STUDY OF THE DOG POPULATION IN İSTANBUL, TURKEY

*Ad VOS** *Belgün TURAN***

* *IDT, PSF 214, 06885 Rosslau, GERMANY*

** *Provincial Veterinary Office, 81060 Erenköy - İstanbul, TURKEY*

TÜRKİYE'DE / İSTANBUL'DA KÖPEK POPULASYONUNA YÖNELİK ÇALIŞMA

ÖZET

İstanbul'da sahipli köpek populasyon büyüklüğünün tespitine yönelik bir çalışma yürütülmüştür. Bundan başka köpek - sahip ilişkileri, köpek ekolojisi ve kuduz aşılama oranıyla ilgili veriler toplandı. Bu çalışmada olduğu gibi İstanbul'daki sahipli köpek populasyonunun yaklaşık 150.000 olduğu tahmin edildi. Kavacık'ın kırsal mahallesinde yürütülen işaretleme ve tekrar yakalama temeline yönelik bir çalışmanın sonuçları bu bölgedeki toplam köpek yoğunluğunun km² de 166 köpek ve bununda %30.5'nin sahipsiz olduğu sonucunu vermiştir.Kavacık'ta sahipli köpek populasyonunun üreme oranı yaklaşık %50 idi. İstanbul'un farklı coğrafik bölge ve farklı sosyo-ekonomik alanlarında toplam 10.137 hane halkı ile karşılıklı görüşüldü. İstanbul için köpeğe sahip olma oranı, ortalama 1/17,7 .Bunların %41'i sahipli köpek olup 1 yaşında veya azdı. Sahipli erkek ve dişi köpeklerin oranı, dişi köpeğe doğru ağırlık göstermekteydi; 6.8 : 1.Sahipli köpeklerin sadece %31.9'unun kuduza karşı aşılı olduğu belirlendi. Köpeğe sahip olmanın başlıca nedeni korunma amaçlı idi (%81.7). Sahiplerine göre, köpeklerin %61.6'sı her zaman bir yerde tutulmakta idi ve sadece %5.4'ü kesinlikle bağlı değildi.

SUMMARY

A study was carried out to determine the owned dog population size in İstanbul, Turkey. As of the present study, the owned dog population in İstanbul is estimated at approximately 150.000. A total of 10137 households in different socio-economic and geographical areas of İstanbul were interviewed. The average dog to household ratio for İstanbul was 1 : 17.7. 41% of the owned dogs were less than 1 year old. The ratio of male to female owned dogs was extremely biased towards males; 6.8 :1. Only 31.9% of the owned dogs were proven to be vaccinated against rabies. The main reason for ownership of a dog was for guarding purposes (81.7%). According to the owners 61.6% of the dogs were always confined, and only

5.4% of the dogs were never restricted. Results of a mark-recapture-study in the urban neighbourhood of Kavacık indicated an estimated overall dog density in this area of 166 dogs per km², of which 30.5% were more or less ownerless. In Kavacık, the annual turnover of the owned dog population was approximately 50%.

INTRODUCTION

Dogs *(Canis familiaris)* remain the most important transmitter of rabies to man, even in areas where the main reservoir are wildlife species (Brooks, 1990). 99% of all human rabies cases are accounted for by dogs (Fekadu, 1991). These animals are more numerous than ever before, no other wild canid populations are known to exist at such densities (Wandeler et al., 1993). Since 1981, the annual number of rabies cases in Turkey, the only European country with dog-mediated rabies, decreased (Aylan et al., 1998). However, this decrease in rabies-incidence has not been observed in and around the city of İstanbul. This city has expanded enormously in the last decades, new suburbs have mushroomed everywhere. Due to constant rural migration into this city the local government is not able to meet the increasing demands for housing, sanitation and waste disposal. Hence, a high percentage of the population have to settle in marginal areas. The habitat resulting from these conditions favours an increase in the urban dog population. So far, urban rabies control programmes have not been successful to eradicate rabies from İstanbul. Therefore, oral vaccination of dogs as a supplementary method to parenteral vaccination is presently under investigation. A prerequisite of any rabies control programme is adequate knowledge of the dog population involved, e.g. dog density, population turnover and - structure, vaccination coverage (Joshi & Bögel, 1988). The study presented here was planned with the objective of estimating the approximate density of the owned dog population and the ratio of households to owned dogs in İstanbul. Furthermore, some of the characteristics of the owned - and ownerless dog population were studied.

