

Department of Obstetrics and Food Animal Medicine Clinic
University of Veterinary Medicine Budapest

LEGISLATION ON STERILIZATION AND BREEDING OF DOGS TO PREVENT
OVERPOPULATION IN NORWAY, GERMANY, ITALY, AND THE US.

By: Ida Johanne Ånes Bjerke

Supervisor:

Dr. Linda Müller, Head of clinic

Department of Obstetrics and Food Animal Medicine Clinic

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Abstract

Overpopulation of dogs is a problem all over the world and can cause a risk to human health and animal welfare. There are many ways to manage the rising dog population, including sterilization programs, educational programs, and legislations. The US and Italy are countries with large dog populations, both stray and owned dogs, whereas Norway and Germany are considered stray dog free. These four countries have differing degrees as to how they implement legislations to control dog populations. Norway and Germany have a moderate approach to legislate dog control, which both prohibit sterilization of dogs unless it is medically necessary, though Germany permits the procedure as a measure for preventing uncontrolled reproduction. The US and Italy are handling the population problem with a more progressive approach, with implementing sterilization programs and mandatory identification of dogs into their laws, and all dogs in shelters must be sterilized before released to their new owners. Which approach is the most effective is difficult to decide, as further research regarding the demography of dog populations and actual stray dog population numbers is needed, especially in Norway and Germany.

1 Introduction

Humans and domestic dogs have had a close relationship for centuries, and it is thought that the first domestication process from wolf to dog occurred at least 27,000 years ago [1, 2]. It is hypothesized that domestication resulted from a reciprocal relationship between human and dog, where the dogs helped humans with hunting and guarding their land, and received food and shelter in return [3]. Nowadays people have dogs for a myriad of reasons, including herding, military, and police work, guarding, and maybe furthest for companionship. The global dog population is estimated to be around 700 million dogs [4], consisting of both owned and stray dogs, and is exponentially increasing. Dogs can be classified into different categories based on their ownership status and on their capability to walk freely out on the streets. They can be owned with or without confinement, and likewise, they can be unowned with complete freedom to roam (as with stray dogs) or with restricted movement (dogs in a shelter) [5, 6]. The World Organisation for Animal Health (hereafter referred to as the OIE) describes a stray dog as “*any dog not under direct control by a person or not prevented from roaming*” [7], thus suggesting that all dogs roaming freely on the streets without supervision of a human, either unowned or owned, should be referred to as stray dogs. The increasing population of stray dogs are considered a problem all over the world and pose a great risk to the public with regards to transmissible diseases and bite attacks.

The sources of pet animals are numerous, including breeders, pet shops, friends/relatives, and shelters and rescue organizations. According to the AVMA annual report of 2017-2018, the most popular ways to acquire a dog in the US in 2016 was through a shelter or rescue organization, and next in line through a friend or relative and from a breeder [8]. An increasing demand for puppies creates an increased need for supply, and thus a great business opportunity for breeders, especially for commercial dog breeders, which produce hundreds of puppies each year for profit [9]. Animal welfare organizations greatly oppose the trend of buying puppies, as there are numerous dogs in overfilled shelters waiting for a new home, and they work intensely to encourage new potential dog owners to choose adoption rather than buying one from a breeder or pet shop. One of the major sources for stray dogs is previously owned dogs that are abandoned by their owners, and let to fend themselves out on the streets. Abandonment is a critical problem in dog population management, as many of these dogs are unsterilized and able to reproduce freely, consequently adding to the growing size of dog populations worldwide.

In the United States the dog population is predicted to be around 77 million dogs and exponentially increasing with around 70,000 puppies born every day [8]. It is believed that there is no problem with stray dogs in the US, however, a huge number of unwanted dogs are surrendered to or taken in by shelters every year [10]. Dogs are also left by themselves on the side of the street, but these are usually captured by animal control agencies and delivered to a shelter. Shelters in the US are at maximum capacity, and a large number of dogs are euthanized annually to make room for new dogs recently abandoned by their owners [10]. Measures to curb the overpopulation of dogs in the United States have been in the works since the 1970s, with the implementation of shelters and spay/neuter programs, and although adoption rates have increased and numbers of euthanized animals each year has declined [11], the need for the continuation of the control measures are still of utmost priority.

Italy has an estimated dog population of about 8 million according to the European Pet Food Industry (FEDIAF) [12], and the number of stray dogs are currently unclear. Stray dogs in Italy have been under management by the Italian government since 1991 under the law n. 281/1991 [13]. Several management practices, such as kennelling, sterilization programs, and “community dogs”, have been implemented in the legislation for a long time and are generally controlled on regional or municipal level. “Community dogs” are stray dogs, that are captured, sterilized, microchipped, and vaccinated, and then released, under the responsibility of the municipality, to the place where they were captured [14]. This approach for managing stray dogs frees space in shelters for dogs in need and allows the dog to live in a free state, instead of being locked up in a shelter for the rest of its life. A study done by Paolini et al (2020) revealed that many Italians are unaware of the existence of community dogs, however, about fifty percent agreed that it is a reasonable intervention for managing stray dogs [14]. In Italy, as described in law n. 281 of 14th August 1991, it is illegal to euthanize dogs unless they are incurably ill or proven dangerous, and all dogs are required to be registered in a central register. Studies have shown however, that the legislation for registration of dogs in the electronic database in Italy is not fool proof, as many owners fail to register or forget to update the information regarding a dog's death, disappearance, or change in ownership [15–17]. Even with the current control measures regulated in the legislation, Italy still struggles with an increasing population of dogs, and one could question whether the interventions are effective or not.

Norway and Germany are countries which considered themselves free of a stray dog population. The population of dogs in Norway is estimated to be just under 500,000 [18], and around 10 million in Germany [19]. Legislations in these countries does not consider population control measures and are more concerned about welfare and public health safety. In Norway, it is illegal to perform surgeries on animals, unless it is deemed medically necessary for the health of the animal, and in Germany it is also generally prohibited with surgical procedures, however, it is considered legal if it is a measure for population control. The prohibition of sterilizing dogs unless it is medically necessary have been in force since 1993 in Germany, and the veterinarian must decide on individual-case basis if the surgical castration is required for the health and wellbeing of the animal [20]. In 1995 the law that enabled sterilization as a means for population control was enacted, though the veterinarians are still obliged to evaluate each individual case, and must ensure that other therapies, such as behavioural therapy or hormonal medicines, will not have the same effect [20].

2 Literature review

2.1 Importance of population control

Overpopulation of dogs, especially free-roaming dogs, is frequently associated with several problems in relation to public health, wild life, health and welfare of dogs, and the environment [21–23].

2.1.1 Public Health

Dogs are a potential hazard in the human population with regards to public health by the means of bites, attacks, and disease transmission. Dog bites are considered a problem worldwide, it can result in physical and psychological trauma, in addition to disease transmission. One of the most feared diseases transmitted by dogs is rabies, which is a fatal viral zoonotic disease occurring in over 150 countries, and is estimated to cause 59,000 human deaths a year [24]. Dogs are one of the main reservoirs of the virus, and it is estimated that 99% of all human cases originate from a dog bite. Research on rabies control measures highlight the need to attack the source of the problem, essentially the size of the dog population, to control the rabies epidemic [25]. Other studies also support the evidence that regulating the dog population will decrease the prevalence of other zoonotic diseases. The prevalence of *E. multilocularis* in voles, which cause Echinococcosis in humans, was greatly

reduced when the free-roaming dog population was decreased [26]. Thus, it is important to reduce the population of dogs to lower the risk of transmitting dangerous diseases to humans.

