1.8 (0.6–5)	–	0.4 (0.2–1.0)	0.5 (0.2–1.1)
Confined to yard				
No	–	1.0 (reference)	–	–
Yes	–	0.1 (0.02–0.4)	–	–
Trained to sit, stay or come				
No	1.0 (reference)	–	–	–
Yes	2.7 (1.0–7)	–	–	–
Trained to leash				
No	–	1.0 (reference)	–	1.0 (reference)
Yes	–	0.2 (0.05–0.6)	–	2.0 (1.0–4)
Visited to veterinarian				
No	–	1.0 (reference)	–	–
Yes	–	0.01 (0.001–0.1)	–	–
Region				
Central hills	1.0 (reference)	1.0 (reference)	1.0 (reference)	–
Mountain	1.4 (0.3–6)	2.8 (0.5–14)	0.7 (0.2–2.3)	–
Coast	1.6 (0.6–4)	0.1 (0.02–0.9)	1.2 (0.6–2.5)	–

[a] Was the dog sterilized? No or yes. $N = 174$ observations, likelihood ratio chi-square = 27.76, $p = 0.0001$; Hosmer–Lemeshow goodness-of-fit test $p = 0.2$.

[b] Was the dog allowed to roam free? No or yes. $N = 176$ observations, likelihood ratio chi-square = 58.03, $p \leq 0.0001$; Hosmer–Lemeshow goodness-of-fit $p = 0.8$.

[c] Was the dog registered with the national registry? No or yes. $N = 175$ observations, likelihood ratio chi-square = 19.31, $p = 0.0004$; Hosmer–Lemeshow goodness-of-fit $p = 0.6$.

[d] Was the dog registered with the national registry? No or yes. Region was not forced into the model. $N = 174$ observations, likelihood ratio chi-square = 21.83, $p = 0.0006$; Hosmer–Lemeshow goodness-of-fit $p = 0.6$.

We were very careful in the design of the questionnaire and the choice of wording and sequence of questions, taking advantage of the expertise at IZSA&M. However, no formal evaluation for reliability or validity was conducted.

We considered that the data had a hierarchical pattern, with pets within HH and HH within region. However, we were interested in the specific regions themselves, there were only three regions and there were no region-level predictors. For these reasons, we chose to model region as a fixed effect and include region in all models (Dohoo et al., 2003). For cats or dogs within HH, being able to examine HH as a random effect would have added to our understanding of HH

patterns. However, with more than 70% of HH owning only one cat or one dog, and with small numbers of cats and dogs to study, the random effects models were highly unstable.

Published data on pet ownership demographics are difficult to find. Most work has been in the United States. Very little has been published from Europe, at least in the English language. There are marketing data, but most are very expensive to purchase and not available from library sources. This limits our ability to appropriately compare Italy to the rest of Europe. Cross-cultural comparisons of attitudes and pet keeping from a psychological and sociological perspective would further illuminate owner decisions about pet care.

Variables examined in the current study included specific owners' actions or care of their cats and dogs. In the past, visits to the veterinarian have been suggest as a factor that may lead to a higher level of responsibility and an increased level of health care. We suggest that veterinary visits are just one of several variables that indicate a higher level of interest, education, attachment and/or responsibility taken toward a pet. The results of the logistic regression analyses support the links between what are considered to be markers of responsible pet ownership such as sterilization, confinement, veterinary visits, training, etc. Qualitative work in this area is needed to better elucidate the decision making process for pet management by owners.

4.1. Pet ownership and household information

Forty-six percent of households in the Province owned pets and dog ownership was about twice as common as cat ownership. In Australia, 63% of HH owned pets in 2005 (Anon., 2006). The current study found a higher percentage of dog and cat ownership (41%) when compared to Italy as a whole where only 35% of households own dogs and/or cats (Federazione Nazionale degli Ordini Veterinari, www.fnovi.it, accessed 5 January 2005). A previous regional Italian study showed that only 15% of the households owned one or more dogs (Fico, 1995). In Europe, 21% of HH owned dogs and 20% owned cats (http://www.engormix.com/a_changing_landscape_the_e_arti-cles_423_BAL.htm, accessed 19 December 2007). The regional Italian pet ownership rates were a slightly lower than a 2002 survey in Canada (53%) (www.legermarketing.com, accessed 11 November 2004), a 2004 survey in the United Kingdom (52%) (www.pfma.org.uk/overall/pet-population-figures-2.htm, accessed 19 December 2007) and a 2004 United States survey (63%) (APPMA, 2005). Studies in the United States have confirmed the variability in pet ownership by location (Manning and Rowan, 1998). Ownership is typically self-defined in these surveys and respondents with different backgrounds likely have differing definitions. In addition, survey methodology and changes with time can result in different estimates of ownership.

