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Article

The shelter dog in a One Health view. A model kennel in Southern Italy

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Simple Summary: Human-dog relationship, mainly focused on the physical and emotional wellbeing, has evolved a lot in recent decades, becoming even more intense. Such a novel conception should also be applied to the life that takes place into kennels, which have been wrongly regarded as a landfill or a burden on society for too many years. Here, we investigated the effects of a shelter dog in a One Health view upon environment, humans and dog adoptions. Accordingly, we documented the main structural and functional features of an innovative shelter in southern Italy, underlying its beneficial and sustainable environmental impact. Then, we evaluated the effect of the educational training on the adoption attitude in the same shelter, analyzing two different groups of dogs, one including animals housed from 2015 to 2017 (n = 479), not enrolled in the training program, and another one,, consisting of animals housed from 2018 to 2020 (n = 555), and who had been undergoing trainer program for 4 months. Interestingly, in contrast to what normally happens, we found a higher number of adoptions in both adult- and old-trained dogs, compared to the age-matched not trained animals.

Abstract: Today, the kennel is considered one of the crucial concerns of the human-animal relationship, since it is very often regarded as animal dump where dogs exile, thus representing a burden on society. Therefore, drawing up strategies for a new "kennel conception", as an added value for human society, environment, and dogs is still an unmet need. Here, we described the activities of a shelter dog in southern Italy, which faithfully meets criteria aimed at One Health perspective. It normally relies on an initial careful assessment by veterinary behaviorist, in order to guarantee the most suitable life conditions for the animals in the kennels, increase the chances of adoption and enroll them in projects tailored to their predispositions. Accordingly, dogs housed there are normally included in training courses to increase the skills to be used in different human social contexts, like support to the inmates, rescue in the rubble, animal-assisted interventions, as well as zooanthropology educational programs. The main strength for this groundbreaking shelter relies on the environmental protection schedule, where the purposes, employing technically and economically sustainable tools, point towards the continuous improvement and minimization of the environmental impact, promoting joint integrative projects for a sustainable One Health framework.

Keywords: One Health; shelter dog; dog adoption; dog well-being; dog behavior

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1. Introduction

Animals are involved in every aspect of human life, ranging from farming and servicing to research and companionship, of course. Notably, human-animal relationship has significantly evolved over the past centuries as, for instance, the role of pets has changed from work animals (being in charge of protecting houses and/or catching mice), to those who perform a social function, and provide companionship [1]. On the other hand, given their ability to feel positive and negative emotions, animals can even benefit from humans, thus highlighting the importance of developing practical welfare assessment indicators either for husbandry or companion animals [2]. Despite the deep relationship between humans and dogs, there are multiple dysfunctional issues to take into account, including excessive aggression, fear and anxiety, or abnormal repetitive behaviors [3], thereby becoming victim of anthropomorphism, animal hoarding[4], and eventually ending up imprisoned in kennels. Unfortunately, the kennel is considered one of the crucial concerns of the human-animal bond, since it is very often regarded as animals dump, a place where dogs exile and thus a burden on society. Among several rules about the protection of dogs in force in the Italian legal system, the law no 189/04 includes crimes against the feeling of animals in the penal code and provides for severe punishment for any kind of killing, caused by cruelty or with no need. Likewise, euthanasia is not allowed in Italy, in fact the law no 281 of 14 August 1991 provides for that stray dogs found, captured, or admitted to kennels cannot intended to allow experimentation be suppressed or intended to allow experimentation, unless they are seriously ill, incurable or proven dangerousness. In no case stray dogs or cats present in the feline colonies may be transferred to countries whose legislation on the mistreatment of pets and their use for aims of scientific experimentation contrasts with the Italian legislation [5]. Therefore, in the present work we aimed at examining the impact of kennel built in a One Health perspective on society, environment, humans and dogs. One Health is a multidisciplinary worldwide strategy to study all aspects of health care, by recognizing the interconnections between people, animals, plants, and their shared environment [6]. It basically relies on multidisciplinary collaboration between physicians, veterinarians, environmental scientists, public health professionals, wildlife experts, and many others [7]. The shelter dog in southern Italy here described might represent a model of multifunctional structure aiming towards the One Health perspective, since it combines eco-sustainable solutions with a tightly scheduled educational programs, tailored to the dog attitudes, thus allowing an improvement of dog-human well-being and a healthy environment framework.

2. Materials and Methods

2.1. Dog kennel. The building is in the Municipality of Ottaviano, spanning on an area of about 16,000 square meters in the Municipality of Ottaviano, a city with a highly-densed populations of the province of Naples, Southern Italy, and has about 300 boxes. The veterinary part occupies an area of approximately 200 square meters and includes the Operating Room, Outpatient Clinic, Radiology, Analysis Laboratory, Hospitalization with high technological innovation monitoring. The kennel of our research, indeed, is managed in compliance with managing and environmental quality protocols, that is IOS (International Organization for Standardization) 14001 and EMAS (EMAS = Eco-Management and Audit Scheme), a system to which companies and organizations, both public and private, based in the territory of the European Community or outside it, who wish to commit themselves to evaluating and improving their environmental efficiency, can voluntarily join (https://www.isprambiente.gov.it/it/attivita/certificazioni/emas/il-regolamento-emas). In this respect, structural, environmental and managing activities, namely housing floor warming, waste cycle and phytoevaporation systems, which will be described in the Results section, aim towards a growing improvement of the processes there accomplished. The structure is also the operational headquarters of numerous projects by the Campania Region for the sterilization of stray dogs with relative hospitalization and reintroduction on the territory. In fact, Art. 13 of the April 2019 law recognizes the right to the dog to be

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a free animal, if it is ascertained the non-existence of dangerous conditions for humans, animals and things. It is the municipalities that regulate the conditions for the recognition of free cared for dogs. Free dogs looked after are sterilized by the veterinary service of the ASL competent for the area or by affiliated veterinarians. They are registered in the database in the name of the Mayor of the Municipality who made the recognition and the proposing association takes care of them. After its sterilization and the relative census, the free dog is reintroduced in the exact area from where it was taken.