MATERIAL AND METHOD

A questionnaire survey (house-to-house visits) including all households with dogs was carried out in selected areas of İstanbul, representing different socio-economic and geographical areas (Table 1). The survey included censuring of (owned) dogs in relation to the numbers of people or households, confinement of dogs, purpose of keeping dogs, sex ratio, age distribution and vaccination status of the animals involved. Veterinary staff was provided by the Provincial Veterinary Office in Erenköy, İstanbul.

To obtain information on the ownerless dog population and the ratio owned to ownerless dogs the urban neighbourhood of Kavacık in the

Table 1. Areas of İstanbul where a questionnaire survey was carried out, representing different socio-economic and geographical areas.

Area	Date	Geographical category	Socio-economic category	Number of households visited
Tokatköy	May'94	suburban	low & middle	506
Cavuşbaşı	Jun.'94	rural	low & middle	236
Kavacık	July'94	urban	low & middle	551
Gümüşsuyu	Aug.'94	urban	low & middle	457
Kanlıca	Sep.'94	urban	high	27*
Erenköy	Jan.'95	urban	high	5817
G. Osmanpaşa	Apr.'95	urban	low & middle	2489
Hüseyinliköy	July'95	rural	low	81
K. Karabekir	Oct.'95	urban	low	173*
Hekimbaşı	Nov.'95	urban	low	81*
A. Dudullu	Nov.'95	suburban	low	82*
Sarıgazi	Dec.'95	urban	low	125*

* - only households with dogs visited

district of Beykoz was selected. This neighbourhood is characterized by moderate to low standard housing with many open public areas. The neighbourhood of Kavacık is divided into two areas by a freeway. The overall dog density was estimated separately for both areas; both approx. 0.64 km^2. A higher abundance of food (waste disposal) was available in South-Kavacık, which was an overall 'lower-income' area than North-Kavacık. Like Heusner et al. (1978) the dog population was divided into the following two categories: owned-and ownerless dogs. Two methods were used to collect data on population density. To estimate the number of owned dogs in the study area every household was visited. All owned dogs were marked with a blue neck-collar and, on request, vaccinated parenterally against rabies. Shortly after the survey a number of households were visited a second time to check if the dogs were still there and, whether or not they had lost their collar. From this data a daily collar loss-rate was estimated.

The ownerless dog population was calculated by using the capture-recapture-method. Ownerless dogs were caught by hand or with the aid of an immobilization gun (Telinject-system. Telinject, Römerberg). The blow-pipe-pistol was used to inject the dogs *i.m.* with a 1.5 ml mixture of xylazine-hydrochloride (Rompun, Bayer AG) and ketamine-hydrochloride

(Ketalar, Parke-Davis GmbH), also 3 mg hyaluronidase 300 I.U. (Hylase, IDT) was added. As an antidote 7.5 mg yohimbine hydrochloride (Yohimbin Spiegel®, Kali-Chemie Pharma GmbH) was administered *i.m.*. The dogs were marked with a green neck-collar and ear-tagged. Afterwards, during one night, a fixed route was followed by car, covering almost every street and open areas in the study-areas. Of all dogs observed, it was recorded if they wore a blue-, green- (and eartags) or no neck-collar. From these observations the number of ownerless dogs was estimated, using the following formula:

$$N = (M \times R) / Mr$$

where:

N = number of ownerless dogs
M = number of ownerless dogs initially marked
R = number of ownerless dogs marked and unmarked reobserved
Mr = number of ownerless dogs initially marked and reobserved

To estimate the annual population turnover of the owned dog population, the area was visited one year after the first survey. For every household it was recorded if the dog present had entered the population after the first survey was carried out or if it had been recorded during last years' survey.