The majority of respondents were the primary caretakers for the household pets. Since most respondents were women, it is likely that women are the predominant decision maker in the household about pet care. In United States, it is also more common for women (73%) to be the primary caretaker of the pet (Wise, 2002).

4.2. Cat demographic, reproductive and health data

Owned cats were evenly split between males and females with a median age of 3 years (range 0.2–10 years). This finding indicates a fairly young population of cats. In Europe, 26% of cats were <2 years old; Italy was reported to have a higher percentage of cats <2 years old as was found in this study (20%) (http://www.engormix.com/a_changing_landscape_the_e_arti-cles_423_BAL.htm, accessed 19 December 2007). Italy was also reported to have 1.6 cats/HH, which is similar to the current regional study.

The most common source of cats in the present study was finding them as a stray, followed by gifts and being born in the household. A regional US study in Massachusetts found that almost half the cats were from family/friends, 17% were strays and 12% were from shelters with only 3% born in the home (Luke, 1996). A national US study reported that 21% of cats were acquired as strays, 19% were born in the house, 14% were from a friend and 12% adopted from shelter (New et al., 2000). A more recent national US study reported 43% from friends/relatives, 35% strays, 15% from a shelter and 15% born in house (APPMA, 2005). These figures demonstrate considerable variability in sources of cats between different locations and time periods. However, patterns do support that family/friends (gift cats) and strays are the primary sources. In the current study, a much higher percent were strays and a much lower percentage were gifts (presumably from friends or relatives) and almost none were adopted from shelters. These results emphasizes that cats in the Teramo Province are neither purchased nor sought out but rather are acquired casually or even accidentally.

Forty-three percent of cats were sterilized with almost a third having had a litter prior to sterilization. A study in Massachusetts found that 91% of cats were sterilized with 8% of all dogs and cats having a litter prior to sterilization (Manning and Rowan, 1998). All of the cat litters were accidental, with half due to the cat roaming or running off and the rest due to owner inattention or the cat living outside all of the time. Like the current study, 94% of litters in a Midwest US region were unplanned (Patronek et al., 1997). One US study estimated that 5% of US households had a litter of kittens in 1996 and that 68% were unplanned (New et al., 2004). The most common reason for unplanned litters of kittens in the US was cost, but a number of respondents indicated that the cats were strays who arrived pregnant or barn cats living on their own (Patronek et al., 1997; New et al., 2004). The present study did not ask for reasons cats were intact, but comments about cats being pregnant because they lived on their own were made.

These results demonstrate the need for earlier sterilization to prevent accidental litters. We know that sterilizing dogs and cats before their first heat prevents a number of health problems in the future, particularly breast cancer (Schneider et al., 1969; Dorn et al., 1968; Hayes et al., 1981). We also know that it is possible to safely sterilize puppies and kittens as young as 6–8 weeks of age without any long-term negative effects (Howe, 1997; Spain et al., 2004a,b). This means that kittens and puppies can be sterilized after their first vaccination or two and before their first heat, somewhere between 4 to 5 months of age.

Data on the disposition of kittens indicated an even split between keeping the kittens, giving them away and kittens dying. In the US, about 40% of kittens were given away, 24% died and 22% were kept (New et al., 2004). Both studies reported high mortality rates for kittens. However, cause of death was not ascertained.

Compared to data in the United States, where nationally more than 50% of cats are indoor-only, a much lower percentage of cats were kept completely indoors in this part of Italy (Patronek et al., 1997; Clancy et al., 2003; APPMA, 2005). In the current study, among cats allowed outside, 31% were confined to a yard or garden while 26% were allowed to roam freely. It is unclear whether cats in a yard or garden were truly confined, although anecdotally, this is the perception by cat owners. Problems related to free-roaming cats would be greatly reduced if all were sterilized and provided with identification in case they were lost or injured.

