



## Canine Research

# Interobserver agreement and sensitivity to climatic conditions in sheltered dogs' welfare evaluation performed with welfare assessment protocol (Shelter Quality protocol)



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## ARTICLE INFO

## Article history:

Received 11 October 2017

Received in revised form

24 August 2018

Accepted 28 September 2018

Available online 7 October 2018

## Keywords:

dog  
animal welfare assessment  
shelter  
protocol  
reliability  
sensitivity

## ABSTRACT

The Shelter Quality protocol (SQP) is a concise and easily implemented tool for assessing dog welfare and to identify critical aspects of the shelter environment. A first version of the protocol has been modified to improve its performance. The aim of this study was to evaluate the reliability of the measures included in the second version of the protocol (SQP2) by testing the interobserver agreement between two independent assessors. We evaluated the sensitivity of animal-based measures in detecting the shelter dogs' welfare outputs during two different seasons. Ten Italian shelters were assessed contemporaneously by two assessors to determine the reliability of SQP2 measures. Interobserver agreement was evaluated using the Cohen's kappa for qualitative variables and Pearson's correlation for quantitative variables. The SQP2 was also applied twice (January and August) by the same observer in five Italian shelters to evaluate the sensitivity of the protocol to seasonal condition changes. The quantitative variables, "Number of animals shivering/huddling" and "Number of animals panting" were analyzed by Wilcoxon test. Credible intervals (95%) were calculated using a beta distribution for qualitative variables: "Body condition", "Skin condition", "Dog cleanliness", "Signs of diarrhea", "Coughing", and "Lameness". The level of agreement between the two observers on the qualitative variables such as body condition, lameness, skin condition, was quite high, ranging from substantial (0.61–0.80) to almost perfect (0.81–0.99). Interobserver agreement was also significant with Pearson correlation coefficients ranging from 0.51 to 0.92 (e.g., curious = 0.74; sociable = 0.83; barking level = 0.61). "Number of animals panting" and "Signs of diarrhea" showed a significant difference between the assessments ( $P < 0.05$ ). The observations of animals with lameness, coughing, and inadequate body condition increased in the winter season, whereas the observations of animals with skin lesions increased during the summer, but not significantly. The behaviors of shivering/huddling were observed too infrequently to be meaningfully analyzed. Consistent interobserver agreement exists in assessing dogs' welfare using the SQP2 confirming the reliability of the measures included in the protocol. The SQP2 shows potential in detecting changes in dogs' welfare outputs due to different climatic conditions. Further investigations are required to confirm the sensitivity of selected measures to different seasons.

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## Introduction

It is widely recognized that the shelter environment negatively affects animal welfare and poses a challenge to most dogs. The main challenges include the unfamiliar housing systems, different daily routines, changes in feeding regimen and type of food, unfamiliar sounds, smells and sights, social deprivation, presence of several unfamiliar animals and humans, and the absence of an attachment

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figure (Moesta et al., 2015; Tynes et al., 2015). Several studies have reported that the stress associated with shelter environment can contribute to onset of behavioral problems, such as stress-related aggression, abnormal or repetitive behaviors, anxiety, and fear-related disorders (Tuber, 1999; Beerda et al., 2000; Hennessy et al., 2001; Hiby et al., 2006; Dalla Villa et al., 2013; Titulaer et al., 2013). However, the behavioral responses of the dogs can vary depending on the stressors (acute or chronic; physiological or psychological) and individual variability (e.g., genetics, age, early life experiences, and the success or failure of previous responses to stress) (Moberg, 2000; Notari, 2009; Moesta et al., 2015). Moreover, the experience of dogs in shelters is of concern, not only in terms of animal welfare, but also for its potential effect on the likelihood of adoption (Diesel et al., 2008; Duffy et al., 2014). In the worst case, dogs remain in the shelters for the remainder of their life or, in the countries where “no-kill” policy is not in force (e.g., USA, UK some regions of Spain), they are euthanized if they are not adopted (Moesta et al., 2015). In Italy, however, euthanizing dogs is forbidden by the law unless they are seriously ill, incurable, or proven dangerous (Ministry of Health, Italy, 1991). The dogs can be hosted in long-stay facilities until the day of the adoption. Improving the welfare of shelter dogs must be considered a primary goal of rehoming centers. One way to improve welfare is to reduce the time dogs spend in the shelter environment. This could be achieved through successful adoptions and a decreased return rate (Posage et al., 1998; Diesel et al., 2008; Luescher and Medlock, 2009; Braun, 2011; Reid and Collins, 2015). The detrimental effects of a shelter environment can be mitigated through providing adequate housing and management which meet the dogs’ ethological needs and ensuring the highest quality of care in the case of long-term sheltering (Miller and Zawistowski, 2015).

The Shelter Quality protocol (SQP) was developed in response to the issues related to long-term sheltering and it fills the existing gap in the assessment of shelter dog welfare. This gap is due, in part, to the lack of and/or variation in regulatory frameworks defining minimum requirements for shelters (Barnard et al., 2016). The SQP was designed to be concise and easy to implement in assessing dog welfare (Barnard et al., 2016). This protocol was inspired by the Welfare Quality® approach. In particular, it was built around the four principles of good feeding, good housing, good health, and appropriate behavior. Each one of these principles is composed of different welfare criteria which in turn include different welfare measures (Welfare Quality®, 2009). Because welfare is the outcome of multifactorial effects, multiple variables need to be considered when applying the protocol (Sherman, 2010; Barnard et al., 2016). For example, the criterion “Absence of prolonged hunger” is composed of welfare measures: “Body condition” and “Feeding”. The latter measure includes “Type of diet”, “Presence of special diets” and “Feeding regime”. The measures were selected to assess specific welfare criteria, reflecting management procedures (management-based measures), housing environment (resource-based measures), and direct welfare outcomes (animal-based measures). The animal-based measures are considered the best indicator of animal welfare because they give a direct reflection on animal welfare state (EFSA, 2012; Kiddie and Collins, 2014). However, in some cases, resource- and management-based measures were maintained because of the valuable information they provide to complement the animal-based measures (Veisser et al., 2011). The SQP provides three different levels of assessment: i) measures taken at shelter level, which encompass all management-based measures; ii) measures taken at pen level (both resource- and animal-based measures) assessed by observing a random sample of pens and all animals confined within; iii) measures taken at the individual level—all animal-based, assessed by observing a subsample of dogs housed in the preselected sample of pens.

