

Determination of the welfare status of free-roaming dogs in two urban centres in Chile

This paper (No. 15052019-00147-ES) is a translation of the original Spanish article, which was peer-reviewed, accepted, edited, and corrected by authors before being translated. It has not yet been formatted for printing. It will be published in December 2019 in issue **38** (3) of the *Scientific and Technical Review*.

G. Chávez ^{(1)*}, G. Clementi ⁽¹⁾, C. Águila ⁽²⁾ & M.J. Ubilla ⁽³⁾

(1) School of Veterinary Medicine, Faculty of Natural Resources and Veterinary Medicine, Universidad Santo Tomás, Avenida Limonares 190, Viña del Mar, Chile

(2) School of Veterinary Medicine, Faculty of Natural Resources and Veterinary Medicine, Universidad Santo Tomás, Avenida Ejército Libertador 146, Santiago, Chile

(3) School of Veterinary Medicine, Faculty of Life Sciences, Universidad Andrés Bello, Avenida República 440, Santiago, Chile

*Corresponding author: gchavez@santotomas.cl

Summary

Free-roaming dogs are not only a public health and ethical problem, they are also an environmental and economic one. Although the general belief is that free-roaming dogs are not in good condition, there have been insufficient studies in Chile to address and analyse the issue. The objective of this research was to assess the welfare of free-roaming dogs in the centre of the cities of Santiago and Valparaíso. The evaluation was carried out using an observational method and assessed a total of 554 dogs. The following variables were analysed: body condition, motor impairment, skin condition, respiratory disease, reaction to humans and other variables. In addition, spatial distribution was considered, and age, sex and social behaviour were estimated. When the results were analysed in terms of frequency, it was found that, in Valparaíso ($n = 204$), 37% of the dogs assessed had

compromised welfare (poor or fair), while 63% had positive welfare (good or optimal). In contrast, in Santiago ($n = 350$), only 21.7% had compromised welfare, while 78.3% had positive welfare. With respect to social behaviour, 55% of the dogs assessed in Valparaíso and 68% of those assessed in Santiago led a solitary lifestyle. Although most of the individuals were in good condition, a high percentage were unable to meet the requirements for them to live in harmony with their environment.

Keywords

Animal welfare – Free-roaming dogs – Public health.

Introduction

The dog (*Canis lupus familiaris*) has marked the course of civilisation because it is a companion animal. Although the size of the world's canine population is unknown, it is positively correlated with that of the human population. Based on a number of observations, it may be as high as one-tenth of the human population, meaning that there could be more than 700 million dogs in the world. Most of these dogs, particularly in parts of Africa, the Middle East and Latin America, are regarded as free-roaming dogs (1). These animals often suffer from hunger and disease and frequently seek refuge in human communities, where they are commonly seen as a nuisance and health risk.

Responsible dog ownership is understood as the state where the guardian of an animal agrees and undertakes to provide it with adequate food, shelter, protection, health and good treatment for the duration of its life, as well as to prevent any risks, such as assaults, injuries or infectious diseases, that a dog may pose to the community, other animals or the environment (2).

Welfare of companion animals

There is consensus in the scientific community that animal welfare is achieved when physical, mental and natural needs are met. The World Organisation for Animal Health (OIE) has established a set of basic principles of animal welfare that reflect this consensus (3). Various

authors have explored this subject in more depth, arguing that, to be able to assess the welfare of companion animals, it is necessary to carry out an assessment that addresses mental, physical and natural welfare aspects (4). The concept of mental welfare is based on the idea that animals are sentient beings, that is to say, they have the capacity to feel subjectively (to feel pain or pleasure) (5). The concept of physical welfare is based on the idea that biological functioning, body condition and health can be observed at first hand by an assessor, although it should be borne in mind that good physical health *per se* is not always synonymous with welfare (6). The environment in which an animal lives also has a bearing on its physical welfare, since environmental stimuli will determine a dog's adaptability to the environment (7). Finally, natural welfare is measured in terms of an animal's opportunity to express natural behaviour (6).