2.1.2 Wildlife

The free-roaming domestic dog population have a detrimental impact on native wildlife by the means of predation, hybridisation, disease transmission, and resource competition [21, 27, 28]. A study done in India found that the domestic dog presents a great threat to the intrinsic wildlife, both by direct predation, but also through competitive harassment [21]. They found that large packs of dogs without a human presence attacked, killed, and consumed wildlife, predominantly ungulates, but also other carnivores in the area. Dogs also chased other animals away from carcasses, depriving them of food resources, which could indirectly lead to the extinction of critically endangered species. A study using data from hunting reports in Poland revealed that free-ranging dogs killed approximately 33,000 wild animals annually [29]. The Brown Hare were shown to be the most popular type of prey among the dogs, and kills by dogs accounted for 3.4% of the estimated brown hare population every year. Consequently, controlling the increasing dog population around the world is essential also for the wildlife ecology and conservation of endangered species.

2.1.3 Health and Welfare of the dogs

Unowned, free-roaming dogs are subject to poor welfare, often lacking adequate food, shelter, and veterinary care. These dogs are also more prone to injuries from traffic accidents and abuse from people in the community, as well as an increased risk of acquiring various diseases. Sterilizations are found to correlate with several positive health and welfare aspects of dogs, such as decreased risk of neoplasia, decreased tendency to roam and fight with other conspecifics, decreased prevalence of diseases, and increased body condition score [30, 31]. Many countries have implemented Catch-Neuter-Return-Programs (CNR-Programs) for free-ranging dogs, where dogs are captured, sterilized, vaccinated, and then returned to the place of capture [32, 33]. Dogs are then able to live free lives with the health and welfare benefits of being sterilized, however, these programs also provide some degree of stressors to the animals, in terms of capture, transport, surgery and possible post-surgical complications. A welfare assessment protocol have been developed so that organizations that carry out the CNR-programs can evaluate the welfare status of dogs they take care of and interventions they perform [34]. Many unowned dogs are captured by animal

organizations or animal control officers and accommodated in shelters. These shelters are often overfilled, thus exposing the dogs to stress, potential diseases, and in the worst case scenario could end in euthanasia [35, 36]. Some dogs also risk spending their entire life in a shelter, so called long-time shelter dogs, with little social interaction and exercise [37]. The long-time shelter dogs are frequently of old age with behavioural issues, and are more sensitive to environmental stressors, thus relaxing in a shelter could be proven difficult. A need to decrease the population of dogs is essential for welfare of dogs all over the world, both for decreasing the population of strays, but also to ensure that less animals are needed to spend their entire lives in a shelter.

2.1.4 The environmental impact

A growing number of dogs leads to an increasing demand for pet food and pet products, which in turn leaves a significant environmental footprint. It is estimated that the entire life of one dog has the environmental impact equal to 7% of the annual climate change impact of an average EU citizen [22]. The biggest contributor to this footprint is the production of pet foods, and a study on the environmental impact of food consumption of Chinese dogs and cats revealed a carbon emission footprint of 2.5%-7.8% of the total carbon emission of Chinese people in 2015 [38]. Halting the growing population of dogs might thus also aid in halting the global environmental crisis.

2.2 Methods of population control

2.2.1 Lethal methods

There are several methods aimed at managing the increasing population of dogs in the world, and studies highly suggest that a combination of certain methods are necessary for successful population control. One of the primary, and probably most used, methods are removal of dogs through culling, which have been implemented in several strategies over the world to control rabies epidemics [39, 40]. Even though studies demonstrate that killing dogs for population control does provide an initial rapid decline in the population size, the long term effects are shown to be unfavourable and the population size increases after a period of time [41]. People have expressed an aversion for this method, stating that it is unethical and not in terms of animal welfare norms [42, 43], and many countries have banned euthanasia as an approach for population control [32, 44]. Nevertheless, some still rely on this method for

reducing their rapidly increasing population of dogs, mainly due to the costs of other measures and lack of resources [45, 46].

2.2.2 Reproductive control

Interventions focusing on reproductive control is a more favourable method and have shown to be more successful in population control when compared to euthanasia [6, 47]. Decreasing the reproductive ability of dogs will naturally decrease the reproductive rate and could provide a better balance of “supply and demand” of wanted dogs in the community. Considering that puppies are more susceptible to disease, preventing the birth of new unwanted litters will consequentially decrease the prevalence of possible zoonotic diseases. There are various ways of enforcing reproductive control measures in dogs, including surgical, and nonsurgical sterilization, such as chemical sterilization and chemical contraception [7]. Surgical sterilization is the most frequently used intervention all over the world, though nonsurgical sterilization methods are becoming increasingly more accepted [48]. There are advantages and disadvantages to both methods. Surgical sterilization requires both pre- and post-operative care, anaesthetics and analgesics, qualified personnel, and it is more expensive, however, it causes a permanent solution with one time intervention. Nonsurgical sterilization methods are generally applied either in a fully conscious state or with light sedation, it is less time consuming and does not require post-operative care. However, the nonsurgical methods do not yet provide a permanent solution, as with the surgical removal of the reproductive organs, and might thus not be as favourable in terms of free-roaming dogs.

In terms of population control, it is shown through modelling studies, that focusing sterilization on young dogs yields a greater reduction in population size, and an even greater decline if also aiming only at female, young dogs[49]. It is also hypothesized that sterilization of dogs leads to decreased roaming behaviour, however, studies of free-roaming dogs have shown that sterilized dogs do not necessarily decrease their range of motion [50, 51].

2.2.2.1 *Surgical sterilization*

There are many different techniques and procedures for surgical sterilization of dogs, including, ovariohysterectomy, gonadectomy, and gonad-sparing surgical sterilization. The

most frequently used method is ovariohysterectomy in female dogs and castration for males. Ovariohysterectomy involve the removal of the whole reproductive tract in female animals [52], which could be considered very invasive to some owners. Gonadectomy in females refers to the removal of the ovaries (Ovariectomy), but the uterus and cervix remain [52]. Sterilization procedure preserving the gonads in female dogs, also called ovary-sparing surgical sterilization (OSH), is a technique which removes the uterus and most of the cervix but keeps the ovaries intact [53]. It is a favourable procedure for those who wish to keep the ovarian function, but don't want their dog to reproduce. However, it is believed that these dogs pose the same risks and benefits as intact dogs, excluding pyometra and pregnancy complications.