The approach of SQP can be considered innovative for companion animal welfare assessment. Although the protocol was validated through field testing, which demonstrated its feasibility and reliability, the SQP was modified in light of subsequent field application and feedback (Barnard et al., 2016). The refined version of the Shelter Quality protocol (SQP2) remained similar in structure to the first version (SQP). The SQP2 was built following the Welfare Quality® principles (4) and criteria (12) (Table 1).

The aim of this study was to assess the reliability of SQP2 measures. This was achieved by testing the interobserver agreement between two assessors who evaluated a sample of ten dog shelter which were long-term confinement shelters. Reliability indicates the reproducibility of measurements; in particular, it is the degree to which a measure is free from errors and will therefore yield the same results when repeated (Taylor and Mills, 2006; Martin and Bateson, 2007; Thanasegaran, 2009). In addition, the SQP2 was tested in five shelters to evaluate the sensitivity of selected animal-based measures in detecting the shelter dogs’ outputs related to seasonal conditions. Sensitivity concerns the ability of a tool (e.g., a protocol) or measurement to detect small but important changes (Martin and Bateson, 2007).

## Materials and methods

### *Shelter quality protocol—second version*

In a previous study by Barnard et al. (2016), the SQP was proven to be a valid, reliable, and practical tool for assessing dog welfare in long-term shelters and for identifying critical aspects and welfare risks in shelter management and environment. To improve the animal welfare measurements and increase the applicability to persons with varying backgrounds (e.g., veterinarians and shelter operators) (Taylor and Mills, 2006; Barnard et al., 2016) the SQP was reviewed and refined using feedback obtained from its dissemination and field application. This resulted in the Shelter Quality Protocol—second version (SQP2). The SQP2 contains 23 welfare measures, which mainly involve animal-based measures as these allow for direct information on the welfare state of animals. The welfare indicators within the protocol were selected to assess the aforementioned principles and criteria identified by Welfare Animal® Consortium (Blokhuys et al., 2010) (Table 1).

The refinements of the SQP included both the elimination and introduction of specific variables to improve tool performance; changes in the level of assessment (i.e., from shelter to pen level or from individual to pen level) to obtain more accurate information and reduce assessment time; and, finally, the modification of the measurement approach to simplify the data collection (e.g., defensive and offensive aggression was merged in a single behavioral category). The refinements are set out in the following in detail.

The variables “Nasal discharge” and “Dyspnea” included in the SQP were eliminated because of the low prevalence (below 1 per cent) of expression resulting from previous on-field assessment of 29 shelters. “Morbidity” was also excluded because of the difficulty in collecting this information and because shelter managers not always are able to provide this information (Barnard et al., 2016).

The level of assessment of “Signs of diarrhea”, “Coughing”, and “Evidence of pain” was altered from the individual level to pen level to obtain a more accurate estimate. The assessor had to record these variables by observing all the animals in the pen instead of taking a sample of selected dogs.

In the SQP2 welfare measures “Barking level” and “Emotional state” were assessed at pen level instead of the shelter level. The assessment of shelter dog emotional state was performed using a qualitative behavioral assessment (QBA). QBA is a method which focuses on the observation of the whole animal and characterizes

**Table 1**  
SQP2 measures associated with welfare principles and criteria

Principle	Welfare criteria	Welfare measure (type)	Submeasures	Unit of assessment
Good feeding	Absence of prolonged hunger	Body condition (ABM) Feeding (MBM)	Feeding regimen Type of diet Special diets	Individual Shelter
	Absence of prolonged thirst	Water supply (RBM)	Type of drinkers Availability of water Cleanliness of water Safety of drinkers	Pen
Good housing	Comfort around resting	Bedding (RBM)	Type of bedding At least one bed/dog Safety of bedding Cleanliness of bedding	Pen
	Thermal comfort	Safety of pen (RBM) Cleanliness of animals (ABM) Thermoregulation (ABM) Shelter from adverse weather condition (RBM) Space allowance (RBM)	Signs of thermal discomfort Shelter from excessive sun; wind; rain Air circulation	Pen Individual Pen
	Ease of movement	Skin condition (ABM)		Pen
Good health	Absence of injuries		Presence of wounds; hair loss areas, swelling areas; evidence of parasites	Individual
	Absence of disease	Lameness (ABM) Evidence of pain (ABM) Signs of diarrhea (ABM) Coughing (ABM) Mortality (MBM)		Individual Pen
	Absence of pain induced by management procedures	Surgeries and control pain (MBM)	Euthanasia for clinical problems; behavioral problem; Deaths (other than euthanasia) Presence of operating procedures for post-surgical monitoring; Presence of hospital pens Presence of protocol of analgesia	Shelter Shelter
	Expression of social behaviors	Social housing (MBM)	Single housing pens Pair housing pens Group housing pens ( $\leq 5$ ) Group housing pens ( $> 5$ )	Shelter
Appropriate behavior	Expression of other behaviors	Abnormal behavior (ABM) Barking (ABM) Exercise (MBM)	Repetitive and compulsive behaviors	Pen Pen Shelter
	Good human-animal relationship	Reaction to human (ABM) Training and rehabilitation (MBM)	Exercise in outdoor areas Walking at leash Presence of training personnel for activities with dogs, and specialized personnel in behavioral rehabilitation	Individual Shelter
	Positive emotional state	Emotional state (ABM)	QBA	Pen

Type of measures defined in brackets: MBM, management-based measure; RBM, resources-based measure; ABM, animal-based measures. Measures were assessed according to different three units of assessment: the shelter (evaluate the shelter as a unit and all the animals within); the pen (evaluate the pen as a unit, taking in to account all of the dogs housed in the pen); and the individual (evaluate each animal as a unit).

and quantifies the animal's dynamic demeanor as an expressive body language using descriptors such as "sociable", "aggressive" or "anxious" etc. (Wemelsfelder, 2000). Arena et al. (2017), through a scientific approach (free-choice-profiling methodology) developed a list of terms specifically focused on shelter dogs' emotional state. This list was included in SQP2.

To obtain information about shelter turnover, the following variables were included: "Number of dogs entered in shelter", "Number of adopted dogs", "Number of dogs returned after adoption", "Number of dogs returned to owner".

To obtain information about the promotion of human-animal relationship in the shelter, the variables "Presence of qualified personnel for dog training" and "Presence of qualified personnel for behavioral rehabilitation" were added. There is evidence that in shelters, basic dog training can help the development of mental activities and constitute the basis for an adequate human-animal bond, which is important for successful adoptions. Similarly, dog behavioral rehabilitation facilitates the human-animal relationship, improves dog welfare, and increases the likelihood of adoption (Taylor and Mills, 2007; Luescher and Medlock, 2009).