Assessment of animal welfare using indicators

There has been little development of instruments for assessing the welfare of companion animals. One suggestion has been to quantify animal welfare using direct and indirect indicators. This method involves using direct (animal-based) indicators, including aspects of behaviour, body posture, body condition, the quality of the animal's interaction with humans and other animals, signs of disease and signs of physical or functional health. Indirect indicators are the resources to which an animal has access: the quality of its habitat and food, and access to health care (7). Therefore, the application of assessment protocols calls for knowledge of the specific needs of a species, mainly with regard to its health (physical and mental), environmental conditions and behavioural repertoire. The indicators most commonly used to determine the welfare of free-roaming dogs are body condition and skin condition, presence of external parasites, presence of wounds, presence of neoplastic or infectious diseases, serum cortisol level, intraspecific aggression, play behaviour, dog-human interactions and criteria that allow a qualitative assessment of behaviour (8).

Situation of free-roaming dogs in Chile

The exact number of dogs in Chile is unknown. However, according to the population census for 2014, the ratio of number of people to number of dogs was estimated to be 5:1. This gives a total of 3,249,505 dogs, of which 487,425 are believed to be free roaming and 207,415 are thought to be ownerless (Office for Regional and Administrative Development, Ministry of the Interior and Public Security, Government of Chile, 2017).

A free-roaming dog is defined as one that has been abandoned or which, despite having an owner, roams freely in public areas (2, 9). These animals are abandoned under the assumption that they will scavenge for food in the rubbish, this may be because the owner is not in a position to maintain them (10). Indeed, in many countries, the majority of dogs defined as free roaming actually have an owner. Community-owned (or neighbourhood) dogs are dogs that do not have an owner but are fed by, and receive basic care from, the community (11). This is the result of a series of socioeconomic and cultural factors stemming from inadequate civic education and poor legislation on the impact of the canine population on the environment and public health (12). Free-roaming dogs face high mortality, malnutrition, starvation, disease and abuse, and are associated with dozens of zoonotic diseases. Additional problems with free-roaming dogs include road accidents, dog fighting, noise, bites, faecal contamination, spread of rubbish and uncontrolled breeding (13). Studies indicate that in countries like the Bahamas, more than 70% of free-roaming dogs suffer from diseases such as echinococcosis, toxocariasis, parvovirus, leptospirosis or venereal tumours (13). One study conducted in Mexico found that 34% of free-roaming dogs had mites (*Demodex canis* in 23% of these cases). In a rural community in South Africa, 51% of the free-roaming dogs had clinical disease (10% of these were seriously ill and half were chronically ill). As a result of their free-roaming lifestyle, these dogs have high mortality rates, and, a life expectancy of 1.1 years in some communities in countries such as Zimbabwe. Overpopulation is a welfare problem in itself because it leads to the devaluation of these animals by a society in which the

dogs which cost little or nothing are those at greatest risk of abandonment (14).

Despite all this, the assessment of the welfare of dog populations in Latin America has been an under-studied area, which is why the authors undertook this systematic and rigorous research into the level of welfare in a sample of dogs in the civic centre of two major cities in Chile.

Materials and methods

This was an observational study. To obtain a representative sample, a heterogeneity of 50%, a margin of error of $\pm 5\%$ and a confidence level of 95% were considered, with these criteria determining the minimum representative sample size (Win Episcopo 2.0) (Table I).

Table I

Characteristics of the geographical areas assessed

	Valparaíso	Santiago
Location	33°02'46.84"S – 71°37'11.55"W	33°26'34.47"S – 70°39'13.93"W
Importance	Port city, UNESCO World Heritage Site (since 2003)	Capital of Chile and the country's largest conurbation
Sampled area	Civic centre of the city	Civic centre of the city
Perimeter of the sampled area	7.14 km (Google Earth®)	14 km (Google Earth®)
Surface area of the sampled area	1.18 km ² (Google Earth®)	12 km ² (Google Earth®)
Estimated number of free-roaming dogs in the area to be sampled	287 (environmental consultancy Ecoestudios Ltda., 2012)	3,703 (dog population control programme of the Metropolitan Regional Government of Santiago, 2015: a comprehensive regional dog population control and prevention programme in the Santiago Metropolitan Region)
Number of dogs to be assessed	215	350
Criteria for inclusion	Free-roaming dogs not under supervision. There was no discrimination by sex, age or breed	
Criteria for exclusion	Animals under supervision, with a dog tag, collar, on a leash or tied up	

Geographical scope of the study

For sampling purposes, a spiral path was established through the streets in the civic centre of each of the cities, and these predetermined routes were travelled in multiple visits to the study area (over a period of five weeks in Valparaíso and nine in Santiago).