2.2.2.2 Nonsurgical sterilization and chemical contraceptives

Chemical sterilization refers to injected or implanted chemicals which renders the animal infertile, and chemical contraceptives prevents the birth of offspring. These methods might be favourable as opposed to surgical sterilization, due to being less costly, less invasive, and more time efficient [5]. There are several types of chemical fertility controls, including hormonal agents, immunocontraceptives/immunosterilants, and chemosterilants. Megestrol acetate (MA), a hormonal agent, is a synthetic progestin which have shown to postpone oestrus in the female dog, however, it is required to be administered orally at a specific time of the oestrus cycle and for eight days straight [54], thus might not be a viable option for unowned, free-roaming dogs. Deslorelin[®], a GnRH agonist, is administered as a subcutaneous implant and has shown to successfully postpone oestrus in the female dog for up to 27 months, and cause infertility in male dogs for up to 12 months depending on concentration [55]. GnRH agonists can cause an initial oestrus and ovulation in female dogs, and thus renders them fertile for the beginning of treatment and must not be left uncontrolled for this period if wanting to prevent pregnancy. Immunocontraceptives cause an immune response against the body's own reproductive hormones and render them inactive, therefore preventing conception [52]. These are favourable in terms of fertility control in stray dog populations, as they can be given orally in bait, or as a vaccine. A GnRH-based vaccine, called GonaCon[™], targets GnRH and prevents the release of Follicle Stimulating Hormone (FSH) and Leutenizing hormone (LH) [5]. One single dose of this vaccine has shown to produce infertility in other animals, however, studies are lacking with regards to the effect and duration of infertility in dogs. A study in Mexico showed promising results with administration of GonaCon[™] vaccine together rabies vaccination in female dogs, where

both experimental groups (with and without rabies vaccine) had decreased progesterone production compared to the control group [56]. Furthermore, immunogenicity of the vaccines were affected with simultaneous injection of rabies and GonaCon™. This could prove to be beneficial for stray dog population management, as it could provide easy, non-invasive fertility control together with mass vaccination campaigns, however, further research on the duration and extent of infertility after administration of GonaCon™ in dogs are needed.

2.2.3 Education

Educational programs are claimed to be equally, if not even more important than other intervention methods, as the willingness of owners to sterilize and confine their animals is critical for curbing the growing population of dogs. Understanding the owner-dog relationships and being acquainted with the attitudes of owners towards pet ownership and sterilization can aid in targeted educational campaigns. One of the major contributors of overpopulation in the US are abandonment of dogs, either directly to the street or surrendering them to shelters. Reasons for surrender is often due to behavioural issues of the dogs, and owners seems to think that relinquishment is an acceptable solution of the problem [57]. Modelling studies show that reducing the abandonment rate significantly decreases the population size, and that the impact of sterilization rate is cancelled out if abandonment rate increases [22]. Educational campaigns which focus on responsible ownership could influence potential owners to think twice before acquiring a dog.

One of the main reasons for owners not wanting to spay or neuter their pets seem to be that they don't think it is necessary as they believe to have control of their pets [58]. Many owners also want to breed their pets [58, 59] and seem to believe that dogs should have one litter before being sterilized [60, 61], although scientific literature indicate that prepubertal sterilization results in healthier dogs [62]. It could therefore be important to provide accurate information to the public regarding health benefits of sterilization and importance of population control, so that more people will be willing to spay or neuter their pets. The younger population in the US have problems with seeing the importance of sterilization and seem more concerned about the potential negative effects of the procedure [63]. Attitudes regarding sterilization of pets can vary depending on cultural, societal, economical, and educational differences, and it is imperative to take these into consideration when planning a sterilization campaign or program.

2.2.4 Legislation

Legislation can be a tool to provide a framework of how countries shall encounter the problem of overpopulation of dogs. This can be achieved through federal, national, and central legislations. A good national regulatory framework is essential for an effective control strategy, and the OIE recommend that it should include among others, registration and identification, vaccinations, veterinary procedures, and regulations on breeding and sale of dogs [7]. Legislation can enable countries to command owners to register and sterilize their pets, and assorted legislative norms are already implemented in several countries. For example, in Norway and Germany it is considered illegal to sterilize your dog unless it is for medical reasons [64, 65], and other countries, require sterilization procedures for all pets that are eligible for adoption through both private and public shelter facilities.

2.3 Demographics and population studies

2.3.1 Dog ownership and Demographics

It is important to understand the demographic patterns and the pet ownership dynamics in a country or region to successfully plan and implement population control measures. Population dynamics describes how a population changes over time, and population dynamics modelling can be a useful tool to see the effectiveness of various control measures [66]. Modelling predicts the required extent of interventions to successfully achieve the wanted goal, which in case of dog population control is reducing the overall population size. Factors affecting population size depends on whether the population is considered open or closed. Closed populations are solely dependant on the birth and death rates within the population, whereas open populations both receives and loses animals from and to the outside. A study used mathematical modelling to determine factors affecting the dynamics of owned and stray dog populations, which revealed complex interactions between abandonment, sterilization rate, adoption rate and the overall population size [47]. They found associations between a decrease in population size and increased sterilization rates, however, sterilization rates were highly influenced by both immigration and abandonment rates. Increased abandonment halted the effect of sterilization rates, leading to an increase of stray dogs, whereas immigration impeded the effects of both sterilization and abandonment. Another study developed an agent-based simulation model to investigate the

impact of dog management methods and what type of control regime was most effective in northwest India, where the demographic and behavioural variables matched the dog population in Jaipur [41]. Here they found that the largest reduction in population size was achieved with an informed-percentage fertility control method, where the chance of placing a capture team was greater in areas with higher proportions of unsterilized dogs. The study also compared fertility methods with lethal methods of control and revealed that although lethal methods provided an initial decline in population size, it quickly bounced back due to the remainder of animals being able to reproduce and have less competition for resources. Thus, population modelling can be effective tools in order to find the most efficient ways of controlling a said population and can provide estimates of the proportion of animals and the time required for successful interventions.

2.3.2 Dog population estimation

Estimation of population size is vital for planning and monitoring the success of the control measures implemented in a country. There are various methods for estimating dog population size, including plot sampling, distance sampling, mark-recapture methods, and surveys [67]. The most precise method of obtaining population size is through complete census surveys, where every individual in the population is counted, though this is practically not feasible and generally not used. Mark-recapture methods have been frequently used to estimate free-roaming dog populations in several cities [68–72]. With this method the total number of dogs present in the area at the first sighting are counted and marked. Markings can be done in various ways, with physical markings, such as paintings or tattoos [68], or with the help of using photographic tools [73]. At the second sighting the total number of animals are counted again, but the number of marked animals are recorded as well. The data retrieved from the sightings are then used to calculate the estimated population size in the area. This method is a good way of estimating population size of free-roaming and stray dogs, especially since it is possible to perform without imposing the stress of capturing the dogs. However, for the estimation to be accurate it would have to assume a closed population (no emigration, immigration, births, or deaths), which is not a representation of the real-life scenario, nonetheless this can be achieved with short intervals between the first and second samplings.

When considering dog population control interventions, it isn't enough to only estimate the population of free-roaming dogs, but one has to consider the owned dog population as well, as they both contribute to the problems associated with overpopulation. The most frequently

used method for estimating owned dog population size are different type of surveys, for example via door-to-door, telephone, or online surveys [17, 69, 74]. Pet product associations frequently hold surveys and provide reports of the number of pets owned in their country, as their business success is largely driven by these numbers, and they can estimate potential revenue. For instance, the American Pet Products Association (APPA) have biannual surveys estimating the population size in the US [8], and the European Pet Food Industry (FEDIAF) provide a report every year on the estimated population of animals in the European countries [12]. These surveys often cover a large base, and usually include the various demographic groups in the country.