2.2. Animals enrolled in the study. In the present work we documented the activity of 1034 mixed-bred dogs (488 males and 546 females), hosted in the kennel of Ottaviano between 2015 and 2020. The behavioral program started off from 2018, as reported in the next paragraph. Depending on their age, the dogs were grouped into four categories, namely Pre-Adolescent (Pre-Ad, < 1 year); Post-Adolescence (Post-Ad, 1-2 years); Adult (3-8 years); Old (9-17 years).

2.3. Training program.

Dogs that we analyzed in the present work (n=555) were enrolled in training courses, with the aim of increasing the skills to be used in different human social contexts, - such as zooanthropology's project with child, Animal-Assisted Intervention (AAI), and families. It normally relies on a careful behavioral assessment and categorization by veterinary behaviorists, using the evaluation scale for emotional disturbs of dogs (EDED Scale) of Pageat [8], which allows the classification of dogs' behavior according to the presence/absence of centripetal and centrifugal behavior and the expression of homeostasis or emotional disturbances. The centripetal activities are represented by feeding, drinking, self-directed behaviors and sleep; while the centrifugal activities are social contacts, exploratory capacity and aggression. For each behavior considered, a specific score was attributed to each subject. Each dog then obtained a total score, which indicated its general emotional state. The dogs selected in the present study had a score from 9 to 12, corresponding to a normal state for emotional and cognitive profile. After the behavioral visit, the dogs hosted were followed by dog trainers or trainer students during their internship, under the supervision of a tutor (expert dog trainer). Several activities were carried out to increase dog 'skills, such as Feel safe during touch, Luring technique (to capture the dogs' attention); How to improve interspecies socialization; The command "sit"; Nose-working activity; -The command "stay"; Management of the leash; Recall; The command "give the paw". The training was performed on average once a week for 4 months, using positive reinforcements (treats and vocal reinforcements) and gentle management (no physical or psychological pressure was induced) using the luring technique. The total duration of each session was approximately 60 min, with a break of 15 min after 30 min of working to safeguard animal welfare. At least two activities were carried out in each session. At each new session, a review of the previous learned activity was carried out. Every training's plan is tailored to the dog's predispositions, socialization intra-interspecies and experiences.

2.4. Statistical analysis. Statistical analysis was performed with GraphPad (version 9.0; La Jolla, CA). The number of dog adoptions based on their age was assessed using one-way ANOVA, followed by Holm-Šídák's multiple comparisons test. The effect of training upon dog adoptions was analyzed through the Unpaired Student's t test. Results were considered statistically significant for $p < 0.05$.

3. Results

3.1. Main features of the "kennel environment"

Here, we documented the management practices of the kennel in Ottaviano (Naples), that set the stage for a good welfare in canine health. Technologies are recruited for

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environmental protection, too. Accordingly, the shelter dog is equipped with a photovoltaic system of 50 KW, on the roof of the boxes, that covers 80% of the needs (Figure 1a). This energy is used for heat lamps in indoor areas of the box. The shelter uses chemical-physical purification areas and phytovaporation of wastewater, thus reducing environmental pollution (Figure 1b). The enclosure is equipped with a nebulization system to abate bad smells, make environmental disinfection, as well as introduce water in the boxes, during the warmest time of the hot seasons, either for dog refreshment or reinstatement of the thermoneutral zone (Figure 1c). Each box has a sleeping area, as well as covered and uncovered outdoor space. Of note, the sleeping area is characterized by the heated floor system (see representative picture in Figure 1d).