RESULTS

A total of 10137 households in seven areas of İstanbul were visited, of these only 5.2% owned one or more dogs (Table 2). The highest percentage of households with dog(s) was found in rural areas; Hüseyinliköy (45.7%) and Cavuşbaşı (19.1%). The lowest percentages of households with dog (s) were found in urban areas with high rise apartment buildings with few (public) open areas; Erenköy (4.3%) and Gazi Osmanpaşa (0.1%). The average number of people per household was estimated at 4.44 (s.d. = 1.93) in a sample of 957 households. A conservative estimate of the human population of İstanbul is 12 million. In view of the obtained data, the total number of owned dogs in İstanbul was estimated to be approximately 150.000.

The age- and sex-distribution of the owned dogs is illustrated in table 3 and 4, respectively. Of all owned dogs 41% were less than one year old. The proportion of adult male dogs was significantly higher than the proportion of adult female dogs (χ^2-Test, $\chi^2 = 4.84$, df=1, $P<0.05$). The ratio of male to female owned dogs was extremely biased towards males; 6.8 : 1 (χ^2 -Test, $\chi^2 = 477.2$ df=1, $P<0.001$). The sex ratio of ownerless dogs caught (n=70) in different urban areas of İstanbul was slightly biased towards males; 1.12: 1. However, it did not differ significantly from the evolutionary stable sex ratio 1:1 (χ^2-Test). According to the owners, on average, 61.6%

Table 2. Ratio of owned dogs to households obtained during a survey in different areas of İstanbul.

Area	Number of households visted	Households with dog(s) n	%	Number of owned dogs	Ratio dog:household
Tokatköy	506	63	12.5	73	1 : 6.9
Cavuşbaşı	236	45	19.1	57	1 : 4.1
Kavacık	551	73	13.2	85	1 : 6.5
Gümüşsuyu	457	43	9.4	48	1 : 9.5
Erenköy	5817	252	4.3	252	1 : 23.1
G.Osmanpaşa	2489	14	0.1	14	1 : 177.8
Hüseyinliköy	81	37	45.7	44	1 : 1.8
Total	**10137**	**527**	**5.2**	**573**	**1 : 17.7**

Table 3. The age distribution (years) of a sample of the owned dog population in İstanbul.

	0-1	1-2	2-3	3-4	4-5	5-6	6-7	>7	adult*	Total
Male	290	154	92	51	45	15	14	21	50	732
Female	53	12	17	4	2	1	3	7	5	104
Total	343	166	109	55	47	16	17	28	55	836

* - exact age unknown, but older than one year

Table 4. The sex ratio of the owned dog population for different areas of İstanbul.

Area	Number of owned dogs	Male(%)	Female(%)	Male:Female
Tokatköy	73	78.1	21.9	3.6 : 1
Cavuşbaşı	57	87.7	12.3	7.1 : 1
Kavacık	85	77.5	23.5	3.5 : 1
Gümüşsuyu	48	85.4	14.6	5.9 : 1
Kanlıca	32	81.3	18.7	4.3 : 1
Hüseyinliköy	44*	83.3	16.7	5.0 : 1
K. Karabekir	188	94.1	5.9	16.1 : 1
Hekimbaşı	99	92.9	7.1	13.1 : 1
A. Dudullu	99	85.9	14.1	6.1 : 1
Sarıgazi	138	89.1	10.9	8.2 : 1
Total	**863**	**87.2**	**12.8**	**6.8 : 1**

*- gender of two dogs was not recorded

Table 5. Confinement and purpose of keeping dogs for different areas of İstanbul.

Area	Number of owned dogs	Confinement[1]			Purpose of keeping[2]				
		A	S	N	I	II	III	IV	V
Tokatköy	73	63	9	1	50	-	6	8	9
Cavuşbaşı	57	27	13	17	47	-	1	4	5
Kavacık	85	54	22	9	65	-	2	10	8
Gümüşsuyu	48	38	6	4	14	-	8	11	15
Kanlıca*	32	22	3	7	21	-	-	5	6
Hüseyinliköy	44	4	15	25	22	1	18	-	3
K. Karabekir*	187	113	55	19	170	-	-	9	8
Hekimbaşı*	97	59	37	1	96	-	-	1	-
A. Dudullu	99	72	25	36	130	2	1	2	4
Sarıgazi	139	78	25	36	130	2	1	2	4
Total	**861**	**530**	**198**	**133**	**704**	**3**	**29**	**52**	**63**

