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# International Best Practice: Possible Solutions of the Stray Animal Problem

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## ABSTRACT

Stray dog and cat overpopulation creates problems throughout the world regarding public health, animal welfare, and wildlife. There are no common European regulation concerning stray animal control, hence it is controlled on a national level which results in different approaches between the countries. Certain countries utilize reproductive control methods such as surgical (gonadectomy), and non-surgical methods (hormonal methods, immunological methods, and chemical or physical sclerotization methods). However, other countries attempt to decrease stray animals through lethal methods including euthanasia drugs, shooting, and poisoning. In addition to reproductive and lethal methods, effective and enforced legislation as well as educational courses on pet ownership are mentioned as possible control strategies. The aim of the thesis is to provide information concerning the different stray control practices, including topics such as definitions of stray animals and shelters, origin of stray animals, population data, consequences of stray animal overpopulation, strategies to control populations including reproductive and lethal methods, national legislation, and educational courses. Further objectives consist of finding a potential solution for the stray animal problem through examining European practices which have an efficacious stray animal management. According to the Norwegian Veterinary Institute, stray dogs do not exist in Norway. Based on information provided by animal welfare organizations, there are thousands of stray cats living in Norway. Therefore, several Norwegian animal welfare organizations were asked to participate in research concerning stray dogs and cats in Norway. 38 animal welfare organizations located in Norway were contacted from October to November 2022 regarding stray animal control, and whether they would like to participate in extended research. The written study contained 57 questions related to the stray dog and cat situation in Norway. Based on the literature and the results of the research, there are no single strategy existing for a successful stray animal management. Different approaches should be adjusted to the national situation, and adoption of more than one strategy seems to be a more successful solution.

## Table of Contents

<b>ABSTRACT .....</b>	<b>2</b>
<b>1. INTRODUCTION.....</b>	<b>4</b>
<b>2. LITERATURE REVIEW .....</b>	<b>5</b>
<b>2.1: DEFINITION OF STRAY ANIMALS.....</b>	<b>5</b>
2.1.1: Stray Dog Definition .....	5
2.1.2: Stray Cat Definition.....	6
2.1.3: Origin of Pet Animals and Stray Animals .....	6
2.1.4: Shelters .....	7
2.1.5: Population Statistics .....	8
<b>2.2: THREATS OF STRAY ANIMALS .....</b>	<b>9</b>
2.2.1: Animal Welfare .....	9
2.2.2: Public Health .....	9
2.2.3: Wildlife.....	10
<b>2.3: METHODS TO CONTROL POPULATION.....</b>	<b>11</b>
2.3.1: Reproductive Control .....	11
2.3.1.1: Surgical Methods .....	12
2.3.1.2: Non-Surgical Methods .....	15
2.3.2: Lethal Methods .....	16
2.3.2.1: Lethal Injection and Inhaled Agents .....	17
2.3.2.2: Physical Methods.....	17
2.3.2.3: Poisoning .....	18
2.3.3: National legislation.....	18
2.3.4: Education.....	20
<b>3. MATERIAL AND METHODS.....</b>	<b>21</b>
<b>4. RESULTS.....</b>	<b>21</b>
<b>5. DISCUSSION.....</b>	<b>30</b>
<b>6. CONCLUSION .....</b>	<b>34</b>
<b>7. BIBLIOGRAPHY .....</b>	<b>35</b>
<b>8. ACKNOWLEDGEMENTS .....</b>	<b>39</b>
<b>Appendix I: Electronic License Agreement and Copyright Declaration .....</b>	<b>40</b>
<b>Appendix II: Thesis Progress Report Form .....</b>	<b>42</b>

## 1. INTRODUCTION

Every year there are millions of companion animals entering animal shelters. In addition to the inflow of animals to shelters, there are several animals euthanized yearly. Stray animal overpopulation is an important global issue with several adverse effects on animal welfare, public health, and wildlife. Increased population density can result in higher risk of zoonotic infections, transmission of pathogens to domestic animals, bite and scratch incidences, environmental pollution, vocalization due to aggressive interactions or reproduction, odor from secretions, predation of bird and small mammal populations, digging in gardens, and road traffic accidents. In addition to this, stray animals can experience decreased welfare due to malnutrition, abuse, diseases left untreated, and injury acquired from aggressive interactions or car accidents. The consequences associated with an increased stray animal population demonstrate the importance of finding adequate solutions to decrease it.

Various methods exist to regulate the population number such as reproductive control and lethal methods. Reproductive alternatives can be surgical sterilization such as gonadectomy, and non-surgical methods including hormonal, immunological or sclerotization methods. Furthermore, euthanasia drugs, shooting or poisoning are lethal methods utilized by several countries to decrease stray animal population. Besides reproductive and lethal strategies, the legislative aspect as well as educational conditions are important factors in an efficacious stray animal management. These different methods have both negative and positive aspects regarding effectiveness, cost management and animal welfare.