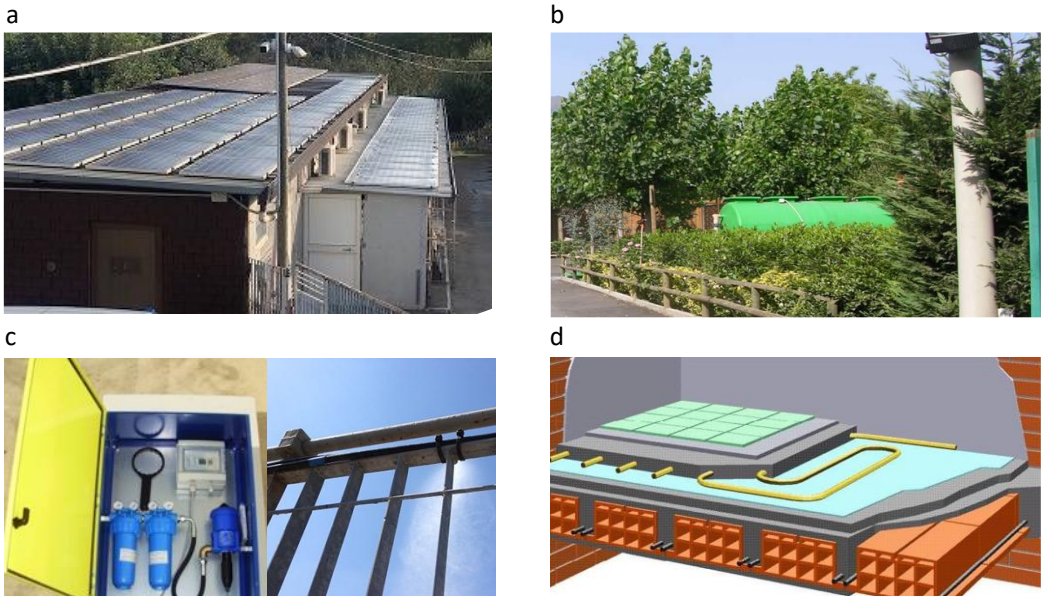

Figure 1. Main features of the shelter dog. (**a**) Solar panels above the dog boxes; (**b**) Phytoevaporation area; (**c**) Nebulization system; (**d**) Representative picture of heated floor system in each dog boxes.

3.2. Integrated system of waste disposal

The disposal system for box cleaning is carried out through eight well characterized steps. All boxes are structured with sewage collection channels, that gather in a main tube (Phase 0). At this stage, sewage ends up in a sweeper (Phase 1), which can segregate any solids from hairs from liquid, which turns into the Imhoff tanks (Phase 2). Then, by means of a special pump, liquids are conveyed in a further very thin mesh cleaner, with a subsequent entry into the purifier (Phase 3). Soon after the purification process (Phase 4) with activated sludge, the purified liquid is introduced into the overflow-mediated phytoevaporation system (Phase 5). This “integrated” and innovative process involves the systematic control of the sludge (using special forms), to verify its status, and possible excess, that must be removed in the appropriate tank (Phase 6) to allow sedimentation and following entry into the filter press (Phase 7). The sludge produced by the filter press (the reduction of which is about 80%), is being thrown away by a specialized company with waste CER code 19.08.13. Overall, this system allows the "zero" liquid discharge coming from the cleaning of the boxes. Noteworthy this dog shelter obtained the Nomination for the EUROPEAN EMAS AWARD in 2010, the highest European recognition on company management.

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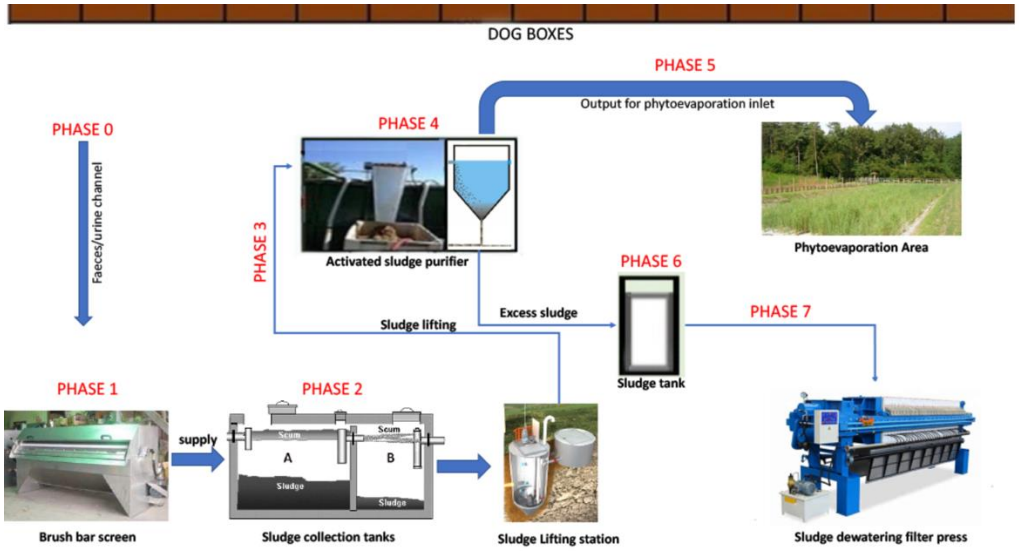

Figure 2. Depiction of the waste disposal phases of the shelter dog in Ottaviano, which emplyos phytovaporation process of wastewater, thus reducing environmental pollution of the area. PHASE 0: Collector channel for dog faeces and urine; PHASE 1: Brush sludge collector; PHASE 2: Sludge tanks (Imhoff); PHASE 3: Fine-mesh sludge purifier; PHASE 4: Purification process; PHASE 5: Phytoevaporation; PHASE 6: Excess sludge tank; PHASE 7: Dewatering filter press entry.