Seventy-one percent of cats (62/88) had been to the veterinarian at least once during their lives. Of these 62 cats, 58% of cats had been to the veterinarian in the last year. Only 13 cats were reported to have had a health problem as the reason for their veterinary visit. This implies that a proportion of cats went to the veterinarian for routine health prevention, which would provide the veterinarian the opportunity for education. However, there is still room for improvement in terms of the numbers of cats who never see a veterinarian or who perhaps only go once.

4.3. Dog demographic, reproductive and health data

Almost two thirds of the owned dogs were male with a median age of 4 years (range 0.1–17 years). The national US figures indicate a more even split between males and females, however, with approximately 53% males (Wise, 2002). This median age was similar to that in the US which has been reported to be 5 years, between 5 and 10 years or between 2 and 5 years (Patronek et al., 1997; New et al., 2000; Wise, 2002). In Europe, 9% of dogs were <2 years old and 16% were >10 years (http://www.engormix.com/a_changing_landscape_the_e_articles_423_-BAL.htm, accessed 19 December 2007). In the current study, 20% of dogs were <2 years old. Italy was reported to have only 12% of dogs older than 10 years; our current study had only 8%, indicating a very young population, possibly with high turnover.

Forty percent of the Italian dogs were purebred compared to 50–61% of dogs in United States (New et al., 2000; APPMA, 2005). We did not ask about specific breed because we were concerned about questionnaire length and had no specific hypotheses. However, given the associations between purebred and other variables, in the future, dog breed information should be collected.

In the present study, almost half the dogs were given to the owners (gifts), followed by being adopted as a stray, purchased or born in the household. A previous Italian study showed quite different results: 23% were born in the household; 19% of dogs were adopted; and 43% were purchased or received as gifts (Fico, 1995). A national study in the United States found that 21% of dogs were purchased from a breeder, 17% were given to the owner by friend, 16% were from stranger, 13% were born in the household and 11% were adopted from an animal shelter; 6% were strays (New et al., 2000). Another US study also reported friend/relative and breeder as the most common sources, followed by animal shelter and newspaper/private party; 9% were strays (APPMA, 2005). Like cats, the majority of dogs in Italy seem to be acquired more casually than deliberately and stray dogs are a much more common phenomenon in this part of Italy than in the US.

Only 16% of dogs (29/181) were sterilized and 24% (7 dogs) were known to have had a litter prior to sterilization. Male dogs were substantially less likely to be sterilized than females. This trend is true in the US as well, with 48% of males sterilized and 70% of females (New et al., 2000). About half of the dog litters were accidental with the reasons divided evenly between the dog running away and the owner not paying attention. In the US, 3% of households had a litter of puppies in 1996 with 54% unplanned (New et al., 2004). In a regional US study, 32% of dog litters were accidental (Patronek et al., 1997). This frequency of accidental litters of puppies is lower than that of cats and may be due to a higher proportion of dogs truly confined to yards. However, it is still high enough to suggest early sterilization would be helpful.

Puppies in Italy were most commonly given away with about 3% dying. In the US, about 1/3 of puppies were sold and 1/3 given away; less than 9% died. This is quite different from the pattern in kittens in both countries.

Over 3/4 of the dogs were trained to sit, come, stay and/or walk on a leash. These behaviors were selected as common basic commands that most dogs can and should learn if they are to be good companions. However, only 59% of dogs were trained to do all of these things. Questions about training were included as an indirect measure of the type of relationship between the dog and the owner. In theory, owners who take the time to train their dogs would spend more time with them, value them more highly and be more attached to them. One US study found that dogs trained at home were significantly less likely to be viewed as disobedient than formally trained dogs (Jagoe and Serpell, 1996). In Italy, formal dog training is still relatively rare. The relationship between training and perception of disobedience could be due to more tolerance (if

the bond is stronger) or to the fact that dogs trained at home may be easier to manage than dogs who might need formal training.

Twenty-eight percent of dogs were kept entirely indoors while 62% were kept entirely outside, despite the fact that 81% of dogs were considered companions rather than working animals. Only 13% were reported to be free roaming. These data contrast with a previous study in a mountain town where only 21% of owned dogs were kept confined, 18% were free to roam sometimes and 61% were entirely free-roaming dogs (Fico, 1995). Merely keeping the dog outside was not associated with sterilization, free-roaming or registration, suggesting that being an outside dog by itself, may not be an important factor to consider. Rather, where the dog is kept and whether the dog has any training could be the real predictors.