Methodology

The visits were made between 11:00 hours and 14:00 hours because, during this period, it is still possible to find free-roaming dogs in the places where they usually sleep (15). To avoid the duplication of sampling, a photographic record was made of each individual.

Variables to be assessed

The investigation used some of the direct indicators recommended in the guide for monitoring and evaluating dog populations by the International Companion Animal Management Coalition (ICAM) (16), as detailed below.

Body condition

An assessment of visible body fat coverage was made while the animal was standing. In cases where a thick coat prevented reliable assessment, the variable was not recorded. A five-point scale was used, with three being the optimal score.

Skin condition

The presence or absence of visible pathological alterations of the skin was recorded. The variables considered were: hair loss, skin swelling, presence of ectoparasites and presence of wounds.

Motor impairment

The dogs were observed while moving and any that were lame were not categorised.

Respiratory disease

A number of variables were verified: coughing, upper respiratory tract secretions and/or ocular secretions.

Reaction to observer

From a distance no greater than 1.5 metres, the assessor would establish non-verbal contact with the dogs by making a neutral sound (snapping the fingers twice) and waiting 10 seconds to observe the reaction. The assessor would then establish verbal contact and record the reaction. Depending on this reaction, the assessor would record a score in accordance with Table II.

Table II

Reaction to humans

Adapted from (17)

Score	Description
0	Indifference: no signs of fear or aggression, posture is neutral, relaxed while looking at or ignoring the assessor
1	Sociability: friendly and sociable, decreasing distances and/or inviting the assessor to play
2	Fear: signs of fear, expressed in low or very low postures, often increasing distances or hiding from the assessor, ears back, eye contact brief and indirect, tail hangs low or tucked between back legs
3	Defensive aggression: signs of fear and aggression, with body lowered, weight over back legs, tail down tense or tucked between legs, hackles raised, ears back, pupils dilated, muzzle tense, nose wrinkled, snarling with bared teeth
4	Offensive aggression: signs of aggression, with weight forward, tail stiff, ears erect and forward, bared teeth and lips curled, eyes staring, hackles may be up

Other variables

Other variables included sex (male, female, indeterminate), size (small, medium, large), breed and, in the case of males, reproductive status (castrated or uncastrated). The 'social behaviour' variable was also considered, that is to say, whether the dog was alone, in a group of two or three, or in a larger pack.

Lastly, each dog's level of welfare was rated in accordance with the sampling data collected (Table III).

Table III

Welfare status according to the results obtained in the study

Welfare	Characteristics
Optimal	All the variables analysed meet the criteria: body condition score 3; absence of skin lesions; absence of motor problems; absence of respiratory problems; reaction to observer score 0 or 1
Good	Only one of the variables analysed is outside the normal range
Fair	Two of the variables analysed are outside the normal range
Poor	Three or four of the variables analysed are outside the normal range
Very poor	All of the variables analysed are outside the normal range: body condition score 1, 2, 4 or 5; skin with type 1, 2 or 3 lesions; presence of motor problems; presence of respiratory problems; reaction to observer score 2, 3 or 4

Results and discussion

Characterisation of the study sample

A total of 554 dogs were assessed (204 in Valparaíso and 350 in Santiago), 70% of which were male (33% uncastrated) (Table IV). The likely reason why there were more males than females is that females require more care and handling during the mating season, during pregnancy and while rearing pups. Therefore, a larger proportion of females than males would seem to be destroyed, or removed from the street while on heat (15). Although there is a general preference for adopting males, more males than females are abandoned because of behavioural problems.

Table IV
Summary of overall characteristics of the samples studied

Sex	Samples studied		Reproductive status			Phenotype	
	No.	%	U	C	I	M	B
Valparaíso							
Males	139	68	19	120	0		
Females	65	32	No information available				
Subtotal	204	100				98%	2%
Santiago							
Males	247	70.6	109	36	102		
Females	103	29.4	No information available				
Subtotal	350	100				94.3%	5.7%
Total	554	100					