3.3. Age-dependent dog adoptions of the analyzed kennel

In our research we investigated the age-dependent effect upon dog adoptions, from 2015 to 2020 (Table 1). We focused on 4 groups of age: Pre-Ad: 7 to 11 months (n = 567); Post-Ad: 1-2 years (n = 255); Adult: 3-8 years (n = 170); Old: 9-17 years (n = 42). We firstly evaluated whether our experimental data even fit to a normal distribution. Accordingly, Shapiro-Wilk normality test showed that, within each analyzed group, values normally distributed (Pre-Ad: W = 0.9119, p = 0.4488; Post-Ad: W = 0.9638, p = 0.8483; Adult: W = 0.9673; p = 0.8737; Old: W = 0.9468; p = 0.7147). Then, one-way ANOVA showed an overall significant effect of the dogs age over the number of adoptions ($F_{(3,20)}$ = 21.32 p < 0.0001). In particular, we documented a higher number of younger dog adoptions, when compared to the aged ones (Holm-Šídák's comparisons test; Pre-Ad vs Post-Ad: p = 0.0008; Pre-Ad vs Adult: p < 0.0001; Pre-Ad vs Old: p < 0.0001) (Figure 2).

	Years	
Group	**2015-2017**	**2018-2020**
Pre-Ad	305	262
Post-Ad	106	149
Adult	56	114
Old	12	30
Total	**479**	**555**

Table 1: The number of dogs analyzed over 2015-2020, organized by those non-trained (2015-2017) and trained (2018-2020) and age Pre-Adolescent (Pre-Ad, < 1 year); Post-Adolescence (Post-Ad, 1-2 years); Adult (3-8 years); Old (9-17 years).

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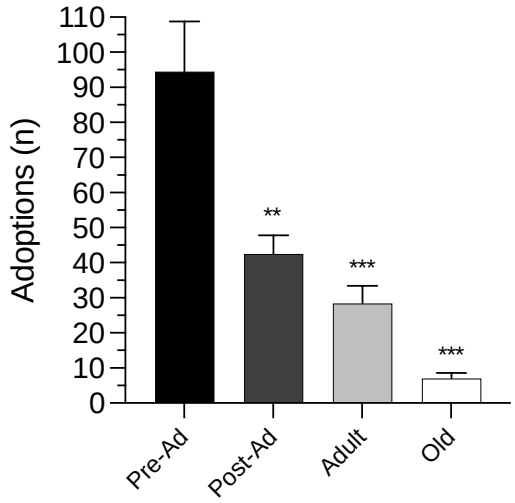

Figure 3. Age-dependent dog adoptions in the analyzed shelter, from 2015 to 2020. **p < 0.01, $p < 0.0001$, compared to Pre-Ad group (one-way ANOVA, followed by Holm-Šídák's multiple comparisons test). All values are expressed as mean ± SEM.

3.4. Impact of the training upon dog adoptions

Then, in order to assess the effect of training on the efficacy of dog adoptions, we analyzed two different group, one including dogs housed from 2015 to 2017 (n = 479) and not enrolled in the training program, and another one, consisting of dogs housed from 2018 to 2020 (n = 555), who had been undergoing trainer program for 4 months. Statistical analysis, carried out within each age considered, showed no main effect of training on the number of adoptions in Pre-Ad and Post-Ad groups ($p > 0.05$, Student's t test). On the other hand, we found a higher number of adoptions in both adult and old trained dogs, compared to age-matched animals who were not trained (Adult; $p = 0.0324$; Old; $p = 0.0351$), as shown in Figure 3. Finally, when we evaluated the influence of the size upon the train-dependent adoptions we failed to find any significant effect (two-way ANOVA, treatment x size interaction: $F_{(3,16)} = 1.387$, $p = 0.2828$, data not shown).

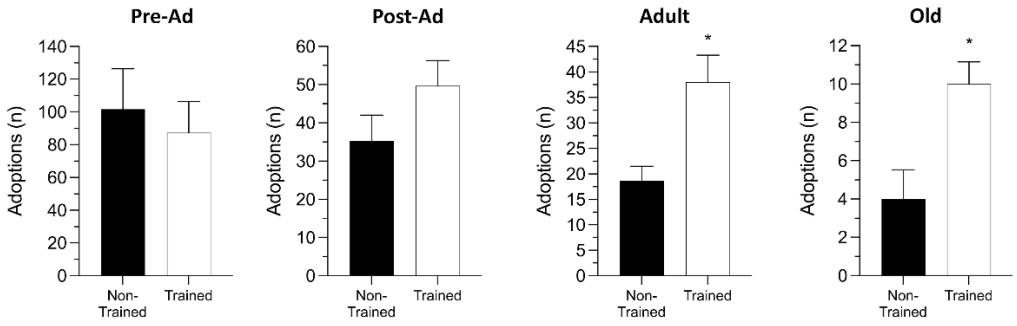

Figure 4. Effect of training upon age-dependent dog adoptions. *p < 0.05, compared to non-trained group (Unpaired Student's t test). All values are expressed as mean ± SEM.

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4. Discussion

The dogs analyzed in the present work were selected from the guests of the Coop kennel, Dog Park of Ottaviano (Naples-Italy), where they were housed after being caught on the territory, by the local health authority. The building is organized in multiple boxes to meet the social needs of the canine species [9]. Each box presents a surface of 6 square meters/dog, with an open space in front of it, where animals can have a walk and interact with each other. We went through the importance of combining the innovative "shelter dog conception", with a careful behavioral program upon a greater in the number of dog adoptions. Our data point towards a tantalizing impact of educational training on aged animals, thus indirectly suggesting that a well-managed environment-dog interaction might be regarded as a key factor for the animal welfare.