2.4 Commercial breeding and puppy trade

The increasing demand for puppies must be met in some way or the other, and commercial dog breeding provides an easy access to puppies through sale in pet stores or online retailers. Commercial dog breeding may contribute to the overpopulation of dogs by producing immense numbers of puppy litters every year. Breeders usually provide dogs of specific purebreds or so-called “designer” breeds, with specific phenotypic and behavioural characteristics which owners are specifically looking for. However, the easy accessibility to buy dogs makes it difficult to evaluate the owners knowledge, experience, and motivation before purchase. The easy access further provides a market for impulse buying, and consequently, could potentially result in abandonment due to a mismatch between owner and dog. A range of unwanted behaviours, such as aggression, fearfulness and separation anxiety, have been reported for dogs coming from pet stores or commercial breeding facilities [75]. Given that behavioural problems are thought to be one of the most common reason for abandonment [57], the sale of dogs through these channels might contribute to increase in relinquishments and an increasing burden of unwanted animals in society. Commercial dog breeding establishments are often scrutinized due to the welfare concerns of the breeding animals, which are kept for the sole purpose of producing puppies, and of the puppies produced [76]. Providing adequate housing, exercise, and enrichment for such large volumes of dogs could be difficult, and an ethical question arise for what happens to the breeding dogs after their breeding career is over. One could also question whether it is satisfactory to produce such high volumes of puppies without a guarantee of a home.

3 Objectives/Aim of this study

The aim of this study is to provide review of the literature on dog population control in general, and further examine the legislations and regulations in USA, Italy, Germany, and Norway with regards to sterilization and breeding of dogs. Furthermore, this study will also investigate how animal welfare and rescue organizations in the respective countries work towards preventing overpopulation of dogs.

4 Methods

4.1 Population statistics and demographics

The human population statistics for each country was retrieved from the US census bureau [77], which provide estimates based on census, surveys and administrative information. Data of the estimated number of dog populations in the US, Italy, Germany and Norway was gathered from the American Veterinary Medical Association [8], Fédération Cynologique Internationale (FCI) [78], The European Pet Food Industry (FEDIAF) [12], Industrieverband Heimtierbedarf e.V. [19] and Nordic Pet Food Association [18], respectively. The estimated number of dogs per capita was calculated by dividing the estimated dog population size, retrieved from the respective associations, with the estimated human population size.

4.2 Legislation

Review of the animal welfare legislations and dog keeping regulations in Germany, Norway, Italy, and the United States of America. The laws and regulations were found on the governmental websites of the countries and regions. National german legislation were acquired from the Bundesministerium der Justiz und für Verbraucherschutz. National regulations were included for all four countries, and regional/state laws in Germany, Italy, and the US. The legislations primarily regulating sterilization and breeding regulations, but also those regarding prevention of stray animals, were included in this review.

4.3 Animal Welfare organizations

As animal welfare organizations and animal control agencies greatly participates in the management of overpopulation of dogs, this study also looked at what measures some organizations in Germany, Italy, Norway, and the US are implementing either nationally or

locally. Google search engine was used to search for animal welfare organizations in the respective countries, with search words such as “Animal Welfare Organizations in the US”, “Tierschutzorganisation”, “Organizzazione per il benessere degli animali” and “Dyrevernorganisasjoner”. As there are numerous international organizations working on animal welfare related issues worldwide, this study focused on organizations that preemptively worked with issues in their own country. This study excluded organizations which only aimed at welfare for food-producing animals. A list of organizations included in this study, as well as country of origin and founding year, can be seen in table 1. This review further looked at what their main topics of interest were and which campaigns relating to dog overpopulation the organizations are executing.

Table 1 List of the animal welfare organizations and their main topics with regards to dog control presented in this review

Country	Organization	Founding year	Main interest topics relating to dogs
<i>Germany</i>	PETA Germany	1980	Sterilization for cats and dogs, Petition for pet protection law, Puppy trade
	Deutscher Tierschutzbund E.V.	1881	Puppy trade
	Action Animal Awareness	1985	Puppy trade
<i>Norway</i>	Dyrevernalliansen	2001	Adopt, don't shop
	Dyrebeskyttelsen	1859	Mandatory identification of animals, Adopt, don't shop
	NOAH	1989	Primarily educational campaigns, political engagement, influence law making
	Dyrehjelperne	2013	Unserious breeding, bid adversary against abandonment, Puppy trade, mandatory microchipping, central register for all dogs
<i>Italy</i>	ENPA	1871	Shelters, animal rescue, cooperation with municipalities
	ANPANA	1985	Supervision on compliance with legislations and regulations
	LNDC	1950	Daily management of shelters/Oases
	LAV	1977	Care for “community-dogs”, shelters, adoptions, influence law making
	ALFA	2012	Adopt-don't shop, reduce abandonment, sterilization campaigns, free microchipping campaigns
<i>USA</i>	ASPCA	1866	Shelters, spay/neuter services
	The Humane society	1954	Puppy mills
	American Humane	1877	
	Planned Pethood International	1990	Offer affordable veterinary service to everyone, low cost spay/neuter clinics

5 Results

5.1 Population statistics and the stray dog problem

The size of the human and dog populations in the countries, as well as the number of dogs per inhabitant, can be seen in table 2. Research regarding number of stray animals in any country is scarce. According to a report on stray animal control practices in Europe by the Royal Society for the Prevention of Cruelty to animals International (RSPCA), both Norway and Germany consider themselves free from the problem with stray dogs, and Italy have an unknown, but stable size of population of strays [79]. According to a survey initiated by the animal welfare organization LAV in Italy, the number of stray dogs have improved from 2006 to 2017, with a decline of 23% in number of dogs present in the shelters nationally [80]. In the US the data on number of stray animals is also limited, however, intake data from animal shelters are available from the “Shelter animal count” which gather data from animal rescue and animal welfare organizations all over the country [81]. According to a report on shelter intakes and outtakes, stray animals were the primary source of intakes in 2020 comprising of 46.9% of the total intakes, and thus implying that stray animals very much are a part of the animal population in the country [82]. Furthermore, the report states that an average number of 1,2 million dogs were taken into shelters during the year 2020.

Table 2: Human and dog population numbers, presence of stray dogs, and population management strategies in Norway, Germany, Italy, and the US.