The variable "Shelter from adverse weather conditions" (sun, wind, rain) was introduced in the SQP2 to replace the resourced-

based measures "indoor/outdoor area". This addition alleviated issues which arose during the on-field assessment using SQP for the assessment of thermal comfort (criterion "Good housing") due to the different definitions of outdoor/indoor area established by each Italian regional law.

The last refinement of SQP merged defensive and offensive aggression into a single category to assess the reaction of dogs toward unfamiliar people to facilitate the interpretation of dogs' behaviors (Barnard et al., 2016). These refinements are summarized in Table 2.

Before the on-field application, the two assessors were familiarized with SQP2 through teaching materials (videos and photos).

#### Interobserver agreement assessment

An interobserver agreement was performed to assess the reliability of the protocol measures after refinement (SQP2). Ten Italian long-term shelters were evaluated by two different assessors simultaneously and independently. The two assessors were female, aged between 30 and 40 years, both veterinarians with specialization in applied ethology and animal welfare. Both assessors had previous experience working with dogs and were made familiar with the SQP2

**Table 2**  
Refinements of SQP performed to develop the SQP2

Variable	SQP	SQP2
Nasal discharge	At individual level	Eliminated
Dyspnea	At individual level	Eliminated
Morbidity	At shelter level	Eliminated
Signs of diarrhea	At individual level	At pen level
Coughing	At individual level	At pen level
Evidence of pain	At individual level	At pen level
Barking level	At shelter level	At pen level
Emotional state	At shelter level	At pen level. The adjectives' list was also refined
Number of dogs entered in shelter	-	Added
Number of adopted dogs	-	Added
Number of dogs returned to owner	-	Added
Number of dogs returned after adoption	-	Added
Presence of qualified personnel for dog training	-	Added
Presence of qualified personnel for behavioral rehabilitation	-	Added
Thermal comfort (good housing)	Indoor/outdoor area	Shelter from adverse weather conditions" (sun, wind, rain)
Defensive and offensive aggression	Considered as two separate categories	Considered as a unique category

by training in field and by video and photo support. Shelters were selected on the basis of the following inclusion criteria: long-stay facility and manager availability to take part in the study. The shelters were located in four regions of North and Central Italy: Trentino (1), Veneto (2), Emilia Romagna (6), and Marche (1). The assessment was carried out according to the methodological procedures described in the SQP2 (Shelter Quality protocol, 2017).

The dogs were assessed while housed in their home pen. The pens were selected using a shelter map and on the basis of the number of dogs housed in each pen (taking sample size into account). The sample size depended on the total number of dogs housed in the shelter at the time of visit (Table 3). The selected pens covered the different facilities. The sample of animals assessed at individual level only included dogs over 6 months of age and those who had been housed in the shelter for 2 months or more. A maximum of three dogs per pen were assessed at individual level. The shelter assessment was carried out in a single day.

As previously underlined, the measures were taken according to 3 scoring levels: shelter level (the shelter was evaluated as a unit), pen level (each selected pen was evaluated as a unit and all animals confined were observed irrespective of the total number of animals), and at the individual level (each selected animal was evaluated as a unit). Except the management section (measures at shelter level) that consisted of an interview with the shelter manager, the whole assessment was carried out independently by the two assessors.

The assessment was carried out first at the pen level. The assessor stood in front of the pen, 2 meters from the fence and without interacting with animals (unless this was required by the protocol, e.g., short test to assess reaction toward human), recording the measures at pen level. The individual animal-based measures were then recorded. Among these measures, a short behavioral test was carried out to assess the dogs' reactions toward unfamiliar people. The test was divided in two steps to record the dogs' reaction. First, the assessor approached the fence, standing in front of the pen and ignored the dog for 30 seconds. Second, the assessor crouched talking gently to the dog for 30 seconds. Finally,

**Table 3**  
Sample size

Total number of housed dogs	Number of dogs to assess
Up to 29	All dogs
30–59	30
60–89	40
90–139	50
140 over	60

The sampling includes only dogs over 6 months of age and that have been in shelter for 2 months.

the assessor recorded the emotional state of dogs in the pen by filling in the Emotional State Profile sheet.

After assessing the first pen, the assessor moved on to the next one, following the same procedure. The assessment ended when the last pen was assessed (Shelter Quality, 2017).

Interobserver agreement was evaluated using the Cohen's kappa for qualitative variables; these variables were all categorical. The Pearson' correlation was used for quantitative variables which were discrete and continuous. Level of significance was set, respectively, at  $\alpha \leq 0.0020$  and  $\alpha \leq 0.0025$ , after applying the Bonferroni correction. For all analyses, z scores and P values were also computed to indicate whether agreement was more than that could be expected by chance alone (Cohen, 1968). Table 4 summarizes the different variables with their score system.

#### Seasonal sensitivity protocol assessment

To better define the sensitivity of SQP2 to seasonal changes, five Italian long-term shelters were assessed during winter and summer.

The SQP2 was applied twice (January and August) by the same assessor in five selected shelters located in three regions of Central Italy: Marche (1), Abruzzi (3), and Molise (1). Shelter inclusion criteria were the same as those used for the interobserver agreement assessment. The assessments were carried out following the same procedure described previously. During the assessments, temperature and humidity were recorded.

A random selection of dogs was used for each assessment because the shelter population and the location of dogs in their pens could change in time. This sampling approach reduced possible bias in the results by limiting the likelihood that the assessor could remember the scoring of the dogs recorded during the first assessment (Barnard et al., 2016).

Because animal welfare may be affected differently between seasons, eight variables potentially sensitive to changes in seasonal conditions were included in the analysis. These measures were selected because animal-based measures can give direct information on dogs' output. They were assessed according to the SQP2.

The variables selected were either quantitative—that is, "Number of animals shivering/huddling", "Number of animals panting"—or qualitative—that is, "Body condition", "Skin condition", "Dog cleanliness", "Signs of diarrhea", "Coughing", and "Lameness". The quantitative variables were analyzed by Wilcoxon test. Credible intervals (CI) (95%) were calculated using a beta distribution for qualitative variables.