4.1 *The impact of a shelter on environment*

Generally, box cleaning water turns eventually into wastewater, having the potential to be contaminated with dog by-products, such as faeces and urine. The contagiousness degree for this waste material surely depends on animals' health and/or preventative treatments (e.g., worming cure), implemented by the shelter operators. However, the spreading effect of the diseases will be determined by the hygiene standards of the facility, too. Dogs are regarded as a "major reservoir for zoonotic infections", insofar they can pass most of the viral and bacterial infections to humans through bites and, importantly, protozoa by the oral-fecal route [10]. Therefore, shelter represents a high-risk habitat, where disease is more likely to occur, thus spreading out more easily, because of environmental stressors, as well as limited inter-boxes space. Thus, thorough cleaning schedule in kennels can assist in preventing dogs from being infected by and spreading pathogens [11]. In this respect, the kennel we analyzed in the present study uses chlorine-based sanitizers, in compliance with the EMAS certification. In addition, wastewater may also present an environmental hazard due to the relatively high levels of dogs' faeces-derived nitrogen, which is 40% more abundant than that found in the wet cattle manure [12], thus suggesting a careful attention to the nutrient levels in the natural environment to avoid streams eutrophication [13]. For this reason, the goal of the present kennel in Ottaviano has always been zero discharge challenge, that was pursued with an evapo-transpiration system, including several plants (aucuba japonica, bambù, calycanthus floridus, cornus alba, cornus florida, cornus stolonifera, kalmia latifolia, lauro cerasus, rhamnus frangula, sambucus nigra and canadensis, spirea salicifolia and thuja canadensis). Accordingly, the pre-treatment system relies on the activated sludge with denitrification and prefiltration, and includes a biological pretreatment, followed by the phytodepuration process. Lastly, dog boxes have a floor of waterproof concrete, and during the box washing all the leached material goes to the appropriate collector, thus avoiding any kind of animal waste-derived soil and subsoil pollution.

4.2 The potential impact of dog training program in shelter

Once arrived at the shelter in Ottaviano the analyzed dogs were suddenly subjected to the clinical examination and laboratory testing (routine biochemical and hematological evaluations), and behavioral examination as well, to certify their health status. Based on their ability to be enrolled in training protocols for animal-assisted intervention (AAI), as well as zooanthropology projects with children, or peculiar olfactory discrimination (i.e search for bugs and rubble), all the dogs were grouped into different categories, aimed at improving adoption success [14]. Clustering animals tailored to their behavioral attitudes has the benefit to shorten the kennel housing time. Accordingly, prolonged stay in a shelter can generally affect dogs' behavior, since they become less interested in their environment, and spend more time in the back of their kennel, so making them less attractive to potential adopters [15]. In addition, in line with work by Jensen et al. (2020), indicating that about 25% of the animals are relinquished because of their behavioral issues, dogs

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that recovered from behavioral disorders might be easily adopted [16]. However, there are many reasons for choosing to adopt a dog, based on some peculiar features, including the appearance, social behavior with the adopter, personality [17,18], or surrender it to the kennel, due to the owner's health, human deprivation, behavioral problems of the animals, housing issues and lack of time, actually [16,19-23]. A further key issue to achieve a conscious choice is based on the adopters' expectations for dog ownership prior to adoption, and their experience with dog behavior, as well. Powell and coworkers documented that owner who returned their dog to the shelter within three months from the adoption nourished higher expectations of their dog and human–dog relationship, but also exhibited desirable behavior, compared with adopters who did not return their dogs [24]. Moreover, the same authors found that two-thirds of owners experienced behavioral concerns following adoption, although some of them reduced over time (e.g., training difficulty and fear). Noteworthy, findings from Shore's group reported that about 50% of relinquishing adopters considered the return process "very difficult", and 41% indicated they would not adopt one more animal in the future, while 13% weren't sure if they would do it again [25]. These data suggest that the unsuccessful animal adoptions may detrimentally affect individuals' desire to own a companion animal in the future. Considering that behavior is the main reason of post-adoption returns, animal shelters are required to minimize behavioral incompatibility between adopters and their animals. In this context we argue that the presence of a qualified dog trainers and vet behaviorist in the kennel, who is in charge of categorizing the behavioral profile, can definitely allow a more suitable choice by the owner. The combined effect of the educational training with higher number of interspecies contacts, likely let the animals to increase their wellbeing [26]. Moreover, such an innovative approach allows us, on one hand, to detect strengths and weaknesses of each dog and, on the other, make shelter dogs more attractive from a behavioral perspective, reporting to the future adopter and tackling the expectations of future adopters. In this line, Weiss et al. (2012) reported that most adopters gave importance to the information about the animal health and behavior from a staff member or volunteer, rather than cage cards [18]. Again, several studies suggested that enrichment programs might enhance desirable behaviors and decrease unwanted ones in shelter dogs, which enventually can improve welfare [27]. Among several studies, which focus on adopter preferences, suggest that dog appearance is one of the most important factors taken into consideration before adopting kennel dogs [17,21], Wells and colleagues emphasized the fact that dog's behavior is much more important to a potential adopter than the canine's physical appearance [28]. In addition to this, training paves the way for predictable interactions, increases the management of the environment, by giving the dog the ability to act around it with predictable results and, lastly, can improve the dog wellbeing [14,29]. However, further investigations are required to address any direct impact of such an innovative approach on the dog welfare.