Country	Norway	Germany	Italy	US
Human population	5.5 million[77]	79.9 million [77]	62.4 million [77]	332 million [77]
Dog population	480,000[18]	9,4-10,7 million[19]	8,3-15 million[12]	77 million[8]
Dogs per inhabitant	0,09	0,12-0,13	0,13-0,24	0,23
Stray dogs	No	No	Yes	Yes
Laws on stray dog prevention	No	Yes	Yes	Only state legislations
Mandatory sterilization	No	No	For shelter dogs	For shelter dogs
Population management strategies	Education and responsible ownership	Education, responsible ownership, dog tax & licensing	Sterilization campaigns, municipal shelters, mandatory registration in registry, education on responsible ownership & birth control	Sterilization campaigns, shelters, adoption campaigns, education on responsible ownership and birth control
Dog tax	No	Yes	Yes	In some states

5.2 Legislation and Regulations

5.2.1 German legislation

Germany have two federal laws, the animal welfare act (Tierschutzgesetz) [65] and the Animal Welfare Dog regulation (Tierschutz-Hundeverordnung) [83]. The animal welfare act §5 prohibits surgical interventions unless it is required based on veterinary suggestion, however, it allows for surgical interventions if the purpose is for population control [65]. The law further requires permission from the competent authority for engaging in commercial breeding of animals, and for keeping animals in shelters or similar services. Furthermore, according to the animal welfare dog regulation, puppies are not to be weaned before the age of eight weeks old and commercial breeders are required to provide a supervisor with sufficient knowledge and skill to look after up to 10 dogs and their puppies [83]. The individual states in Germany have local legislations with regards to keeping dogs, however, many of these regulations are specified only towards keeping and breeding of dangerous dogs. The states of Bavaria, Saxony, Rhineland-Palatinate, Hesse, Saarland, and Baden-Württemberg only have regulations specified for keeping of dangerous dogs. Laws with mandatory leashing on dogs traveling in public areas are present in five states in Germany [84–88], and Hamburg and Bremen require female dogs in heat to be leashed during the reproductive period [84, 89]. Mandatory identification with a microchip is required in six states for all dogs [84, 86, 88, 90–92], in Hesse and Saarland only for dangerous dogs [93, 94], and in Brandenburg and North Rhine-Westphalia only for dogs over 40 cm in height and more than 20 kg bodyweight [85, 88]. Dog tax is required in all states.

5.2.2 Norwegian legislation

In Norway the animal welfare law and the dog law (Hundeloven) are the legislations that are significant in terms of keeping dogs and dog control [64, 95]. According to the animal welfare law §9, medical and surgical interventions are prohibited unless there is a justifiable reason based on the animals health [64], there is no specification regarding permission of sterilization for the management of overpopulation of animals. In Norway it is required that owners keep their dogs on a leash between 1st of April and 20th of August (Dog Law §6) [95]. There are no laws that require mandatory identification of the dog, only mentioned in the animal welfare law that it is allowed with regards to surgical interventions on animals [64]. There are barely any regulations on breeding dogs, only in the animal welfare law § 25, that breeders are obliged to promote good health and function of the animal [64]. The

Norwegian dog law §10 also stipulate that dogs that are found straying should be taken in and returned to the owner of the dog, if the owner is present [95]. If the dog is not picked up by the owner within one week after given notification, the police is able to sell, adopt out or euthanize the animal.

5.2.3 Italian legislation

In Italy, the law n. 281 14th August 1991 specifically concentrates on the protection of pets and implementation of stray prevention [13]. It stipulates in article 2 that stray dogs found on the street should be captured, checked for identification, and if not identified, shall be microchipped, sterilized, and vaccinated before eventual adoption. Euthanasia of any dog is prohibited in this law, unless the dog has an incurable injury or disease, or is proven to be dangerous. The law furthermore requires all dogs to be microchipped, which is the only approved identification method since 2005 (Decree of the Prime Minister, 28 February 2003), and to be registered in a regional and central database register. According to the law of n. 281, regions can regulate their own laws and adopt own stray prevention programs. The law furthermore allows for the creation of community dogs, and it is up to the regions to set this into motion and clarify the criteria for taking care of this group of dogs. The regions Abruzzo [96], Campania [97], Latium [98], Liguria [99], and Puglia [100], all have implemented the community dog in their regional laws for the protection animals and prevention of stray dogs. The community dog is defined in the legislature as a stray dog that is captured, identified with a microchip, sterilize, vaccinated, and then released to the place of capture to live a free life. The local veterinary service must declare the dog undangerous for the human public, and it is also required for the free dogs to wear an identification tag that can be visible from a distance. Failure to comply with the law can result in fines or even jailtime. As with the law in Germany, the Italian dog law require dog owners to pay a dog tax.

Dog breeding activity in Italy is regulated by law n. 349 of August 23rd 1993, which defines commercial breeders as persons having 5 or more intact female dogs on their premises and produce 30 or more puppies a year [101]. It is also stated in this law, that breeding of purebred dogs shall comply with the regulations set forth by the Italian national Dog Association (ENCI). Most regions in Italy follow this national regulation in terms of defining a commercial breeder, however, the regions of Emilia-Romagna and Friuli-Venezia Giulia

defines a person as a commercial breeder if said person has more than 3 breeding females or 10 puppies per year [102, 103].

Each region in Italy have implemented regional laws for the management of the Canine Registry and the prevention of stray animals. In each region, the veterinary service of the competent health unit are the ones responsible for the registration and updating of the canine registry, and the implementation of the permanent identification code. Only the veterinary service of the competent health unit is allowed to capture stray dogs and deliver them to a suitable facility. Stray dogs found wandering without identification, but where the owner is claiming the dog, will be, in accordance with the regional laws, identified and registered in the database at the owner's expense before release. Dogs found wandering without identification shall be held in a temporary shelter for a certain amount of time before being discharged to the custody of welfare organizations, or to private individuals who wants to adopt the animal. The time period for how long dogs are temporarily held in shelters before being considered surrendered varies between regions, with the majority of Italian regions having a deadline of 60 days [96, 98–100, 102–114]. The regions of Calabria and Campania allows for a temporary holding of dogs for 30 days [97, 115], whereas Molise require a holding period of 90 days before the dog can be released to a new owner [116]. All regions in Italy require dogs to be identified and registered in the regional database, vaccinated, and sterilized before being released to new owners or animal welfare organizations [96–100, 102–117].

5.2.4 Legislation in the US

In the United States of America there are no federal laws regulating sterilization programs or strict breeding restrictions in dogs, however, the animal welfare act of 1966 does require a license for anyone who wish to breed or sell animals and who has more than four intact breeding females in their care [118]. Nevertheless, several states have implemented varying degrees of regulations in terms of sterilization requirements. There are no mandatory sterilization requirements for all dogs in any state in the US, but the majority of states in the US require dogs to be sterilized before being adopted from a public or private animal shelter, or a similar facility, as can be seen in figure 1.