The authors hypothesized that the likelihood of observing animals panting, with diarrhea, or with skin lesions, would increase

**Table 4**  
Scoring system of quantitative and qualitative variables

Quantitative variables	Type	Score	Qualitative variables	Type	Score
Aggressive	CV	VAS from 0 to 125 mm	Active-repetitive behaviors	CatV	Y-N
Alert	CV	VAS from 0 to 125 mm	Adequacy of pen area	CatV	Y-N
Anxious	CV	VAS from 0 to 125 mm	Age classes	CatV	Y-N
Barking level	CV	VAS from 0 to 125 mm	Air circulation	CatV	Y-N
Comfortable	CV	VAS from 0 to 125 mm	Body Condition	CatV	Adequate Too thin Too fat
Curious	CV	VAS from 0 to 125 mm	Clean water	CatV	Y-N
Depressed	CV	VAS from 0 to 125 mm	Cleanliness	CatV	Y-N
	CV		Coughing	CatV	Y-N
Excited	CV	VAS from 0 to 125 mm	Dry/clean bedding	CatV	Y-N
			Evidence of pain	CatV	Y-N
Fearful	CV	VAS from 0 to 125 mm	Fear/aggression test	CatV	Sociable Only fear Offensive/defensive aggression
Hesitant	CV	VAS from 0 to 125 mm	Lameness	CatV	Y-N
Playful	CV	VAS from 0 to 125 mm	One bedding/dog	CatV	Y-N
Relaxed	CV	VAS from 0 to 125 mm	Safe bedding	CatV	Y-N
Nervous	CV	VAS from 0 to 125 mm	Sharp edges	CatV	Y-N
Sociable	CV	VAS from 0 to 125 mm	Shelter from adverse weather conditions (sun, wind, rain)	CatV	Y-N
Number of animals > 20 Kg	DV	Ordinal number	Signs of diarrhea	CatV	Y-N
Number of animals ≤ 20 Kg	DV	Ordinal number	Skin condition	CatV	Y-N
Number of animals shivering/huddling	DV	Ordinal number	Type of bedding	CatV	Y-N
Number of animal painting	DV	Ordinal number	Type of drinkers	CatV	Y-N

CV, continue variable; DV, discrete variable; CatV, categorical variable; VAS, visual analog scale; Y-N, yes-no.

during summer season, whereas the likelihood of observing animals shivering/huddling, coughing, with inadequate body condition, with lameness, and with dirty coat would increase in the winter season. Statistical analyses were carried out using R V.2.15.3.

## Results

### Interobserver agreement

For the interobserver agreement study, 222 pens and 710 dogs, living in the same pens, were assessed over a population of 847 dogs hosted in 406 pens. A subsample of 365 dogs was selected.

After analyzing the qualitative variables, the Cohen's kappa analysis showed a high level of agreement between the two observers, ranging from substantial (0.61–0.80) to almost perfect (0.81–0.99) for most variables. As could be expected, perfect agreement was obtained for the variable of “Type of drinkers” ( $k = 1$ ). The measures of “Shelter

from rain” ( $k = 0.89$ ), “Age class” ( $k = 0.89$ ), “Shelter from strong wind” ( $k = 0.88$ ), “Skin condition” ( $k = 0.84$ ), and “Lameness” ( $k = 0.82$ ) obtained an almost perfect agreement. On the contrary, the variable “Active repetitive behaviors” showed a fair agreement ( $k = 0.30$ ). It was not possible to calculate the correlation for the variables of “Other compulsive behaviors”, “Air circulation”, “Shelter from excessive sun”, “Evidence of pain”, and “Coughing” because of the lack of variability in the data (Table 5).

Analyzing the quantitative variables, the agreement among the two assessors was also significant with Pearson correlation coefficients ranging from 0.51 to 0.92. In particular, the number of animals subdivided into two categories (“N° of animals ≤ 20 kg”: 0.92; “N° of animals > 20 kg”: 0.91) obtained high agreement (Table 5).

Level of agreement between the two assessors on the most QBA adjectives (9/13) was ranging from substantial (0.61–0.80) to almost perfect (0.81–0.99), whereas the agreement of remaining adjectives (4/12) was scored as fair (ranging from 0.41 to 0.60). The

**Table 5**  
Interobserver agreement

Quantitative variables	Pearson' correlation Cor.P	Qualitative variables	Cohen's kappa K
Aggressive	0.72 <sup>a</sup>	Active-repetitive behaviors	0.30 <sup>a</sup>
Alert	0.60 <sup>a</sup>	Adequacy of pen area	0.85 <sup>a</sup>
Anxious	0.60 <sup>a</sup>	Age classes	0.89 <sup>a</sup>
Barking level	0.61 <sup>a</sup>	Body condition	0.83 <sup>a</sup>
Comfortable	0.74 <sup>a</sup>	Clean water	0.66 <sup>a</sup>
Curious	0.74 <sup>a</sup>	Cleanliness	0.70 <sup>a</sup>
Depressed	0.51 <sup>a</sup>	Dry/clean bedding	0.60 <sup>a</sup>
Excited	0.65 <sup>a</sup>	Fear/aggression test	0.83 <sup>a</sup>
Fearful	0.83 <sup>a</sup>	Lameness	0.82 <sup>a</sup>
Hesitant	0.60 <sup>a</sup>	One bedding/dog	0.65 <sup>a</sup>
Playful	0.70 <sup>a</sup>	Safe bedding	0.64 <sup>a</sup>
Relaxed	0.74 <sup>a</sup>	Sharp edges	0.72 <sup>a</sup>
Nervous	0.67 <sup>a</sup>	Shelter from rain	0.89 <sup>a</sup>
Sociable	0.84 <sup>a</sup>	Shelter from strong wind	0.88 <sup>a</sup>
Number of animals > 20 Kg	0.91 <sup>a</sup>	Signs of diarrhea	0.77 <sup>a</sup>
Number of animals ≤ 20 Kg	0.92 <sup>a</sup>	Skin condition	0.84 <sup>a</sup>
Number of animals shivering/huddling	1.00 <sup>a</sup>	Type of bedding	0.77 <sup>a</sup>
		Type of drinkers	1.00 <sup>a</sup>

<sup>a</sup> z-score,  $P < 0.001$ . Level of agreement in according to Landis and Kock (1977): 0.00, less than chance agreement; 0.01–0.20 slight agreement; 0.21–0.40 fair agreement; 0.41–0.60 moderate agreement; 0.61–0.80 substantial agreement; 0.81–0.99 almost perfect agreement; 1.00 perfect agreement.

variables “N° of animals shivering/huddling” achieved the perfect agreement. For the variable “N° of animals panting”, the correlation analysis could not be carried out due to the high homogeneity of the data. All results are summarized in Table 5. All *P* values were significant ( $P < 0.001$ ).