4.3. The influence of the dog's age on the adoption

According to the previous findings, documenting that puppies represent the most appealing group, since they normally have more chances to be adopted than both adults and seniors [17,30], our data showed that pre-adolescent dogs were more easily adopted over the time window analyzed (2015-2020), when compared to post-adolescent, adult and old animals. In this line, Svoboda and colleagues reported that 10 to 12 years old dogs are more likely to be euthanized [31]. Interestingly, our results highlighted for the first time a significant increase of old trained-dog adoptions, coherently with the research by Luescher et. al. (2009), which demonstrated that training, as such, causes shelter dogs to be most likely adopted [32]. Noteworthy, the commitment of the kennel in an editorial initiative "Un occhio verde e uno blu", aims to raise adoption awareness of the elderly dog, experienced as an added value for a family (https://www.minervaedizioni.com/un-occhio-verde-e-uno-blu.html).

4.4 The impact of the training and environmental technology on the kennel finances

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One of the major points to be considered is the economic impact of the training on the finances of the kennel. In this respect, Protopopova et al. (2012) suggested that animal shelters are in staff shortage and financial distress, so that additional funding in-shelter programs may result in the cutting of funds to other necessary shelter operations [33]. The intervention proposed by Luescher and Medlock (2009) [32] would result in a cost at least of $4.30/dog/day (based on the amount needed to pay a professional animal trainer, US Bureau of Labor Statistics, 2011), whereas the intervention proposed by Protopopova et al. (2012) [33] would be approximately $1.80/dog/day (the amount to pay a worker the federal minimum wage, US Bureau of Labor Statistics, 2011). In our experience, the advantage of this kennel is to carry out training courses directed for a fee, by qualified dog trainers (ENCI recognized), ensuring the presence of several trainers, who spend about 300 hours in the kennel during their internship, under the supervision of a senior dog trainer. moreover, this kennel in southern Italy is provided of the photovoltaic system, allowing additional savings. Since September 2010, the power self-consumption has been totally offset by the production of renewable energy coming from the photovoltaic system, placed on the roofs of the shelter boxes.

4.5 The impact of a shelter on Humans

Positive human health benefits of interacting with animals, focusing on the companion animal, have been described with the term "zooeyia" [34]. Most research, aimed at addressing the health benefits of pet ownership, showed reductions in distress and anxiety, increased physical condition, decreased loneliness and depression [35], and positive health behaviors [36], and at least some help in emergency conditions, as happened with social isolation during the first COVID-19 lockdown in Italy [37]. Dogs also play an increasing role as a co-therapist or advocate for people with psychological or physical disabilities, especially those animals residing or visiting prisons and nursing homes, thereby turning into improved mood, decreased physiological distress, depression, dementia and loneliness [9,38,39]. Despite the deep human-dog relationship there are multiple dysfunctional aspects behind this to be considered, like excessive aggression, fear and anxiety, or even abnormal repetitive behavior (d'Angelo et al., 2022-Retrospective analysis of dog bites in Southern Italy-Ciência Rural-Accepted manuscript) [3,40], becoming a victim of Anthropomorphism or animal hoarding [4], or ending up imprisoned in kennels. In this view, the safety of humans in the one health perspective should start from the following parameters:

1) Categorization and evaluation of dogs housed in kennels. This will allow a better dog-human match, preserving the needs of either of them, improving human awareness in choosing a dog. In fact, animal relinquishment is a difficult and emotional decision for animal owners, with important drawbacks [41];

2) Children education at schools. Raising awareness about the themes of the animal world is one of the objectives of this kennel. Accordingly, there are several interventions of teaching zooanthropology (with dogs housed in shelter) at schools, to educate children to a correct dog interaction, and reduce bite occurrence [42];

3) AAI in prison. Several studies reported positive physio-psychological effects of AAI for inmates, confirming the general concept that human– animal interactions contribute to human health and welfare [39,43]. Of note, the dogs of kennel we surveyed in this work are involved in activities with the inmates, in order to improve the total emotional quotient, the intrapersonal scale, and the general mood scale as well [9].

5. Conclusions

Kennels should be conceived as a constantly evolving structure, ready to align itself with the One Health vision, so that it is recognized as an entity able to guarantee, on one hand,

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the wellbeing of the dogs hosted, as well as a fruitful interaction and, on the other, a substantial harmonization of the environmental impact. To achieve this goal kennels need an entrepreneurial management, the resources of which can support a circular micro-economy and, hopefully, call for even more funding to support initiatives that involve humans, dogs and the environment as well. In the present work we documented for the first time the great positive impact of the blending innovative shelter with educational program on dog adoptions, representing a novel concept of human-animal-environment integrated framework. Collectively, our data pave the way for additional studies aimed at assessing the welfare of kenneled dogs.