1) Confinement: A - always restricted, S - sometimes restricted, N - never restricted

2) Purpose of keeping: I - guarding, II - herding, III - hunting, IV - companion/pet, V - other

* - From one owner no further data on confinement and purpose of keeping was available.

of all dogs were always restricted, 23% was sometimes restricted and 5.4% was never restricted. However, big differences were found between the areas; in Tokatköy and Hüseyinliköy, 86.3% and 9.1% of the dogs were always restricted, respectively. When asked about the reasons for keeping dogs, 81.7% of the owners gave guard duties as their dogs' main function, followed by companionship (6%) and hunting purposes (4.5%). It was extremely difficult to obtain data on the rabies vaccination-status of the dogs. On many occasions the owner claimed that the dog was vaccinated against rabies. However, the date of the last vaccination was unknown; they were not able to present a valid rabies vaccination certificate. The average vaccination-coverage of the owned dog population in areas investigated was 31.9% (Table 6). The vaccination-coverage of Kanlıca and Hüseyinliköy was significantly higher than that of the other areas (Hypothesis Test for differences between population proportions, $\alpha<0.05$, $z>1.96$, two-sided). The vaccination-coverage of dogs in low-income urban areas was only 25.4%. The overall vaccination-coverage of the dog population, including the ownerless dogs, would be even lower.

Table 6. The rabies vaccination-status of owned dogs for different areas of İstanbul.

Area	Number of	Vaccinated		Not vaccinated		Unknown	
	owned dogs	n	%	n	%	n	%
Kanlıca	33	25	75.8	7	21.2	1	3.0
Hüseyinliköy	44	34	77.3	6	13.6	4	9.1
K. Karabekir	188	41	21.8	142	75.5	5	2.7
Hekimbaşı	99	25	25.3	66	66.6	8	8.1
A. Dudullu	99	32	32.3	66	66.6	1	1.0
Sarıgazi	142	36	25.4	63	44.4	43	30.3
Total	**605**	**193**	**31.9**	**350**	**57.9**	**62**	**10.2**

However, the number of ownerless dogs remains unknown for İstanbul. Only for Kavacık a more accurate estimation of the overall dog population was determined. In North- and South-Kavacık 54 and 94 owned dogs were identified, respectively. 18 days after the first survey several households were visited again during a back-up survey: 32 (68%) animals still wore their collar, 10 (21.3%) dogs lost their collar and 5 (10.6%) left the population (sold, killed, died, etc.) during this period. Hence, the daily rate of animals loosing their collar or 'leaving' the population was 0.178. From this, it was estimated that during the reobservation period 51.6% of the owned dogs had lost their collar or had left the population. A stable owned dog population was assumed; the number of owned dogs which had 'left' the population was equal to the number of dogs that had 'entered' the population during this period. In South- and North- Kavacık, 26 and 9 ownerless dogs were caught and tagged, respectively. No loss of eartag was observed. During the reobservation period (night), 29 days after tagging the owned dogs, all free-roaming dogs in South-Kavacık were recorded; 18 eartagged ownerless dogs, 7 dogs with a blue neck-collar and 27 dogs without a collar or eartag. Using the daily loss-rate of neck-collars and the observation of 7 blue neck-collared dogs, it was estimated that 7.5 owned dogs were observed without a collar, due to collar-loss or that these animals had entered the owned dog population after tagging ($7 : x = 48.4 : 51.6 \Rightarrow x = 7.5$). Hence, 19.5 ownerless dogs were recorded who were initially not tagged. Applying the above mentioned formula, the number of ownerless dogs in South-Kavacık was an estimated 54. The overall population size in this area was 148 dogs (231 dogs/km^2), of which 36% were ownerless dogs. In North-Kavacık, a total number of 65 dogs (101 dogs/km^2) were estimated, here only 17% were ownerless. To estimate the population turn-over of the owned dog population in Kavacık between 1994 and 1995, 148 and 131 owned dogs were counted, respectively. Of the dogs counted in 1995 69

animals (50.7%) entered the population after the first survey was conducted in 1994. Of 6 dogs no decisive answer could be given by the owners on how long they 'owned' their dog, which indicates the often observed disinterest of the owners in the animals as individual pets.