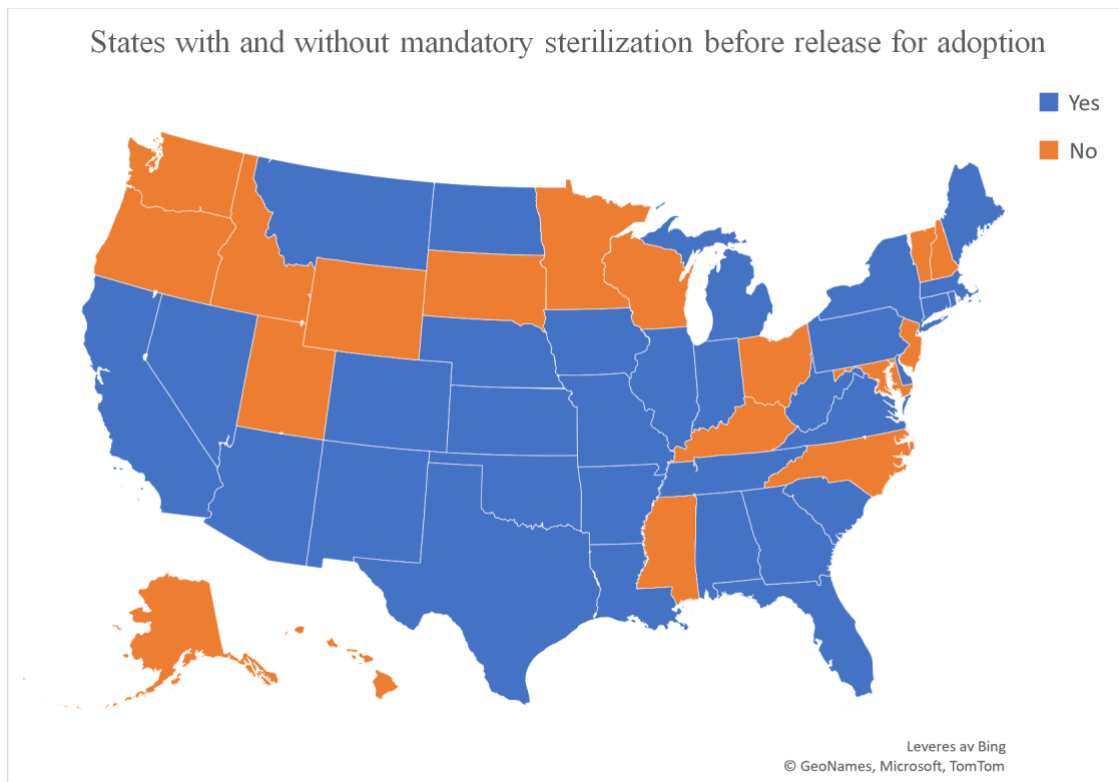


Figure 1: Map made in excel showing the states in America having implemented mandatory sterilization before release from adopting agency in the laws and regulations of the states.

There are various degrees for the regulations regarding sterilization of shelter dogs in the different states. Of the thirty-one states having mandatory sterilization laws for adoptable dogs in shelters, twenty-three of them allows for a written agreement between the adoptee and the releasing agency that allows for adoption before the animal is sterilized [119–139]. The written agreement usually involves a specified deadline for the completion of the procedure, and a deposit to be paid to the releasing agency, which the adoptee is refunded upon providing written proof signed by a licensed veterinarian, that the dog has been spayed or neutered within the set deadline. Arkansas, Illinois, and Indiana do not allow such an agreement, they require the animals to be sterilized solely before the adoption takes place [140–142]. Whereas Colorado, Delaware and California only permit such written agreement if the dog is too sick at the time of adoption to undergo surgery and require specification in the written agreement that the animal is to be sterilized shortly after the dog is declared healthy by a licensed veterinarian [143–145]. An overview of the requirements for the mandatory sterilization regulations by each state can be viewed further in table 3.

Ohio, Vermont, North Carolina, and New Hampshire are states that do not have obligatory sterilization requirements for dogs adopted from animal shelters, however they have implemented animal population control programs into their legislations instead [146–148].

Ohio and North Carolina have state regulated special financial accounts to aid low-income families to sterilize their pets either for free or to a greatly reduced fee. §19A-61 of the Animal Welfare Act in North Carolina states that the Department of Agriculture shall develop a state-wide educational program and have a population control fund to subsidize sterilization and vaccination programs [147]. The pet fund in Ohio, stated in the OH Rev Code §955.201, shall provide criteria for which organizations that are eligible for financial aid and which procedures that can be applied for, as well as stating the criteria that enables owners to apply for subsidized sterilization services [146]. West Virginia is the only state in the US which have implemented a spay/neuter program into the legislation in addition to obligatory sterilization of adoptable dogs from shelters [138]. According to §19-20C-1, the department of agriculture is obliged to create a spay and neuter assistance program that offer financial aid to non-profit organizations that offer subsidized sterilization services to people in the state, and §19-20B-2 states that no dogs or cats are to be released from any agency unless already sterilized or there is a written agreement between agency and adoptee to have the animal sterilized.

State laws in the US regulating the commercial breeding establishments of companion animals is scarce, and the requirements are limited. About half of the states in the US regulate commercial breeders by law, which generally require these breeders to obtain a license, pay a fee, having inspections and follow a minimum set of standards of care. However, there are no joint agreements for what defines a commercial breeder in the legislations, and the requirements for obtaining a commercial breeder license varies greatly, ranging from only having 2 or more litters in Connecticut to having 20 or more intact female dogs in Indiana [142, 149]. Four states have set limits on the number of intact dogs allowed to obtain at any time on the premises, with Oregon, Virginia and Washington limiting the number to 50 dogs [137, 150], and Louisiana (LSA-R.S.2772) having a maximum number of 75 dogs [124]. The state of Missouri did have a maximum limit of 50 owned breeding dogs, however, this law was removed during the 2011 amendments [127]. Three states, Washington, California, and Maine does not allow sale of dogs through pet stores [125, 150, 151]. The West's Annotated California Health and Safety Codes §122354.5 states that dogs are not to be sold through pet stores, and that they are only allowed to display animals for adoption if it is organized by an animal shelter or rescue organization [151].

Table 3: Showing the states in America with mandatory sterilization laws for adoptable dogs from shelters, and whether they allow for a written agreement and deposit until sterilization procedure is completed. **A** = Adult dog, **P** = Puppy.

State	Written agreement	Deadline for completed procedure	Deposit	Deposit amount
Arkansas	No	N/A	N/A	N/A
Illinois	No	N/A	Not specified	N/A
Indiana	No	Not specified	Yes	\$75
Colorado	Only if it jeopardizes the health of the dog	Not specified	Not specified	N/A
Delaware	Only if sick or >6 months of age	Not specified	> 6 months of age	\$75
California	Only if declared unfit for surgery.	Within 14 days after declared fit for surgery	Yes	\$40-\$75
Alabama	Yes	A: 30 days P: 30 days after sexually mature	Not specified	N/A
Arizona	Yes	A: 30 days P: 15 days after turning 6 months	Yes	Comparable to lowest fee charged by vets in county
Florida	Yes	A: 30 days P: 30 days after sexually mature	Yes	N/A
Georgia	Yes	A: 30 days P: 30 days after sexually mature	Not specified	N/A
Iowa	Yes	As soon as possible, ownership not transferred until surgery is done	Not specified	Not specified
Louisiana	Yes	A: 30 days P: 30 days after turning 6 months	Not specified	N/A
Maine	Yes	Appointment with vet must be within 30 days after adoption	Yes	100% of the cost of scheduled surgery
Massachusetts	Yes	Not specified	Yes	Not less than \$40
Missouri	Yes	A: 30 days P: 30 days after turning 6 months	No	N/A
Montana	Yes	A: 30 days P: 30 days after turning 6 months	Yes	Comparable to lowest fee charged by vets in county
Nebraska	Yes	A: 30 days P: 30 days after turning 6 months	Not specified	Not specified
New Mexico	Yes	A: 30 days P: 30 days after turning 6 months	Yes	At least \$25
New York	Yes	A: 30 days P: Before turning 6 months	Yes	No lower than \$35
North Dakota	Yes	Not specified	Yes	Not specified
Oklahoma	Yes	A: 60 days P: 30 days after turning 6 months	Yes	Not under \$10
Pennsylvania	Yes	A: 60 days P: 30 days after turning 6 months	Yes	Not less than \$30
Rhode Island	Yes	Not specified	Yes	Equal to cost of spaying
South Carolina	Yes	A: 30 days P: Before turning 6 months	Not specified	Not specified
Tennessee	Yes	A: 30 days P: 30 days after turning 6 months	Yes	Not less than \$25
Texas	Yes	A: 30 days P: 30 days after female turning 6 months or male 8 months	No	N/A
Virginia	Yes	A: 30 days P: 30 days after turning 6 months	Up to the releasing agency	N/A
West Virginia	Yes	A: 30 days P: 30 days after turning 6 months	Yes	Not more than \$50
Michigan	Yes	A: 4 weeks P: 4 weeks after turn 6 months	Yes	At least \$25
Nevada	Yes, if animal is less than 4 months.	Animal must be sterilized before the dog is 4 months old	Yes	Equal to cost of sterilization, or \$25
Connecticut	Yes, owner receives voucher after paying \$45 to be used for sterilization	Not specified	Not specified	no