Almost all of the dogs had been to the veterinarian at least once and 79% had been at least once in the past year. In the US, 91% of dogs had been to the veterinarian in the past year (APPMA, 2005). The median number of visits was one to three per year which was similar to the average of two to three visits per year in United States (Wise, 2002; APPMA, 2005). About 15% of dogs in the present study had health problem in the last year.

Nearly 1/4th of the respondents were unaware of the national dog registry in Italy. Registration was required legally to try to increase the numbers of lost dogs returned to their owners as well as to gain information on the numbers of owned dogs. About half the dogs in the study were registered even though 72% of HH knew about registration requirements. A previous Italian study found that only one owned dog in 36 was registered (Fico, 1995). However, dog registration only became compulsory in Italy in 1991. In the current study, 17 HH with more than one dog did not have any dogs registered, while 12 had all dogs registered and 6 HH had some registered and some unregistered dogs. These results indicated owner decisions about whether or not to register dogs varied within the HH. We also asked each respondent with dogs whether they knew about the registration law. This question was asked at the end of the section and later in the interview so that a good rapport could be established to get an accurate answer. As of the beginning of 2005, the number of microchipped, registered dogs in the Italian national dog registry in the Abruzzo region, Anagrafe Canina Centralizzata della Regione Abruzzo, was 75,437 of which 6048 were owned by the municipalities (either in shelters or as sterilized community owned dogs) (Personal communication, Dr. Paolo Torlontano, 22 February 2005). 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 was estimated to be 125,000. However, the number of owned dogs who were not registered is unknown. If our study is accurate, much more education about the existence and importance of the registry needs to be provided to dog owners.

4.4. Logistic regression modeling

Overall, HH with three or more people were significantly more likely to own pets than one person HH. The coastal region tended to have a higher level of pet ownership than the central hills. Household size has been shown to be related to pet ownership in the United States as well (Nassar and Mosier, 1991). As in the United States, there was no relationship between education level and pet ownership (Wise, 2002).

Only the older age groups of cats were significantly more likely to be sterilized than the youngest group. Indoor-only cats were more likely to be sterilized than outdoor-only cats. Visiting a veterinarian was associated with being sterilized. Cats whose owners lived in the coastal or mountain regions were more likely to be sterilized than cats in the central hills

region. It seems unusual that sterilization continued to be performed on older animals. It could reflect the relative young age of the cats in the study or some other factor related to cats' changing lifestyles. Sterilization of indoor-only cats could reflect the practical consideration that intact indoor cats are very unpleasant to live with or that pet owners who keep their cats indoor only are better educated about cat health or have stronger relationship with their cats. Clearly, sterilization requires a veterinary visit, but could also indicate that cats who visited a veterinarian received a higher level of health care including sterilization. It would seem reasonable that there may be a perception of increased danger to pet cats in the mountains from predators including dogs as well as the climate. This could also be due to an overall difference in the level of care provided by residents of both mountain and coastal areas compared to the central hills.

Increasing the numbers of sterilized cats could be accomplished by encouraging pet owners to consider these cats as members of their family and to recognize the important health benefits of early sterilization. Since cat litters were accidental, residents were not deliberately choosing to breed their cats. Instead, cats have litters because they are intact and outside and because cats are often sterilized relatively late in life. Three approaches could be useful but have yet to be implemented and evaluated.

First, owners should be encouraged to take their cats to the veterinarian as kittens to receive their vaccinations and to get the cat sterilized before the first heat. Second, veterinarians need to be proactive in recommending sterilization of pet cats. Third, subsidized or low cost sterilization may be needed for some pet owners. This is not commonly available in the Province, especially for dogs. Educational campaigns for both the pet owning public as well as the veterinary practitioner will likely be necessary (Murray, 1992). Furthermore, if veterinarians are not comfortable performing sterilizations on slightly younger animals they will need some additional training in order to do this.