B: breed
 C: castrated
 I: indeterminate
 M: mongrel
 U: uncastrated

Assessment by size, breed and age

Cendón and Holm report that one cause of abandonment is size, with small dogs (< 10 kg) preferred on the grounds of cost, space and vulnerability (18). In the study, medium-sized dogs (10–25 kg) accounted for the largest share (57%). The same was true of biotype, with 95.8% of the dogs being mongrels. A possible reason why there were fewer puppies (6%) than adult dogs might be that this group is quickly removed from the streets and handed over for adoption. However, many of the adopted dogs return to the streets upon reaching adulthood. Senior dogs (over the age of 7 years: 34%) were found mainly in downtown locations, accompanied by other dogs, while young dogs were found roaming alone in more outlying areas. However, as young dogs had spent less time on the streets, their welfare status was good or optimal, while that of senior dogs was fair or poor.

Assessment of social behaviour

Feldmann and Carding found that the density of free-roaming dogs in a specific area and the distance they travelled were nearly always determined by the animals’ weight and size, as well as the availability of food and territory (19), an observation that is still accepted to this day. Other studies have found that the social-group structure of free-roaming dogs differs from that of dogs generally, as free-roaming dogs recruit other dogs as a means of survival but with no specific hierarchy (20). Free-roaming dogs depend on humans for food, which creates a competitive effect. This may explain the large number of solitary dogs (63.2%), which could have been forced to move away from their competitors. Solitary dogs were living in worse conditions than dogs in a group, with accompanied dogs found roaming in more crowded places (Table V). Be that as it may, it is impossible to be certain that dogs remain solitary or accompanied throughout the day and/or night, as social organisations are dynamic and can change rapidly.

Table V
Absolute and percentage distributions of the samples studied according to social behaviour

Social behaviour Valparaíso	No.	%	Total no. of accompanied dogs Valparaíso	Social behaviour Santiago	No.	%	Total no. of accompanied dogs Santiago	Grand total	%	Grand total accompanied dogs
Solitary	112	55		Solitary	238	68		350	63.2	
Group of 2	43	21		Group of 2	46	13.1		89	16.1	
Group of 3	17	8	92 (45%)	Group of 3	42	12	112 (32%)	59	10.6	204 (36.8%)
Group of ≥ 4	32	16		Group of ≥ 4	24	6.9		56	10.1	
Total sample	204	100		Total sample	350	100		554	100	

Assessment of body condition

More than 50% had an optimal body condition score (3/5); 18.4% had a body condition score of 2, due to irregular and poor-quality meals (mainly solitary young dogs) and 30% had a body condition score of

4 or 5 (mainly old community-owned dogs found close to restaurants and street markets) (Figs 1, 2 and 3).



Fig. 1
Food and water distribution points at various street locations



Fig. 2

Between 17% and 20% of free-roaming dogs were wearing some sort of clothing provided by city residents



Fig. 3
Community-owned dog at a street market

Assessment of skin condition

As the research was conducted in autumn and winter, under 10% of dogs in the sample were recorded as having ectoparasites. However, around 15% had bald patches of undetermined origin. As regards lesions (< 10%), there was a predominance of type 1 wounds (small, recent and clean), 80% of which were found on uncastrated males. According to Guerra *et al.*, the leading cause of dog abandonment in Cuba is skin disease (21), while Gallegos *et al.* report that, in Chile, mange is considered to be the fourth most common reason for consultations on infectious diseases in dogs, with abandoned dogs being the primary cause of this disease's persistence (22).

Assessment of motor impairment

Gait, proprioception and lameness were assessed. In Valparaíso, 24% of the dogs studied had motor impairment and, in Santiago, 11.7%. The possible cause was road traffic injuries, which is consistent with excessive exposure to traffic (22). Lesions were found chiefly in young dogs, probably because of their lack of experience of street living.

Assessment of reaction to observer

When a dog answered the call and came to meet the assessor, the reaction was considered positive. Around 40% responded positively, while 57.58% were indifferent and only approached when offered food. This might be precisely because they do meet most of their needs (mainly food), a fact determined entirely by a dog's relationship with humans (Table VI).