The aim of the thesis is to provide information concerning definitions of stray animals and shelters, origin of stray animals, population data, consequences of stray animal overpopulation, strategies to control populations including reproductive and lethal methods, national legislation, and educational courses. Further objectives consist of finding a potential solution for the stray animal problem through examining European practices which have an efficacious stray animal management. Hence, extended research in cooperation with Norwegian animal welfare organizations were conducted to provide data on the national stray animal situation. Since animal welfare organizations participate in the management of overpopulation of dogs and cats, it was decided to perform this research in cooperation with them.

## 2. LITERATURE REVIEW

### 2.1: DEFINITION OF STRAY ANIMALS

The definition of a stray animal differs between countries. According to a report on stray animal control practices by the World Society for the Protection of Animals (WSPA) and the Royal Society for the Prevention of Cruelty to Animals International (RSPCA International), three terms can be used to classify stray dogs and cats based on human dependency. The stray animal can be feral, abandoned, and owned but not controlled [5]. Similarly, The OIE Terrestrial Animal Health Code 2018 (TAHC) defined stray dogs in accordance with dependency [23]. The European Convention for the Protection of Pet Animals defines a stray animal as “a pet animal which either has no home or is outside the bounds of its owner's or keeper's household and is not under the control or direct supervision of any owner or keeper” (Chapter 1, Article 1) [31].

#### 2.1.1: Stray Dog Definition

Based on the report by WSPA and RSPCA, feral dogs do not have any owners or caretakers, but derive from dog populations under human care. They exhibit low sociability towards humans, as well as having low survival rate and reproductive capacity. In contrast to feral dogs, abandoned dogs previously had an owner or caretaker who stopped providing resources such as food and shelter. They survive through scavenging and occasionally receiving food from other members of the society. However, if food or shelter are not regularly provided, the dogs will have a low survival rate. Owned uncontrolled dogs are dogs which are either completely free to roam or are only restricted at distinct times of the day. They depend upon humans for food and shelter and have a high reproductive capacity unless being sterilized [5]. Correspondingly, TAHC (2018) defined a stray dog as “any dog not under direct control by a person or not prevented from roaming” in the glossary section. It further categorized the stray dog into three different types. The feral dogs are domestic dogs which has turned wild, and do not directly depend upon humans anymore. The other types of stray dogs are the free-roaming dog without an owner, and the owned free-roaming dog not being directly controlled or restricted throughout the day [23].

Following revision of Chapter 7.7 of TAHC (2018), the terminology was updated to improve the understanding of the recommended standards. The title of the chapter was changed from

“Stray dog population control” to “Dog population management”. The reason behind this modification was the misinterpretation that only the control of current stray dog population is required to reach successful management. Owned dogs are a frequent source of stray dogs, and therefore population management of all dogs should be considered important. Additionally, the term “stray dog” was changed to “free-roaming dog” due to the former having several definitions around the world [36]. According to glossary section of the TAHC (2022), “Free-roaming dog means any owned dog or unowned dog that is without direct human supervision or control, including feral dogs” [29].

### 2.1.2: Stray Cat Definition

According to the report by WSPA and RSPCA, the feral cat derives from free roaming cats, do not have owners or caretakers, express low sociability towards humans, and survives by hunting and scavenging. The abandoned cat previously had an owner who stopped providing resources such as food and shelter. These cats survive by scavenging and hunting, and by occasionally receiving food from other members of the society. An abandoned cat may express sociability towards humans. Owned uncontrolled cats are either completely free-roaming or stay restricted at distinct times during the day. They depend upon humans for some of their resources and have a high reproductive capacity unless being sterilized [5]. There are no chapters including the management of cat population in the TAHC from 2018 or 2022.

### 2.1.3: Origin of Pet Animals and Stray Animals

Archeologists believe that the domestication of dogs began around 15 000-33 000 years ago in Europe and eastern Siberia. This was when people were hunting for meat and animal products, hence before the agricultural communities had developed [20]. Throughout the years dogs have had different tasks such as hunting, herding, guarding properties, and drafting. They have also provided with meat for food, skins and fur for clothing, and bones and teeth for decoration and equipment [21]. Archeological reports suggest that the domestication of cats happened 3000-6000 BC in Cyprus, Egypt, and China. It is believed that cats were used as pest control through regulating the rodents in grain stores [22]. The roles of dogs and cats in human societies has changed with time, and today they are mostly kept as household pets for companionship. According to Pirrone et al., the primary motives for dog acquisition are companionship, providing a home for the animal, and for utility purposes [27].