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References

1. Overgaauw, P.A.M.; Vinke, C.M.; Hagen, M.; Lipman, L.J.A. A One Health Perspective on the Human-Companion Animal Relationship with Emphasis on Zoonotic Aspects. *Int J Environ Res Public Health* **2020**, *17*, doi:10.3390/ijerph17113789.
2. Wemelsfelder, F.; Mullan, S. Applying ethological and health indicators to practical animal welfare assessment. *Rev Sci Tech* **2014**, *33*, 111-120, doi:10.20506/rst.33.1.2259.
3. d'Angelo, D.; Sacchettino, L.; Carpentieri, R.; Avallone, L.; Gatta, C.; Napolitano, F. An Interdisciplinary Approach for Compulsive Behavior in Dogs: A Case Report. *Front Vet Sci* **2022**, *9*, 801636, doi:10.3389/fvets.2022.801636.
4. d'Angelo, D.; Ciani, F.; Zaccherini, A.; Tafuri, S.; Avallone, L.; d'Ingeo, S.; Quaranta, A. Human-Animal Relationship Dysfunction: A Case Study of Animal Hoarding in Italy. *Animals (Basel)* **2020**, *10*, doi:10.3390/ani10091501.
5. Campania, R.C.o. http://www.regione.campania.it/assets/documents/leggeregionale3-2019-alla-31-2021.pdf. *Regional Campania Bullettin* **2019**.
6. Chakraborty, S.; Andrade, F.C.D.; Smith, R.L. An Interdisciplinary Approach to One Health: Course Design, Development, and Delivery. *J Vet Med Educ* **2021**, e20210021, doi:10.3138/jvme-2021-0021.
7. One Health Initiative. Available online: www.onehealthinitiative.com. [(accessed on 24 December 2019)].
8. Pageat, P.; Verga, M.; Carenzi, C. Patologia Comportamentale del Cane. *Le Point Veterinaire Italie* **1999**.
9. d'Angelo, D.; d'Ingeo, S.; Ciani, F.; Visone, M.; Sacchettino, L.; Avallone, L.; Quaranta, A. Cortisol Levels of Shelter Dogs in Animal Assisted Interventions in a Prison: An Exploratory Study. *Animals (Basel)* **2021**, *11*, doi:10.3390/ani11020345.
10. Ghasemzadeh, I.; Namazi, S.H. Review of bacterial and viral zoonotic infections transmitted by dogs. *J Med Life* **2015**, *8*, 1-5.
11. Dendoncker, P.A.; Moons, C.; Sarrazin, S.; Diederich, C.; Thiry, E.; de Keuster, T.; Dewulf, J. Biosecurity and management practices in different dog breeding systems have considerable margin for improvements. *Vet Rec* **2018**, *183*, 381, doi:10.1136/vr.104996.
12. Nemiroff, L.; Patterson, J. Design, Testing and Implementation of a Large-Scale Urban Dog Waste Composting Program. *Compost Science & Utilization* **2007**, *15*, 237-242.
13. Chislock, M.F.; Doster, E.; Zitomer, R.A.; Wilson, A.E. Eutrophication: Causes, consequences, and controls in aquatic ecosystems. *Nature Edu. Knowledge* **2013**.

14. Luescher, A.U.; Medlock, R.T. The effects of training and environmental alterations on adoption success of shelter dogs. *Applied Animal Behaviour Science* **1999**, *117*, 63-68, doi:doi:10.1016/j.applanim.2008.11.001.
15. Wells, D.L.; Graham, L.; Hepper, P. The influence of length of time spent in a rescue shelter on the behaviour of kennelled dogs. *Animal Welfare,* **2002**, *11*, 317-325.
16. Jensen, J.B.H.; Sandoe, P.; Nielsen, S.S. Owner-Related Reasons Matter more than Behavioural Problems-A Study of Why Owners Relinquished Dogs and Cats to a Danish Animal Shelter from 1996 to 2017. *Animals (Basel)* **2020**, *10*, doi:10.3390/ani10061064.
17. Garrison, L.; Weiss, E. What do people want? Factors people consider when acquiring dogs, the complexity of the choices they make, and implications for nonhuman animal relocation programs. *J Appl Anim Welf Sci* **2015**, *18*, 57-73, doi:10.1080/10888705.2014.943836.
18. Weiss, E.; Miller, K.; Mohan-Gibbons, H.; Vela, C. Why Did You Choose This Pet?: Adopters and Pet Selection Preferences in Five Animal Shelters in the United States. *Animals (Basel)* **2012**, *2*, 144-159, doi:10.3390/ani2020144.
19. Mondelli, F.; Prato Previde, E.; Verga, M.; Levi, D.; Magistrelli, S.; Valsecchi, P. The bond that never developed: adoption and relinquishment of dogs in a rescue shelter. *J Appl Anim Welf Sci* **2004**, *7*, 253-266, doi:10.1207/s15327604jaws0704_3.
20. Coe, J.B.; Young, I.; Lambert, K.; Dysart, L.; Nogueira Borden, L.; Rajic, A. A scoping review of published research on the relinquishment of companion animals. *J Appl Anim Welf Sci* **2014**, *17*, 253-273, doi:10.1080/10888705.2014.899910.
21. Ly, L.H.; Gordon, E.; Protopopova, A. Exploring the Relationship Between Human Social Deprivation and Animal Surrender to Shelters in British Columbia, Canada. *Front Vet Sci* **2021**, *8*, 656597, doi:10.3389/fvets.2021.656597.
22. Hawes, S.M.; Kerrigan, J.M.; Hupe, T.; Morris, K.N. Factors Informing the Return of Adopted Dogs and Cats to an Animal Shelter. *Animals (Basel)* **2020**, *10*, doi:10.3390/ani10091573.
23. Lambert, K.; Coe, J.; Niel, L.; Dewey, C.; Sargeant, J.M. A systematic review and meta-analysis of the proportion of dogs surrendered for dog-related and owner-related reasons. *Prev Vet Med* **2015**, *118*, 148-160, doi:10.1016/j.prevetmed.2014.11.002.
24. Powell, L.; Walsh, M.; Reinhard, C.L.; Satriale, D.; Serpell, J.; Watson, B. Returning a Shelter Dog: The Role of Owner Expectations and Dog Behavior. *Animals* **2022**.
25. Shore, E.R. Returning a recently adopted companion animal: adopters' reasons for and reactions to the failed adoption experience. *J Appl Anim Welf Sci* **2005**, *8*, 187-198, doi:10.1207/s15327604jaws0803_3.
26. Coppola, C.L.; Grandin, T.; Enns, R.M. Human interaction and cortisol: can human contact reduce stress for shelter dogs? *Physiol Behav* **2006**, *87*, 537-541, doi:10.1016/j.physbeh.2005.12.001.
27. Herron, M.E.; Kirby-Madden, T.M.; Lord, L.K. Effects of environmental enrichment on the behavior of shelter dogs. *J Am Vet Med Assoc* **2014**, *244*, 687-692, doi:10.2460/javma.244.6.687.
28. Wells, D.L.; Hepper, P.G. The behaviour of dogs in a rescue shelter *Animal Welfare,* **1992**, *1*, 171-186.
29. Veissier, I.; Boissy, A. Stress and welfare: two complementary concepts that are intrinsically related to the animal's point of view. *Physiol Behav* **2007**, *92*, 429-433, doi:10.1016/j.physbeh.2006.11.008.
30. Patronek, G.J.; Crowe, A. Factors Associated with High Live Release for Dogs at a Large, Open-Admission, Municipal Shelter. *Animals (Basel)* **2018**, *8*, doi:10.3390/ani8040045.
31. Svoboda, J.H.; Hoffman, C.L. Investigating the role of coat colour, age, sex, and breed on outcomes for dogs at two animal shelters in the United States. *Animal Welfare* **2015**, *24*, 497-506.
32. Luescher, A.U.; Medlock, R.T. The effects of training and environmental alterations on adoption success of shelter dogs. *Applied Animal Behaviour Science* **2009**, *117*, 63-68.
33. Protopopova, A.; Gilmourb, A.J.; Weiss, R.H.; Shena, J.Y.; Wynnea, C.D.L. The effects of social training and other factors on adoption success of shelter dogs. *Applied Animal Behaviour Science* **2012**, *142*, 61-68.
34. Hodgson, K.; Darling, M. Zooeyia: an essential component of "One Health". *Can Vet J* **2011**, *52*, 189-191.