Table VI

Distribution of the samples studied according to type of reaction to the assessor

Reaction to the assessor	Valparaíso		Santiago		Grand total	
	No.	%	No.	%	No.	%
0. Indifference	107	52.5	212	60.6	319	57.58
1. Sociability	90	44.1	128	36.6	218	39.35
2. Fear	6	2.9	4	1.1	10	1.80
3. Defensive aggression	1	0.5	2	0.6	3	0.54
4. Offensive aggression	0	0	4	1.1	4	0.72
Total sample	204	100	350	100	554	100

Dogs expressing fear might be new to the streets or have had bad experiences with humans. Both these and dogs displaying aggressive behaviour had poor welfare, owing to their difficult relationship with humans; over time, they might come to pose a threat to the public. Dogs that showed signs of aggression did so even before contact was established with them at a distance of 1.5 metres.

Assessment of animal welfare

The welfare of 37.9% of the dogs was found to be 'optimal' ($n = 210$), which is defined as a situation where all the variables are within the normal range. The welfare of 34.65% of the animals ($n = 192$) was 'good' (where only one variable is outside the normal range). The welfare of 21.48% of the dogs ($n = 119$) was 'fair' (where more than two variables are outside the normal range). The welfare of 5.95% ($n = 33$) was 'poor' (where three or four variables are outside the normal range). No animals were found to have 'very poor' welfare (Table VII).

Table VII

Distribution of the samples studied according to their animal welfare rating

	Valparaíso		Santiago				Grand total		Total positive and compromised welfare			
	No.	%	No.	%	No.	%	No.	%	No.	%		
Very poor	0	0			0	0			0	0		27.4
Poor	20	10	76	37	13	3.71	76	21.7	33	5.95	152	
Fair	56	27			63	18			119	21.48		
Good	55	27	128	63	137	39.1	274	78.3	192	34.65	402	72.6
Optimal	73	36			137	39.1			210	37.9		
Total sample	204	100	204	100	350	100	350	100	554	100	554	100

A number of studies have determined that animals living on the street have diminished welfare and that millions of free-roaming animals are victims of abuse, disease, starvation and road accidents (9, 23, 24). According to the data collected in this study, 27.4% of the dogs had compromised welfare, meaning that over a quarter of the study sample were not in good condition at the time they were assessed. This is linked with the fact that 76.32% of dogs with compromised welfare were alone at the time of the assessment, possibly after being driven out by those in better condition.

Conversely, during sampling, a large section of the local community was seen to show their concern for the conditions in which these animals live by providing them with food, clothing and shelter, in contravention of municipal by-laws (Figs. 1, 2 and 3).

The results for certain variables were deemed to have a direct relationship with the welfare category in which dogs were placed. This relationship was seen mainly in the age, body-condition and motor-impairment variables, with older animals tending to be overweight and have motor impairment, while puppies had a good or optimal welfare status, an ideal body condition score and no motor impairment.

A point of note is that Chile has a large dog population, with more free-roaming dogs than in other countries, largely as a result of rubbish being left on the street. These dog populations cause harm to humans, mainly in the form of attacks, the transmission of zoonoses, faecal contamination and road accidents; they are also blamed for killing livestock and wildlife (25).

Correlation between the number of dogs per area and animal welfare

A direct relationship was found between the area where a dog is located and its level of welfare. It was in downtown areas (with many restaurants, markets and street vendors) that the largest number of dogs were found, mainly with 'optimal' or 'good' welfare status. The opposite was true in areas with many offices or dwellings, where the reduced flow of people means that the opportunity for dogs to receive food decreases.

Conclusions

Contrary to the public's idea or general perceptions concerning the welfare status of free-roaming dogs, most of the animals studied had good or optimal welfare status (> 70%), suggesting that these populations are in a better state than free-roaming dogs from other places (the reason being that the study was conducted in two urban centres of two of Chile's biggest cities, meaning that the animals had shelter and a constant supply of food). However, there are some dogs whose welfare is compromised on account of social isolation, limited access to valuable resources, injuries, abuse or competition, so efforts to satisfy needs should be focused on these dogs. As regards the

sampled populations, the closer dogs were to the city centre, the less isolated they were and the better their condition, whereas the closer dogs were to the city outskirts, the more isolated they were and the more their freedom/supplies were at risk. These results provide a starting point for addressing the overall welfare status of two groups of dogs, which will facilitate decision-making on plans for the humane treatment of free-roaming dog populations.