#### Seasonal sensitivity protocol assessment

For the climatic sensitivity protocol assessment, 244 pens and 612 dogs (304 in summer and 308 in winter), living in the same pens, were assessed over a mean population of 935 dogs hosted in 398 pens. A subsample of 505 dogs was selected (254 in summer; 251 in winter). The recorded temperature and humidity during the different assessments are summarized in Table 6.

In summer, 20% (60/304) of dogs showed panting whereas no dogs showed this behavior in winter (0/308). Number of animals panting significantly increased during the summer compared with winter season (Wilcoxon,  $P = 0.0001$ ). In winter, only 1% (3/308) of dogs showed shivering/huddling. No dogs showed this behavior in the summer (0/304). The behaviors of shivering/huddling were observed too infrequently to be meaningfully analyzed.

The beta distribution showed that the observation of “Signs of diarrhea” was statistically significant in summer season (summer: percentage of observations = 21.4%, CI: 0.15–0.29; winter: percentage of observations 7.6%, CI: 0.04–0.13). Although no statistically significant differences were detected, “Body condition” (summer: percentage of observations = 9.2%, CI: 0.06–0.13; winter: percentage of observations 12.4%, CI: 0.09–0.17), “Coughing” (summer: percentage of observations = 0.8%, CI: 0.002–0.048; winter: percentage of observations 3.2%, CI: 0.01–0.07), “Skin condition” (summer: percentage of observations = 8.3%, CI: 0.05–0.12; winter: percentage of observations 7.3%, CI: 0.04–0.11), and “Lameness” (summer: percentage of observations = 2.4%, CI: 0.01–0.05; winter: percentage of observations 4.1%, CI: 0.02–0.07) seemed to support the hypothesis of the authors showing results in the expected direction. The observations of animals with lameness, coughing, and inadequate body condition increased in the winter, whereas the observations of animals with skin lesions increased during the summer. “Dog cleanliness” (summer: percentage of observations = 16.7%, CI: 0.12–0.22; winter: percentage of observations 12.9%, CI: 0.09–0.17) did not show statistical significance difference between the two assessments, and the result was opposite to the expected direction.

#### Discussion

SQP was considered an innovative approach to companion animal welfare assessment, particularly for long-term shelter dogs. Its validity, reliability, and feasibility were proven with a previous study by Barnard et al. (2016). Since the feedback obtained from its application on field and its dissemination, a refinement of the protocol aimed to improve its performance in assessing dogs' welfare. The modifications made in SQP permitted the development of the second version of the protocol (SQP2).

**Table 6**  
Temperature recorded during the assessments

Shelter region	Winter		Summer	
	Temperature	Humidity	Temperature	Humidity
Abruzzi <sup>a</sup>	9°C	74%	24°C	61%
Marche	9°C	76%	27°C	42%
Molise	10°C	70%	28°C	50%

<sup>a</sup> For Abruzzi the average of winter and summer temperatures and humidity were calculated over the three shelters' assessments.

The consistent level of agreement obtained between two assessors evaluating a sample of ten shelters highlighted that the changes made on SQP did not affect the tool performance and confirmed the reliability of measures in the canine welfare assessment. Moreover, because the stressors may differ between seasons, the climatic sensitivity of some animal-based measures suggested the potential usefulness of the SQP2 in assessing changes in dogs' welfare outputs.

On the basis of the results, some considerations of the SQP2 can be made. In particular, the variable “Signs of diarrhea”, that in SQP2 is assessed at pen level instead of individual level, showed substantial agreement and therefore allowed the assessment to be simplified. When group housed, recording signs of diarrhea by considering individual animals does not allow to gain a proper estimate because the presence of diarrhea cannot be associated with an individual dog. The presence of liquid manure in group housing pens allows the detection of animals with potential clinical problems (e.g., enteric disorders) and, consequently, the identification of which individual is affected. This observation allows team member to carry out clinical examinations and treatment (Sokolow et al., 2005; Newbury et al., 2010). This animal-based measure was also significantly sensitive to climatic changes. In this study, the prevalence of diarrhea was found to be higher in the summer; this could depend on the seasonality of gastrointestinal diseases such as intestinal parasites (McCarthy and Moore, 2000; Fontanarrosa et al., 2006).

Although the other animal-based measures which were analyzed did not show statistical significance in the seasonal comparison, results were consistent with the hypothesis of the authors. Outbreaks of coughing and lameness may be increased by cold temperatures and high humidity. On the other hand, the favorable environmental condition because of summer conditions can facilitate ectoparasites' presence which, in turn, could cause the outbreak of skin problems in animals (Altizer et al., 2006). To better understand the seasonality of clinical conditions in shelter's dogs, further investigations are required.

Issues highlighted through the previous application and dissemination of SQP included the challenges in assessing pen adequacy when both indoor and outdoor areas were present. The Italian national framework law 281/1991 on companion animals and stray dog prevention does not provide standards for the managing and keeping of dogs in shelters. Instead, this is defined at regional level, therefore, generating high variability in shelters nationally. Assessing such different housing conditions was therefore challenging. This aspect was addressed in SQP2 by modifying the assessment of the housing adequacy to encompass the ability of the shelters to house dogs from adverse weather conditions. After this refinement, no difficulties were reported during the on-field application of SQP2, as demonstrated by the high level of agreement.

Moreover, maintenance of body temperature is essential for positive animal welfare. Therefore, each dog housed in the shelter must be provided with adequate thermal comfort at all times of year. Seasonal variation in conditions, such as low or high temperatures, may increase stress (Miller and Zawistoski, 2015). The SQP2 allows the assessment of changes in dog welfare due to these different seasonal conditions. In particular, the measure “Number of animals panting” was proved to be sensitive to seasonal changes, increasing during hot seasons. By contrast, the relevance of the measure “Number of animals shivering/huddling” remains still unexplored due to the low prevalence of animals showing these behaviors during the cold season. Further research should include a higher number of individuals to be assessed in winter to confirm its relevance in canine welfare assessment.

Panting as well as shivering and huddling with penmates are physiological responses shown by dogs to cope with extreme

temperatures and can be considered an indication of thermal discomfort. For this reason, the presence of animals showing these behaviors can highlight inadequate housing and/or management which should be corrected accordingly (Rooney et al., 2009). Although animal age, breed, and overall health status can affect an animal's tolerance of temperature, generally the range from 20°C (68°F) to 30°C (86°F) of environmental temperature is considered the “thermoneutral zone”. In this range, the dog is able to maintain normal body temperature without a change in metabolic rate (National Research Council, 2006). United States Department of Agriculture (2013) suggested that the indoor facilities' temperatures must never fall below 7.2°C (45°F) or rise above 29.5°C (85°F) for more than 4 consecutive hours.