Table 4: State laws defining commercial breeders and number of breeding animals allowed.

States	Number of dogs that trigger the law	Maximum number of dogs allowed
Arizona	5 or more dogs	Not specified
California	3 or more litters 20 or more dogs	Not specified
Colorado	Not specified	Not specified
Connecticut	more than 2 litters	Not specified
Delaware	4 or more dogs	Not specified
Illinois	5 or more intact females	Not specified
Indiana	20 or more intact females over 1 year of age	Not specified
Iowa	3 or more dogs	Not specified
Kansas	6 or more litters 30 or more dogs	Not specified
Louisiana	5 or more dogs	Shall not maintain more than 75 dogs over the age of 12 months at any time for breeding purposes
Maine	5 or more intact female dogs	Not specified
Maryland	Not specified	Not specified
Massachusetts	Not specified	Not specified
Michigan	15 or more intact female dogs over 4 months of age	Not specified
Minnesota	10 or more adult intact female 5 litters per year	Not specified
Missouri	more than 10 covered female dogs	Law limiting the number of dogs to 50 dogs was deleted in the 2011 amendments
Nebraska	4 or more litters 4 or more dogs	Not specified
Nevada	Not specified	Not specified
Ohio	9 litters or selling 60 or more adult dogs or puppies	Not specified
Oklahoma	11 or more intact female animals	Not specified
Oregon	10 or more intact dogs over 8 months	50 dogs
Pennsylvania	Not specified	Not specified, but license fee increases based on number of dogs
Tennessee	20 or more intact female dogs	Not specified
Texas	11 or more intact female dogs	Not specified
Vermont	Sale of more than 1 litter per dog a year, or 2 dogs over 6 months of age per year	Not specified
Virginia	30 or more adult female dogs	No more than 50 dogs
Washington	10 or more intact dogs over 6 months	No more than 50 dogs, do not apply to commercial breeder licensed before January 1st 2010 by the USDA
West Virginia	11 or more intact dogs over 12 months	Not specified
Wisconsin	Selling 25 or more dogs a year	Not specified

5.3 Work of Animal Welfare Organizations in Germany, Norway, USA, and Italy

As one would assume, the work of the animal welfare organizations in Germany and Norway differs from the organizations in USA and Italy in terms of which topics they focus on. The animal welfare organizations in Germany and Norway push for mandatory identification, perform adoption campaigns, and educate the public on responsible ownership. Whereas the organizations in Italy and US also work with educational programs for responsible ownership and adoption, however, they also push for sterilization procedures of dogs. The animal protection (Dyrebeskyttelsen) is most likely the largest animal protection organization in Norway and focus much of their work towards reducing the number of homeless animals in the country [152]. The organization have annual information campaigns highlighting the number of animals waiting for adoption, provide shelters for unwanted animals, and lobby for legislation to make identification of animals mandatory. However, they focus very much of their work towards homelessness of cats. Two of the biggest animal welfare organizations in Norway, The animal welfare alliance (dyrevernalliansen) and NOAH, works primarily with political initiatives and education of the public concerning responsible dog ownership [153, 154]. The animal helpers (Dyrehjelperne) are big adversaries against animal abandonment, and works toward mandatory identification of both dogs and cats, but also wants to have a national canine register for all dogs in the country [155].

Italian animal welfare organizations take part in the municipal stray dog prevention programs. The National Animal Protection Authority (ENPA) is Italy's oldest welfare organization with shelters nationwide providing temporary placements for animals in need[156]. The National Association for the Protection of Animals, Nature and the Environment (ANPANA) aid the local governments and police forces in supervision of compliance with the animal protection law [157]. The organization has special officers which carry out the tasks related to the canine registry, abandonment of dogs, control of kennels and stray dogs, and they manage shelters nationwide for the housing of stray animals. ANPANA also run campaigns for identification with microchip, ensuring that owners comply with the identification law and register their animals in the canine register. LAV is an animal association also present throughout Italy, providing information and education of the public, and care for community dogs in terms of providing food and parasite treatment [158].

The American Society for the Prevention of Cruelty to Animals (ASPCA) is a non-profit nationally recognized animal welfare organization [159]. They have animal shelters all over the country and provide both partially or fully subsidized spay and neuter surgeries for low-income families, either through a mobile or stationary spay/neuter clinic. In the year of 2020 the organization performed just over 47,000 spay and neuter surgeries and relocated almost 28,000 animals for adoption [160]. The organization also provides, through the ASPCA Spay/Neuter Alliance, an onsite or virtual training program for veterinarians, which focuses only on spay and neuter surgeries [161]. Along with the hands on approach on helping families to sterilize their pets, they also push for changes in legislations, and current issues that the organization prioritizes include ending of retail puppy sales and further support of subsidized spay and neuter programs [162]. The Humane Society Of the United States (HSUS) is a non-profit national animal advocacy organization which works for the protection and welfare of all animals [163]. One of their biggest fights is to stop the puppy mill industry, and they provide an annual report to educate the public with lists of the current puppy mills in the country. With regards to stray animals, HSUS provide programs for mass vaccination and sterilizations, and have partially or fully subsidized veterinary care options for both owned and unowned animals. HSUS does not directly manage shelters for ownerless animals, however, they advocate for adoption through different campaigns, such as the Shelter Pet Project [164] and pets for life [165]. Planned Pethood International (PPI) is an organization which exclusively focuses on low-cost sterilization services and emphasize that ending overpopulation of dogs is best done through spay/neuter programs, educational campaigns and changing legislations [166]. The PPI also aid with adopting out dogs looking for a new home and has a strict policy of not giving a dog to a family that has a pet that is unaltered.