Cats who were allowed to roam freely were more likely to be 3 years of age and older compared to younger cats. Perhaps younger cats are kept inside to protect them or let them become accustomed to their home. Respondents who indicated that they "confined" cats to a yard or garden may believe that the fence or wall kept the cats in or they may be giving a socially acceptable answer. It is unknown if the yards really could physically contain a cat. Roaming was associated with cats who had never visited a veterinarian. Cats living on the coast were about 1/10 as likely to be allowed to roam freely as cats living in the central hill area. Coastal cats also tended to be sterilized, indoor only and to have visited a veterinarian all of which may be indicators of a difference in owner level of responsibility.

Keeping owned cats indoors clearly prevents them from roaming freely. However, there have not been any published interventions that have been demonstrated to be effective in changing owner behavior in this respect. There are also questions about the cat's need for exercise and behavioral stimulation. Keeping cats "safely confined", which would include an outside area, has been discussed as an alternative to indoor only. In some cases, strengthening the attachment between owner and cat could result in a change in how cats are kept because keeping cats safely confined means they are more likely to live a long, healthy life.

Male dogs were less likely to be sterilized than females. Sterilized dogs were more likely to have training in basic commands and were more likely to be adopted than received as gifts. It is likely that dogs who were adopted from a kennel were already sterilized at adoption or that the personnel running the kennel recommended sterilization to the new owners. In the United States, dogs who were purchased were more likely to be intact than dogs from any other source (Manning and Rowan, 1998). Dogs who were trained were more likely to be sterilized.

Mechanisms to increase the likelihood of owners training their dogs would be beneficial in decreasing unwanted litters. Region was not an important predictor of sterilization in dogs.

In contrast to cats, sterilization of dogs is related to the sex of the dog and this may be a cultural perception about negative effects of sterilization on males. There may be reluctance to neuter males if respondents feel the dog will no longer be a good companion or guard or that sterilization as inappropriate for some other reason. Purebred dogs were more likely to be bred on purpose than mixed breed dogs. In many countries, people deliberately breed dogs because they believe they will earn a profit, because they like their dog and want one of its babies or less often, because they are professional, responsible breeders. The survey did not determine what the reasons were. However, responsible professional breeders do not make a lot of money from their puppies and will always take a puppy back during its lifetime if the owner cannot keep it. The vast majority of people who breed their dogs do not fall into this category and do not take a lifelong responsibility for the puppies produced. These casual breeders are difficult to target and to convince not to breed their dogs.

Roaming free was associated with being a large dog, not having a yard, not being trained in basic commands, not visiting a veterinarian and living in the central hills rather than the coast. Small dogs were often kept indoors; owners of small dogs could be more concerned about injury or attack. It appears that owners do use their yards to confine their dogs. Owners who did not allow their dogs to roam freely may have felt obligated to walk their dog for exercise. Alternatively, they may enjoy walking with their dogs and not allow them to roam. The association with veterinary visits could be due to education by the veterinarian, a previous injury which required a veterinary visit and substantial cost or willingness and interest to provide a higher level of care for the dog. In US, visiting a veterinarian was found to substantially decrease the risk of relinquishment of dogs to an animal shelter but not cats (Patronek et al., 1996a,b). This was presumed to indicate that visiting a veterinarian either provided an educational opportunity or reflected a stronger bond with the dog.

Unowned, loosely owned, neighborhood or community cats and dogs are components of the free-roaming population. This region of Italy does have many cats and dogs in this situation and these animals are typically not sterilized, contributing to the problems associated with free-roaming animals (Slater et al., 2008). However, free-roaming populations also include owned pets allowed to roam and intact lost or abandoned pets. Promoting a strong, positive relationship between humans and companion animals may lead to a decrease in the numbers of free-roaming animals. Education is a commonly cited method for changing this type of pet keeping behavior (Murray, 1992). Yet few programs have been critically evaluated for efficacy. Data on where pet owners seek information in the US reveal that veterinarians were the most commonly cited source for owned cats and dogs (54 and 61%, respectively) (APPMA, 2005). However, past experience and friends/relatives were also commonly used as information sources. Friends and relatives would also need to be educated, to pass on accurate advice. In contrast, when pet owners were seeking information on new pet products, they turned to pet stores, television advertisements and print ads (58, 57 and 42%, respectively). Veterinarians were only listed by 26% of pet owners. If health care like microchipping or sterilization are viewed by pet owners as new products rather than as general information, the best method of disseminating information may be quite different. A much clearer understanding of the decision making process for pet owners, in each culture, is needed to design effective interventions.