The consistent agreement obtained in scoring QBA descriptors (anxious, relaxed, aggressive, playful etcetera) at pen level confirms that the fixed list of terms included in SQP2 allows a reliable assessment of dogs' emotional experience in a shelter environment (Walker et al., 2016; Arena et al., 2017).

To have good welfare, shelter dogs, such as all domesticated animals, should experience more positive (e.g., pleasure, happiness) than negative (e.g., fear, pain) emotions (Boissy et al., 2007).

The richness of the qualitative terms used gives to the assessment the power to address dynamic aspects of welfare including subtle important differentiations, such as between “relaxation” and “depression” or between positive and negative excitement (“excited” vs. “nervous”). From a whole-animal welfare perspective, the aim is to capture larger patterns of expression and their context through a large range of terms. However, it has been demonstrated that training significantly improves interobserver agreement levels ensuring both the interpretation of terms and the use of the QBA scale (Minero et al., 2015).

“Barking level” obtained a moderate agreement. Excessive vocalization may be a sign of frustration, distress, or boredom (Rooney et al., 2009). The presence of subjects who vocalize excessively might also have a detrimental impact on the other dogs housed in the pen (Petak, 2013). Moreover, high noise levels in dog shelters may cause hearing damage and public disturbance (Beelsey and Mills, 2010). For this reason, assessing barking level could indicate that acoustic safety and noise mitigation strategies are required. Such strategies may include removing the subject from the group, controlling visitors' access in the pens' area, or building noise abatement facilities (Coppola et al., 2006; Scheifele et al., 2012).

The only measure which showed a low level of agreement was “Active-repetitive behaviors”. In the scientific community, there is controversy about the definition and the meaning of this behavioral category. The terms “repetitive behaviors” and “stereotypies” are often used interchangeably. Stereotypies are defined as repetitive and unvarying behaviors without apparent goal or function (Mason and Latham, 2004). Some studies interpret repetitive behaviors in sheltered dogs as indicators of compromised welfare, which may be related to stress and frustration or to confinement environments (Hetts et al., 1992; Beerda et al., 1999; Beerda et al., 2000). Their presence is usually observed in association with suboptimal environmental conditions (Denham et al., 2014; Mason, 1991), although this also depends on individual variability (Denham et al., 2014; Overall, 2013). Mason and Latham (2004) underline that repetitive behaviors can be an individuals' strategy to cope with stress and can be correlated with good or neutral welfare. The current results from the measure “Active-repetitive behaviors” highlighted these problems with interpreting the occurrence of these behaviors. Improving the accuracy of the definitions used in the protocol could improve the reliability of this measurement. The reliability of the recording may be influenced by the clarity of definition of behavioral category or measurement (Kiddie and Collins, 2014). For

each possible repetitive behavior shown by sheltered dogs, it could be useful to specify, in addition to the definition of the behaviors, a threshold or the duration of repetition as indicated in other studies. For example, pacing: dog repeatedly (>3) paces around the pen in a fixed routine; wall bouncing: dog repeatedly (>3) jumps up the pen wall from side to side; tail-chasing: dog chases tail (>3) for reasons other than discomfort or grooming; chewing bars: dog repeatedly chews and bites at the wire of the pen (>20 sec) (Hetts et al., 1992; Hubrecht et al., 1992; Beerda et al., 1999; Stephen and Ledger, 2005). The complex relationship between animal welfare and repetitive behaviors suggests that while these behaviors can be used as an indication of suboptimal welfare, they should never be used as the only measure of welfare (Mason and Latham, 2004).

## Conclusion

The lack of uniformity in regulatory frameworks defining minimum requirements of shelters has hindered the development of a specific tool to assess dog welfare in long-term shelters. The SQP was created responding to this need, and its validity, reliability, and feasibility were proven (Barnard et al., 2016). This protocol has been the first tool which can be easily applied by people from different professions (veterinarians, competent authority, shelter manager, etc) and it identifies critical areas requiring intervention.

The feedback obtained from its dissemination and application necessitated the improvement of the tool by developing a second version of the protocol (SQP2). The changes made in the protocol did not modify its applicability or the reliability of the measures included. The good level of agreement obtained in this study confirmed that SQP2 remains a useful tool for welfare assessment of dogs housed in long-term shelters with broad areas of application (i.e., rank dogs' rescue and commercial or breeding facilities according to the level of welfare they are providing). The SQP2 showed its potential in detecting the impact of seasonal conditions on animal welfare. Particularly, some measures included in the SQP2 such as “Presence of diarrhea” and “Number of animals panting” showed their sensitivity in assessing changes in dog welfare due to different seasonal conditions. Further investigations are required to confirm the utility of “Number of animals shivering/huddling”. Although, “Lameness”, “Coughing”, and “Skin condition” showed results in the expected direction but not significantly. These measures also require further research, for example, including a larger sample size to explore more extensively their sensitivity to different seasons.

## Acknowledgments

The authors wish to thank all shelters' staff involved for their participation and cooperation in this research and for their enthusiasm. A special thanks to Dr. Lauren Smith and Dr. Helen Gray for their English revision. Finally, the authors are grateful to the anonymous reviewer for his/her constructive comments and suggestions. This study was a part of a project financially supported by The Italian Minister of Health, grant Ricerca Corrente (IZSAM 04/13 RC).

Authors' contributions: All authors conceived and designed the study. Berteselli and Arena, refined the protocol (SQP), recruited the shelters, applied the SQP2 on-field in the selected shelters, collected the data, and drafted the article. Candeloro performed the data analysis and advised on the study design, and collaborated for the interpretation of the results. Dalla Villa was the responsible of operative unit for animal welfare assessment and the supervisor of on-field activities. He also revised and approved the final article. De Massis was the supervisor on the entire project.

## Conflict of interest

The authors declare that there are no known conflicts of interest associated with this publication and the financial support for this project did not influence its outcomes.