References

1. World Health Organization (WHO) (2013). – Announcement – Dogs, zoonoses and public health, 2nd Ed. WHO, Geneva, Switzerland. Available at: www.who.int/neglected_diseases/zoonoses/dogs_zoonoses_public_health_second_edition/en/ (accessed on 8 January 2019).
2. World Organisation for Animal Health (OIE) (2009). – Draft texts for the OIE Terrestrial Animal Health Code developed by the Terrestrial Animal Health Standards Commission. Chapter 7.7.: Stray dog population control. Article 7.7.2.: Definitions. OIE, Paris, France. Available at: www.oie.int/doc/ged/D9926.PDF (accessed on 27 December 2018).
3. World Organisation for Animal Health (OIE) (2018). – Guiding principles for animal welfare, Article 7.1.2. *In* Terrestrial Animal Health Code, Chapter 7.1. Introduction to the recommendations for animal welfare. OIE, Paris, France, 2 pp. Available at: www.oie.int/index.php?id=169&L=0&htmfile=chapitre_aw_introduction.htm (accessed on 27 December 2018).
4. Yeates J. & Main D. (2009). – Assessment of companion animal quality of life in veterinary practice and research. *J. Small Anim. Pract.*, **50** (6), 274–281. <https://doi.org/10.1111/j.1748-5827.2009.00755.x>.
5. Gimpel J. (2009). – Aspectos bioéticos en el uso de animales de experimentación. *In* 4° Taller de bioética: aspectos bioéticos de la experimentación animal. Comité Asesor de Bioética, FONDECYT-

CONICYT, Santiago, Chile, 23–38. Available at: www.conicyt.cl/fondecyt/files/2012/10/Libro-4-Aspectos-Bio%C3%A9ticos-de-la-Experimentaci%C3%B3n-Animal.pdf (accessed on 27 December 2018).

6. McMillan F.D. (2002). – Development of a mental wellness program for animals. *J. Am. Vet. Med. Assoc.*, **220** (7), 965–972. <https://doi.org/10.2460/javma.2002.220.965>.

7. Bertolini Díaz D.M. (2014). – Evaluación del bienestar animal en perros (*Canis lupus familiaris*) atendidos por el Centro de Salud Veterinaria El Roble y su relación con la calidad de vida de sus responsables. Memoria para optar al Título Profesional de Médico Veterinario [veterinary thesis]. Universidad de Chile, Santiago, Chile, 69 pp. Available at: <http://repositorio.uchile.cl/handle/2250/132608> (accessed on 27 December 2018).

8. International Companion Animal Management Coalition (ICAM) (2007). – Annex A: Tools to assess dog population management needs. Available at: www.icam-coalition.org/download/humane-dog-population-management-guidance/ (accessed on 23 April 2019).

9. World Society for the Protection of Animals (WSPA) (2007). – Surveying roaming dog populations: guidelines on methodology. WSPA, London, United Kingdom, 20 pp. Available at: https://caninerabiesblueprint.org/IMG/pdf/Link65_SurveyingRoamingDogPopulations_WSPA.pdf (accessed on 17 April 2019).

10. Ochoa Y., Falcón N., Zuazo J. & Guevara B. (2014). – Estimación de la población de perros callejeros en el distrito de Los Olivos, Lima, Peru. *Rev. Inv. Vet. Perú*, **25** (3), 366–373. <https://doi.org/10.15381/rivep.v25i3.10114>.

11. Ministry of Health (Chile) (2017). – Ley no. 21020 sobre tenencia responsable de mascotas y animales de compañía. Biblioteca del Congreso Nacional de Chile, Santiago, Chile, 11 pp. Available at:

www.leychile.cl/Navegar?idNorma=1106037 (accessed on 17 April 2019).

12. Ibarra L., Espínola F. & Echeverría M. (2006). – Factores relacionados con la presencia de perros en las calles de la ciudad de Santiago, Chile. *Avances Cienc. Vet.*, **21** (1–2), 21–26. Available at: <https://avancesveterinaria.uchile.cl/index.php/ACV/article/view/1384> (accessed on 27 December 2018).

13. Jackman J. & Rowan A.N. (2007). – Free-roaming dogs in developing countries: the benefits of capture, neuter, and return programs. *In* The state of the animals (D.J. Salem & A.N. Rowan, eds). Humane Society Press, Washington, DC, United States of America, 55–78. Available at: https://animalstudiesrepository.org/sota_2007/10/ (accessed on 27 December 2018).