Registered dogs were more likely to be bought and less likely to be found compared to dogs received as gifts. Region was not significant. If region was dropped from the model, only bought dogs were more likely to be registered and registered dogs were more likely to taught to walk on a

leash. Walking on leash was strongly associated with the coastal region. Dogs trained to walk on a leash may be registered because they are more visible in public places or because training is a measurement of level of care.

Registration does not seem to be a well-known law among dog owners. Registration and licensing in the United States has been variably successful for dogs. This may be related to the perceived benefits of registration, the relationship between the organization which sells the registration and the public, the cost of registration or some other perception of the residents. It must also be easy to obtain registration and if it needs to be renewed, the owners must be reminded to do so.

5. Conclusions

Pet ownership is more common in this region of Italy than in Italy as a whole. Dogs are more commonly kept than cats. Pet ownership varied regionally and was related to HH size. HH size is likely a proxy for a combination of variables reflecting the life stage of the HH.

For the models evaluating sterilization, only visiting a veterinarian (an obvious requirement) was common for cats and dogs. In comparing predictors for roaming free for cats and dogs, confinement to a yard, visiting a veterinarian and region were in both models and had similar odds ratios. Training variables were not asked of cat owners since we did not believe them to be applicable. These results highlight the fact that some owners may have different perceptions, valuation and management practices for dogs and cats, emphasizing the need to study these species separately. This also has implications when designing interventions.

For cats and dogs, it appears that visits to a veterinarian and confinement to an existing yard were modifiable factors which were important predictors of sterilization and roaming. Training a dog was important in all dog models including registration. In addition, it appears that having a yard by itself may be an important factor in determining whether the pet runs free. Pet owners should be encouraged to build a yard (which will actually contain a cat) or to recognize that they will need to walk the dog on a regular basis if that is not possible.

The existence of the dog registry should be publicized in a variety of places where dog owners might go and its benefits to the dog and owner must be clearly emphasized. In the Regions-Government Agreement of February the 6th 2003 at article 4, a nation wide electronic registration system has been approved which should improve the organization and completeness of the data (Conferenza permanente per i rapporti tra lo Stato le regioni e le province autonome di Trento e Bolzano, accordo 6 febbraio 2003, Gazzetta Ufficiale. del 03 Marzo 2003, n. 51 ''Accordo tra il Ministro della salute, le regioni e le province autonome di Trento e di Bolzano in materia di benessere degli animali da compagnia e pet-therapy''). Easy and frequent access to the public health veterinarians charged with microchipping and registering dogs will be crucial to increasing compliance.

Appendix A

Cat (62/88 visited a veterinarian) and dog health (171/178 visited a veterinarian) and reproductive data, including information on litter size and outcomes

Variable	Cats Number (%)	Dogs Number (%)
If visited a veterinarian, how often visited in a year		
More than three times	17 (27)	37 (22)
Two to three times	36 (58)	107 (63)
Once	9 (15)	25 (15)
Missing	–	2 (1)
Total	62	171
If visited a veterinarian, was there a health problem		
Yes	11 (18)	26 (15)
No	49 (79)	143 (84)
Missing	2 (3)	2 (1)
Total	60	171
Pet ever been bred		
No	34 (37)	110 (60)
Yes	29 (32)	43 (24)
Don't know	22 (24)	25 (14)
Missing	6 (7)	4 (2)
Total	91	181
If yes, how often bred		
Once	14 (48)	22 (51)
Two to three times	7 (24)	11 (26)
More than three times	7 (24)	9 (20)
Missing	1 (3)	1 (2)
Total	29	43
If bred, was the breeding		
Accidental	29 (100)	23 (53)
On purpose	0 (0)	19 (44)
Missing	–	1 (2)
Total	29	43
If accidental, why		
Ran off	16 (55)	11 (48)
Not paying attention	5 (17)	10 (44)
Other	8 (28)	2 (9)
Total	29	23
If bred, disposition of offspring for each cat or dog bred		
At least some kept	10 (34)[a]	7 (16)[a]
At least some given away	9 (31)	25 (58)
At least some sold	0 (0)	1 (2)
At least some died	9 (31)	5 (12)
At least some ran away	1 (3)	–
Missing	8 (28)	13 (30)
Total	29	43

[a] Percentages add to >100% due to more than one possible response per animal.

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