## References

- Altizer, S., Dobson, A., Hosseini, P., Hudson, P., Pascual, M., Rohani, P., 2006. Seasonality and the dynamics of infectious diseases. *Ecol. Letters* 9 (4), 467–484.
- Arena, L., Wemelsfelder, F., Messori, S., Ferri, N., Barnard, S., 2017. Application of Free Choice Profiling to assess the emotional state of dogs housed in shelter environments. *Appl. Anim. Behav. Sci.* 195, 72–79.
- Barnard, S., Pedernera, C., Candeloro, L., Ferri, N., Velarde, A., Dalla Villa, P., 2016. Development of a new welfare assessment protocol for practical application in long-term dog shelters. *Vet. Rec.* 178 (1), 1–8.
- Beerda, B., Schilder, M.B., Van Hooff, J.A., De Vries, H.W., Mol, J.A., 1999. Chronic stress in dogs subjected to social and spatial restriction. I. Behavioral responses. *Physiol. Behav.* 66 (2), 233–242.
- Beerda, B., Schilder, M.B., Van Hooff, J.A., De Vries, H.W., Mol, J.A., 2000. Behavioural and hormonal indicators of enduring environmental stress in dogs. *Anim. Welf.* 9 (1), 49–62.
- Beesley, C.H., Mills, D.S., 2010. Effect of kennel door design on vocalization in dogs. *J. Vet. Behav.: Clin. Appl. Res.* 5 (1), 60–61.
- Blokhuis, H.J., Veissier, I., Miele, M., Jones, R.B., 2010. The Welfare Quality project and beyond: safeguarding farm animal well-being. *Acta Agric. Scand. A Anim. Sci.* 6, 129–140.
- Boissy, A., Manteuffel, G., Jensen, M.B., Oppermann Moe, R., Spruijt, B., Keeling, L.J., Winckler, C., Forkman, B., Dimitrov, I., Langbein, J., Bakken, M., Veissier, I., Aubert, A., 2007. Assessment of positive emotions in animals to improve their welfare. *Physiol. Behav.* 92, 375–397.
- Braun, G., 2011. Taking a shelter dog for walks as an important step in the resocialization process. *J. Vet. Behav.: Clin. Appl. Res.* 6 (1), 100.
- Cohen, J., 1968. Weighted kappa: nominal scale agreement with provision for scaled disagreement or partial credit. *Psychol. Bull.* 70, 213–220.
- Coppola, C.L., Enns, R.M., Grandin, T., 2006. Noise in the animal shelter environment: building design and the effects of daily noise exposure. *J. Appl. Anim. Welf. Sci.* 9 (1), 1–7.
- Dalla Villa, P., Barnard, S., Di Fede, E., Podaliri, M., Candeloro, L., Di Nardo, A., Podaliri-Vulpiani, M., Siracusa, C., Serpell, J.A., 2013. Behavioural and physiological responses of shelter dogs to long-term confinement. *Vet. Ital.* 49 (2), 231–241.
- Denham, H.D., Bradshaw, J.W., Rooney, N.J., 2014. Repetitive behaviour in kennelled domestic dog: stereotypical or not? *Physiol. Behav.* 128, 288–294.
- Diesel, G., Pfeiffer, D.U., Brodbelt, D., 2008. Factors affecting the success of rehoming dogs in the UK during 2005. *Prev. Vet. Med.* 84 (3), 228–241.
- Duffy, D.L., Kruger, K.A., Serpell, J.A., 2014. Evaluation of a behavioral assessment tool for dogs relinquished to shelters. *Prev. Vet. Med.* 117 (3–4), 601–609.
- EFSA Panel on Animal Health and Welfare (AHAW), 2012. 2010 Statement on the use of animal-based measures to assess the welfare of animals. *EFSA Journal* 10 (6), 2767–2795.
- Fontanarrosa, M.F., Vezzani, D., Basabe, J., Eiras, D.F., 2006. An epidemiological study of gastrointestinal parasites of dogs from Southern Greater Buenos Aires (Argentina): age, gender, breed, mixed infections, and seasonal and spatial patterns. *Vet. Parasitol.* 136 (3), 283–295.
- Hennessy, M.B., Voith, V.L., Mazzei, S.J., Buttram, J., Miller, D.D., Linden, F., 2001. Behavior and cortisol levels of dogs in a public animal shelter, and an exploration of the ability of these measures to predict problem behavior after adoption. *Appl. Anim. Behav. Sci.* 73 (3), 217–233.
- Hetts, S., Clark, J.D., Calpin, J.P., Arnold, C.E., Mateo, J.M., 1992. Influence of housing conditions on beagle behaviour. *Appl. Anim. Behav. Sci.* 34 (1–2), 137–155.
- Hiiby, E.F., Rooney, N.J., Bradshaw, J.W.S., 2006. Behavioural and physiological responses of dogs entering re-homing kennels. *Physiol. Behav.* 89, 385–391.
- Hubrecht, R.C., Serpell, J.A., Poole, T.B., 1992. Correlates of pen size and housing conditions on the behaviour of kennelled dogs. *Appl. Anim. Behav. Sci.* 34 (4), 365–383.
- Kiddie, J.L., Collins, L.M., 2014. Development and validation of a quality of life assessment tool for use in kennelled dogs (*Canis familiaris*). *Appl. Anim. Behav. Sci.* 158, 57–68.
- Landis, J.R., Koch, G.G., 1977. The measurement of observer agreement for categorical data. *Biometrics* 33, 159–174.
- Luescher, A.U., Medlock, R.T., 2009. The effects of training and environmental alterations on adoption success of shelter dogs. *Appl. Anim. Behav. Sci.* 117 (1), 63–68.
- Martin, P., Bateson, P., 2007. Measuring behavior: an introductory guide. Cambridge University Press, Cambridge, UK.
- Mason, G.J., 1991. Stereotypies and suffering. *Behav. Process.* 25 (2–3), 103–115.
- Mason, G.J., Latham, N., 2004. Can't stop, won't stop: is stereotypy a reliable animal welfare indicator? *Anim. Welfare* 13, S 57–S 59.
- McCarthy, J., Moore, T.A., 2000. Emerging helminth zoonoses. *Int. J. Parasitol.* 30, 1351–1360.
- Miller, L., Zawistowski, S., 2015. Housing, husbandry, and behavior of dogs in animal shelters. In: Miller, L., Zawistowski, S. (Eds.), *Animal Behavior for Shelter Veterinarians and Staff*, pp. 145–159.
- Minero, M., Dalla Costa, E., Dai, F., Murray, L.A.M., Canali, E., Wemelsfelder, F., 2015. Use of Qualitative Behaviour Assessment as an indicator of welfare in donkeys. *Appl. Anim. Behav. Sci.* 174, 147–153.