14. Hsu Y., Severinghaus L.L. & Serpell J.A. (2003). – Dog keeping in Taiwan: its contribution to the problem of free-roaming dogs. *J. Appl. Anim. Welf. Sci.*, **6** (1), 1–23. https://doi.org/10.1207/S15327604JAWS0601_01.

15. Echeverría Lobos M.G. (2004). – Estimación de la población de perros vagabundos y de vecindario en la ciudad de Santiago, región Metropolitana. Memoria para optar al Título Profesional de Médico Veterinario [veterinary thesis]. Universidad de Chile, Santiago, Chile, 54 pp. Available at: <http://repositorio.uchile.cl/handle/2250/130921> (accessed on 27 December 2018).

16. International Companion Animal Management Coalition (ICAM) (2014). – Dog body condition scoring using visual assessment: training set. Available at: https://s3-us-west-2.amazonaws.com/ifaw/ICAM_BCS_Presentation/bcsslider.html (accessed on 27 December 2018).

17. Barnard S., Pedernera C., Velarde A. & Dalla Villa P. (2014). – Welfare assessment protocol for shelter dogs. Shelter quality protocol coordinated by Istituto Zooprofilattico Sperimentale

dell'Abruzzo e del Molise 'G. Caporale', Teramo, Italy, 26–36. Available at: www.izs.it/IZS/Engine/RAServeFile.php/f/pdf_publicazioni/ProtocolloShelterQuality_EN_2016-DEF.pdf (accessed on 27 December 2018).

18. Cendón Panadés M. & Holm A. (2012). – Abandono de animales de compañía. Universidad Autónoma de Barcelona, Barcelona, Spain, 42 pp. Available at: <https://ddd.uab.cat/pub/trerecpro/2011/85680/abaanicom.pdf> (accessed on 27 December 2018).

19. Feldmann B.M. & Carding T.H. (1973). – Free-roaming urban pets. *Health Serv. Rep.*, **88** (10), 956–962. Available at: www.ncbi.nlm.nih.gov/pmc/articles/PMC1616114/ (accessed on 27 December 2018).

20. van Kerkhove W. (2004). – A fresh look at the wolf-pack theory of companion-animal dog social behavior. *J. Appl. Anim. Welf. Sci.*, **7** (4), 279–285. https://doi.org/10.1207/s15327604jaws0704_7.

21. Guerra Llorens Y., Echagarrúa Yera Y., Marín López E., Mencho Ponce J.D., Marín González A., Pascual Wong T., Artze Perón S. & Abad Cambas G. (2007). – Factores que conllevan al abandono de perros en una región de Cuba. *Rev. Electrón. Vet.*, **8** (12), 1–10. Available at: www.veterinaria.org/revistas/redvet/n121207/120704.pdf (accessed on 27 December 2018).

22. Gallegos J.L., Budnik I., Peña A., Canales M., Concha M. & López J. (2014). – Sarna sarcóptica: comunicación de un brote en un grupo familiar y su mascota. *Rev. Chil. Infectol.*, **31** (1), 47–52. <https://doi.org/10.4067/S0716-10182014000100007>.

23. Ibarra L., Espínola F. & Echeverría M. (2006). – Una prospección a la población de perros existente en las calles de la ciudad de Santiago, Chile. *Avances Cienc. Vet.*, **21** (1–2), 33–39. Available at: <https://avancesveterinaria.uchile.cl/index.php/ACV/article/view/3953/3857> (accessed on 27 December 2018).

24. Soto Parraguez A.P. (2013). – Análisis de un problema público no abordado: el caso de los perros vagabundos y callejeros en Chile. Tesis para optar al grado de magister en gestión y políticas públicas [Master's thesis in public policy and management]. Universidad de Chile, Santiago, Chile, 79 pp. Available at: <http://repositorio.uchile.cl/handle/2250/113119> (accessed on 27 December 2018).

25. Bonacic C. & Abarca K. (2014). – Hacia una política y legislación para el control de poblaciones de cánidos y calidad de vida de las personas: un enfoque multidisciplinario. *Temas Agenda Pública*, 9 (65), 14 pp. Available at: <https://politicaspUBLICAS.uc.cl/wp-content/uploads/2015/02/hacia-una-politica-y-legislacion-para-el-control-de-canidos-y-calidad-de-vida-de-las-personas.pdf> (accessed on 8 January 2019).