6 Discussion

The four countries in this review have very different degrees of legislation on dog keeping and population control, as one would assume since the level of dog population problems vary depending on the country. The national legislations in Germany and Norway are quite unspecific and deal with dog keeping in general, whereas Italy and the states in the US have more precise regulations for dog population control. The legislations in Italy and most of US states share similarities in terms of requiring sterilization before adoption, and that shelter

and kennel facilities must be registered in a regional database. Although Italy is stricter with nationwide mandatory registration and licensing of all dogs, compared to only a few states in the US, and requires kennels and shelters to hold a special register with information about intakes and outtakes. Germany seems to be some place in the middle of strictness, compared to the other three countries, with mandatory licensing and registrations in some regions, but require taxes for all dogs nationwide.

For legislation to be an effective contributor for dog population control it is necessary for the public to be compliant with the regulations that are set forth. One way to see if the legislations and regulations are efficient is by looking at the shelter trends for intakes and outtakes in the country. In Italy it is thought that there is a decline in stray dog populations after the law n. 281/1991 on stray dog prevention has been implemented, however, research regarding the stray dog populations before and after the implementation of this law is limited. There also is not much research on shelter trends in Italy, however, one study on the intake trends of a shelter in the Abruzzo region discovered that there were no significant change in the proportion of dogs that entered into the shelter over a 14 year period after the law was set in order, besides a large percent of captured owned dogs were unsterilized and unlicensed [15]. The LAV report on shelter intakes and outtakes in Italy in 2016 and 2017 reports that the south and central regions of Italy, including the Abruzzo region, have a higher entrance percentage compared to the north regions [80]. It further states that the percentage of dogs returned to their owner is a low 6% in the south regions, compared to 69% in the north. The low number of returns could indicate a low number of registered dogs in the database, which makes it difficult for the shelter workers to locate the owners. This is supported by studies which have used the regional database registers to estimate dog populations in the Latium and Veneto regions [16, 17]. Both studies found discrepancies between the estimated number of dogs in the area, and the number of dogs registered in the databases, suggesting that a proportion of Italian owner's do not comply with the law and do not register their dogs as requested by the government. However, the Latium study did suggest that there was an increase in number of registered dogs in the database after the registration process became computerized and the regional authorities implemented awareness-campaigns [16]. Another study in Teramo found that 72% of dog owners in the Teramo province knew about the regional register, but 28% of these owners had at least one dog that wasn't registered [14].

In the US the dog control legislations are decided by each state, and many states have realized laws that require dogs to be sterilized prior to adoption. Woodruff and Smith investigated trends in shelters nationwide in the US and discovered some differences among shelters in the south and west regions [10]. Shelters in the south were subject to larger numbers of intakes, increased euthanasia rates, and less probability of returning dogs to owners, compared to shelters in the West. This could possibly be explained by differences in legislations in these regions, and in the south there are only two states that do not have mandatory sterilization laws for shelters and the seventeen other states without mandatory sterilization laws are located in the west and northeast regions. They also found that municipal shelters received more intakes, especially in terms of stray dogs, than private shelters [10], which could furthermore strengthen the hypothesis of legislation being the reason for the difference in intake rates. As states with mandatory sterilization laws possibly have a larger number of municipal shelters that will comply with the legislations set by the government. Nevertheless, the southern states, except Virginia and West Virginia, do not have mandatory sterilization laws for dogs, which could explain the low return rate of dogs in shelters in these states. It would be interesting to compare shelter intake and outtake trends in states with stricter and less strict sterilization laws and look at the sterilization rates of shelters in these states for further research.

Control of the reproductive ability of dogs is the most common intervention recommended in dog population control methods, and it is highly suggested that countries struggling with overpopulation of stray dogs should implement sterilization into their program for stray dog prevention. However, why is it that countries, such as Norway and Germany where sterilizations of dogs is not legal unless it is for medical purpose, do not have the same problem of stray dogs as countries where sterilization procedures are more common? The RSPCA report about stray dog prevention in European countries suggest that low numbers of stray dogs is concurrent with comprehensive legislations regarding animal welfare, identification, and licensing[79]. Another study revealed that there seemed to be a correlation between the United Nations Human Development Index (HDI) and the degree of stray dog problems, where medium and low-HDI countries were more likely to have issues with stray dog populations [167]. However, all four countries in this review are considered countries of high development index, but still with very different degrees of stray dog populations. Countries of high HDI index in the RSCPA study reported registration of dogs as the most common control method, which could be explained by having more economic

freedom to develop electronic databases. Nevertheless, there are no mandatory registration laws in Norway and Germany only have a national requirement for dog tax, yet they still consider themselves free of stray dogs. This could be due to cultural and societal beliefs, and different attitudes regarding ownership responsibility. Current research regarding dog population size, demographics and shelter statistics are scarce both for Norway and Germany. Further investigations should look into dog population demographics and shelter statistics in Germany and Norway, and explore attitudes of the dog owners in these countries towards stray dogs and sterilization procedures.

Regarding breeding legislations, the countries differ here as well. Norway is the country with least law mandated regulations with regards to breeding, they only require that breeders shall promote good health and welfare of the offspring, however, this does not mean that Norway is free of commercial breeders, as the emergence of puppy mills have been discovered and exposed in the media throughout the years. In Germany, breeders are obliged to apply for a license, though it is not specified at what number of dogs the license is required. However, there is a new ordinance for an amendment to the dog regulation law in Germany, which limits breeders to have a maximum of 3 breeding dogs per year [168]. This will make it more difficult for commercial breeders to breed dogs lawfully at extreme rates, however, it could also lead to an increase in illegal breeding of dogs and increase of puppy trade from other countries, as the demand for puppies most likely will not decline. Italy and states in the US have more comprehensive regulations regarding breeding of dogs, and both Italy and some states in the US have defined commercial breeders in their legislations. A commercial breeder in Italy is defined as a person having more than five intact female dogs and who produce more than five puppies a year, but there are no limitations as to how many dogs a breeder is allowed to keep. In the US, however, the definition of a commercial breeder varies depending on state, though four states also have set a maximum limit of dogs allowed to keep per breeders license. There is a lot of controversy regarding commercial dog breeders all over the world, and most animal welfare organisations oppose sale of dogs in such a commercial manner. However, the demand for puppies will most likely not disappear and a complete ban on commercial dog breeders will not be feasible, as that could result in the emergence of illegal breeders with unsupervised activity and poorer animal welfare.

7 Conclusion

Even though dog overpopulation is a global issue, there seems to be no “one-size-fits-all” approach to manage the problem. As various countries have different degrees of the problem, different interventions are also needed. Since Germany and Norway both consider themselves stray dog free-countries they might not think it is necessary for drastic measures and possibly have more faith in their citizens for controlling their own animals. Italy and the US have had problems with stray dogs and overpopulation over many years, and thus it might have become a part of their culture and everyday lives, which could be difficult to change, even with more comprehensive legislations. Research is still lacking with regards to investigating the actual effects of interventions implemented, and it is essential to consider the effectiveness of the different approaches. It is evident that Italy, Norway, Germany, and the US have different approaches as to how to combat the issue of dog overpopulation with legislation, however, it is not evident as to which strategy is the best, as evidence of dog population demographics is lacking, especially in Norway and Germany.

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