DISCUSSION

Although a questionnaire survey can give useful information on the owned dog population, the results should not be overrated. Like Rautenbach et al. (1991), it was observed that basic questions about e.g. age and vaccination-status of the dogs were often answered inaccurately and a second visit to the same household would produce sometimes completely different answers to the same questions. Also, in some areas the people were reluctant to cooperate, even if the purpose of the survey was explained carefully to them, e.g. by denying the existence of their dog. The data obtained on the age-distribution of the owned dog population was found to be so unreliable, that only the juvenile to adult ratio was determined. Data on e.g. vaccination-status and dog population parameters (age, reproductive performance, etc.) obtained during surveys should therefore be treated carefully.

The finding of more male than female owned dogs in İstanbul is consistent with other surveys (Beck, 1973; Brooks, 1990; Daniels & Bekoff, 1989; Rautenbach et al., 1991). Although in this study the sex ratio was extremely biased towards males (87.2%). This disequilibrium of sex ratio is probably a result of the preference of man for male dogs (guarding purposes). Daniel & Bekoff (1989) found a female biased sex ratio of ownerless dogs, this as possible result of the abandonment of female owned dogs. However, in İstanbul the sex ratio of the ownerless dogs did not differ from the 1 : 1 ratio. The variation in the dog to household ratio, as observed in this study, can be explained by the great contrast that exist in urbanistic infrastructure and socio-economic conditions. Even in the adjacent neighbourhoods, North-and South-Kavacık, a considerable difference in the number of owned and ownerless dogs was observed. One of the difficulties met in estimating the owned and ownerless dog population size, is the determination of the true ownerless status of dogs. For example, it is possible that some of the dogs reobserved without tags were not ownerless dogs but instead owned free-roaming dogs from adjacent areas, resulting in a biased owned to ownerless dog ratio. Also, it is extremely difficult to determine the true ownership-status of free-roaming dogs. People tend to decide arbitrary if these dogs are owned or not. Hence, a dog can be claimed 'owned' one day, and the next day (or even only minutes afterwards) as 'ownerless' by the same person, or *visa versa*.

The average owned dog to household ratio of 1 : 17.7 and the obtained estimation of the owned dogs population in İstanbul suggest a relatively low

population density when compared to estimates obtained in other countries (Rangel et al., 1981; Wandeler, 1985; Chomel, 1993; Belotto, 1988). However, it is not the abundance of dogs *per se* that causes the urban rabies problem. It is rather the socio-economic characteristics that are the source of the dog problem (Chomel, 1993). The local authorities in İstanbul try to control the number of free-roaming dogs through occasional dog elimination campaigns. However, removal of dogs by any method does usually have no long term effect on dog population size (Wandeler et al., 1988). Although ownerless dogs adapt remarkably well to the urban environment, they are not capable at maintaining population levels due to a very low fecundity (Beck, 1973; Fox et al., 1975; Daniels, 1983). It seems that continuous influx from the owned dog population (e.g. abandoned dogs) is the major source of recruitment (Beran, 1982; Daniels, 1983; Boitani et al., 1995). Therefore, the most effective solution is to change the people's attitude towards dog-keeping (Boitani et al., 1995). Unfortunately, this will be very hard to achieve, the indifference to the dogs may simply reflect the (economic) hardship experienced by people living in marginal areas (Jordan in Boitani et al., 1995). This is for example reflected in the low rabies vaccination coverage of the owned dog population in the low-income urban areas of İstanbul: on average 25.4%. Only in areas like the high-income urban neighbourhood of Kanlıca and the rural village of Hüseyinliköy a vaccination coverage of the (owned) dog population of at least 70% was achieved. The low vaccination coverage of the free-roaming owned and ownerless dogs can be seen as the core of the present rabies problem in İstanbul. Therefore, intensified vaccination campaigns are suggested here. Dogs inaccessible to parenteral vaccination could be vaccinated orally in order to reach a sufficient level of vaccination coverage

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Corresponding author: Dr. Ad Vos
IDT, PSF 214, 06855 Rosslau, GERMANY
tel.: +49 - 34901 - 885494
fax: +49 - 34901 - 82528