35. Friedmann, E.; Son, H. The human-companion animal bond: how humans benefit. *Vet Clin North Am Small Anim Pract* **2009**, *39*, 293-326, doi:10.1016/j.cvsm.2008.10.015.
36. Vesnaver, E.; Keller, H.H. Social influences and eating behavior in later life: a review. *J Nutr Gerontol Geriatr* **2011**, *30*, 2-23, doi:10.1080/01639366.2011.545038.
37. d'Angelo, D.; Chirico, A.; Sacchettino, L.; Manunta, F.; Martucci, M.; Cestaro, A.; Avallone, L.; Giordano, A.; Ciani, F. Human-Dog Relationship during the First COVID-19 Lockdown in Italy. *Animals (Basel)* **2021**, *11*, doi:10.3390/ani11082335.
38. Olsen, C.; Pedersen, I.; Bergland, A.; Enders-Slegers, M.J.; Ihlebaek, C. Effect of animal-assisted activity on balance and quality of life in home-dwelling persons with dementia. *Geriatr Nurs* **2016**, *37*, 284-291, doi:10.1016/j.gerinurse.2016.04.002.
39. Contalbrigo, L.; De Santis, M.; Toson, M.; Montanaro, M.; Farina, L.; Costa, A.; Nava, F.A. The Efficacy of Dog Assisted Therapy in Detained Drug Users: A Pilot Study in an Italian Attenuated Custody Institute. *Int J Environ Res Public Health* **2017**, *14*, doi:10.3390/ijerph14070683.
40. d'Angelo, D.; d'Ingeo, S.; Napolitano, F.; Perrotti, G.; Maglione, I.; Caputo, V.; Quaranta, A. Retrospective analysis of dog bites in Southern Italy. *Ciência Rural* **2022**, *52*, doi:10.1590/0103-8478cr20210421.
41. DiGiacomo, N.; Arluke, A.; Patronek, G. Surrendering Pets To Shelters: The Relinquisher's Perspective. *Anthrozoös* **1998**, *11*, 41-51, doi:DOI: 10.1080/08927936.1998.11425086.
42. Parente, G.; Gargano, T.; Di Mitri, M.; Cravano, S.; Thomas, E.; Vastano, M.; Maffi, M.; Libri, M.; Lima, M. Consequences of COVID-19 Lockdown on Children and Their Pets: Dangerous Increase of Dog Bites among the Paediatric Population. *Children (Basel)* **2021**, *8*, doi:10.3390/children8080620.
43. Baybutt, M.; Chemlal, K. Health-promoting prisons: theory to practice. *Glob Health Promot* **2016**, *23*, 66-74, doi:10.1177/1757975915614182.