- Ministry of Health, Italy, 1991. Legge Quadro in materia d'affezione e prevenzione al randagismo. *Off. J.* 203, 30.08.1991.
- Moberg, G.P., 2000. Biological response to stress: implications for animal welfare. In: Moberg, G.M., Mench, J.A. (Eds.), *The Biology of Animal Stress: Basic Principles and Implications for Animal Welfare*. CABI Publishing, Wallingford, pp. 1–21.
- Moesta, A., McCune, S., Deacon, L., Kruger, K.A., 2015. Canine enrichment. In: Miller, L., Zawistowski, S. (Eds.), *Animal Behavior for Shelter Veterinarians and Staff*. Wiley-Blackwell, Chichester, UK, pp. 160–171.
- National Research Council (U.S.), 2006. Ad hoc Committee on Dog and Cat Nutrition. Nutrient requirements of dogs and cats. Academic Press, Washington, DC, USA.
- Newbury, S., Blinn, M.K., Bushby, P.A., Cox, C.B., Dinnage, J.D., Griffin, B., O'Quin, J., 2010. Guidelines for Standards of Care in Animal Shelters. The Association of Shelter Veterinarians, Corning, New York, USA, pp. 1–45.
- Notari, L., 2009. Stress in veterinary behavioural medicine. In: Horwitz, D.F., Mills, D.B.S.A.V.A. (Eds.), *Manual of Canine and Feline Behavioural Medicine*. British Small Animal Veterinary Association Publications, Gloucester, pp. 136–145.
- Overall, K.L., 2013. Abnormal canine behaviours and behavioral pathologies involving aggression. In: Overall, K.L. (Ed.), *Manual of clinical behavioral medicine for dogs and cats*. Elsevier, St Louis, MO, pp. 172–230.
- Petak, I., 2013. Communication patterns within a group of shelter dogs and implications for their welfare. *J. Appl. Anim. Welf. Sci.* 16 (2), 118–139.
- Posage, J.M., Bartlett, P.C., Thomas, D.K., 1998. Determining factors for successful adoption of dogs from an animal shelter. *J. Am. Vet. Med. Assoc.* 213, 478–482.
- Reid, P.J., Collins, K., 2015. Training and behavior modification for the shelter. In: Miller, L., Zawistowski, S. (Eds.), *Animal Behavior for Shelter Veterinarians and Staff*. Wiley-Blackwell, Chichester, UK, pp. 172–187.
- Rooney, N., Gaines, S., Hiby, E., 2009. A practitioner's guide to working dog welfare. *J. Vet. Behav.: Clin. Appl. Res.* 4 (3), 127–134.
- Scheifele, P., Martin, D., Clark, J.G., Kemper, D., Wells, J., 2012. Effect of kennel noise on hearing in dogs. *Am. J. Vet. Res.* 73 (4), 482–489.
- Shelter Quality Protocol, 2017. [http://www.izs.it/IZS/Engine/RAServeFile.php/f/pdf\\_publicazioni/ProtocolloShelterQuality\\_EN\\_rev24102017.pdf](http://www.izs.it/IZS/Engine/RAServeFile.php/f/pdf_publicazioni/ProtocolloShelterQuality_EN_rev24102017.pdf).
- Sherman, B.L., 2010. Pets: behaviour and welfare assessment. In: Breed, M., Moore, J. (Eds.), *Encyclopedia of Animal Behaviour*. Academic Press, Oxford, pp. 691–698.
- Sokolow, S.H., Rand, C., Marks, S.L., Drzenovich, N.L., Kather, E.J., Foley, J.E., 2005. Epidemiological evaluation of diarrhea in dogs in an animal shelter. *Am. J. Vet. Res.* 66 (6), 1018–1024.
- Stephen, J.M., Ledger, R.A., 2005. An audit of behavioral indicators of poor welfare in kennelled dogs in the United Kingdom. *J. Appl. Anim. Welf. Sci.* 8 (2), 79–95.
- Taylor, K.D., Mills, D.S., 2006. The development and assessment of temperament tests for adult companion dogs. *J. Vet. Behav.: Clin. Appl. Res.* 1 (3), 94–108.
- Taylor, K.D., Mills, D.S., 2007. The effect of the kennel environment on canine welfare: a critical review of experimental studies. *Anim. Welf.* 16 (4), 435–447.
- Thanasegaran, C., 2009. Reliability and Validity Issues in Research. *Integration & Dissemination* 4, 35–40.
- Titulaer, M., Blackwell, E.J., Mendl, M., Casey, R.A., 2013. Cross sectional study comparing behavioural, cognitive and physiological indicators of welfare between short and long term kennelled domestic dogs. *Appl. Anim. Behav. Sci.* 147 (1–2), 149–158.
- Tuber, D.S., Miller, D.D., Caris, K.A., Halter, R., Linden, F., Hennessy, M.B., 1999. Dogs in animal shelters: problems, suggestions, and needed expertise. *Psychol. Sci.* 10 (5), 379–386.
- Tynes, V.V., Sinn, L., Koch, C.S., 2015. The relationship between physiology and behavior in dogs and cats. In: Miller, L., Zawistowski, S. (Eds.), *Animal Behavior for Shelter Veterinarians and Staff*. Wiley-Blackwell, Chichester, UK, pp. 63–101.
- United States Department of Agriculture, 2013. *Animal Welfare Act. Animal and Plant Health Inspection Service, Title 7, Chapter 54. Transportation, sale, and handling of certain animals*, pp. 1–34. Available at: [https://www.aphis.usda.gov/animal\\_welfare/downloads/awa/awa.pdf](https://www.aphis.usda.gov/animal_welfare/downloads/awa/awa.pdf).
- Veissier, I., Jensen, K.K., Botrea, R., Sandøe, P., 2011. Highlighting ethical decisions underlying the scoring of animal welfare in the Welfare Quality® scheme. *Anim. Welf.* 20 (1), 89.
- Walker, J.K., Dale, A.R., D'Eath, R.B., Wemelsfelder, F., 2016. Qualitative Behaviour Assessment of dogs in the shelter and home environment and relationship with quantitative behaviour assessment and physiological responses. *Appl. Anim. Behav. Sci.* 184, 97–108.
- Welfare Quality, 2009. Welfare Quality assessment protocol for pigs (saw and piglets, growing and finishing pigs). Welfare Quality® Consortium, Leystad, NL.
- Wemelsfelder, F., Hunter, T.E.A., Mendl, M.T., Lawrence, A.B., 2000. The spontaneous qualitative assessment of behavioural expressions in pigs: first explorations of a novel methodology for integrative animal welfare measurement. *Appl. Anim. Behav. Sci.* 67, 193–215.