It currently exists various sources of pet acquisition, and the most common suppliers are friends and relatives, breeders, animal shelters, rescue organizations, and pet shops [27]. If someone acquire an animal without properly evaluating the meaning of pet ownership, the probability of abandonment increases. Factors contributing to abandonment includes lack of education on responsible pet ownership, time constraint, behavior problems associated with improper socialization and training, sudden sickness, altered economy, and other lifestyle changes. Another source of stray animals is a pet that once had an owner but became lost. Without proper identification and registration of the pet, reunion with owner can become difficult. Lost, abandoned, or free-roaming pets with intact reproductive system may further produce new offspring contributing to an increased stray animal population [28].

#### 2.1.4: Shelters

Following the capture of stray animals, they are reintroduced to their point of capture, relocated, adopted, fostered, or kept in shelters [16]. An animal shelter is a facility housing stray animals temporarily or permanently and are either maintained by the government or animal welfare organizations [9]. The number of shelters differs between countries, and depends on factors such as economy, stray population number, and citizens attitude towards stray animals. If animals are abandoned or lost in developing countries, they usually become a part of the stray population. In contrast, developed countries typically have shelters where these abandoned or lost animals can be brought to before potential reproduction could happen [15]. After being captured and brought to the shelters, the animals may be euthanized, remain permanently in the shelter, become adopted or fostered [9]. The adoption rate varies between individuals, and several factors play a role when a potential owner wants to adopt an animal. Active animals with cage enrichments such as toys, and top tier placed cages are viewed more often, and therefore have a higher chance of becoming adopted [25]. Research was performed to examine factors that contribute to the selection of cats by potential adopters. A survey was performed by cat adopters who completed the adoption process during 2011 at Loudoun County Animal Services. The most important factors affecting the adoption decision were the level of friendliness towards the adopter, playfulness, young age, friendliness towards children and other cats, and cage location [26].

### 2.1.5: Population Statistics

The European Pet Food Industry Federation (FEDIAF) Annual Report 2022 includes figures of the European dog and cat populations in 2021. The figures are based upon estimates provided by FEDIAF, member associations, and pet food companies. The statistics refer to pet animals and therefore excludes stray animals. The estimated dog population was 837 000 in Austria, 10 300 000 in Germany, 2 800 000 in Hungary, 1 850 000 in Netherlands, and 490 000 in Norway. Furthermore, the estimated cat population was 1 985 000 in Austria, 16 700 000 in Germany, 2 380 000 in Hungary, 3 150 000 in the Netherlands, and 783 000 in Norway [34]. These countries are included to provide a comparison with the Norwegian cat and dog population (Figure 1). Additionally, human population number in the five countries are retrieved from The World Bank to calculate the dogs and cats per inhabitant [35]. Besides pet animals, there are no European central statistics on the stray animal population. Furthermore, several countries do not have a national statistic concerning stray animal population, hence only estimates are existing regarding these numbers [5]. Between 2009 and 2010, the World Health Organization (WHO) estimated the number of stray dogs to be greater than 200 million worldwide [2]. According to the Norwegian Veterinary Institute, there are no stray dogs in Norway [13]. In the United States alone it is estimated that there are around 70 million unowned cats, however it is difficult to estimate the number of stray cats due to a high reproductive capacity [3, 2]. A study performed in Denmark by Sandøe et al (2019) revealed that over a period of 14 years, there were a rapid increase in the number of stray cats entering shelters. At the end of the measured period, 80% of cats entering Danish shelters were strays [4]. The growing number of stray dogs and cats indicates the need for proper population control measures.



<i>Country</i>	<i>Austria</i>	<i>Germany</i>	<i>Hungary</i>	<i>Netherlands</i>	<i>Norway</i>
<i>Human population</i>	8 956 279	83 129 285	9 709 886	17 533 405	5 408 320
<i>Dog population</i>	837 000	10 300 000	2 800 000	1 850 000	490 000
<i>Cat population</i>	1 985 000	16 700 000	2 380 000	3 150 000	783 000
<i>Dogs per inhabitant</i>	0,09	0,12	0,29	0,11	0,09
<i>Cats per inhabitant</i>	0,22	0,2	0,25	0,18	0,14

**Figure 1:** Human, owned dog and owned cat population numbers in Austria, Germany, Hungary, the Netherlands, and Norway [34, 35].

## 2.2: THREATS OF STRAY ANIMALS

### 2.2.1: Animal Welfare

The animal welfare of stray animals is significantly lower in comparison to the welfare of pet animals. Stray animals are often prone to malnutrition because of the limited availability to appropriate feed [7]. They can sustain injury from road accidents, or from aggressive confrontation during competition for restricted resources [2, 5]. Furthermore, stray animals are at risk from predation, pathogens, intentional or accidental poisoning, persecution, and abuse by members of the community [16]. In contrast to pet animals, stray dogs and cats are usually not a subject of veterinary care. If they get injured or become sick, no medical care is provided which can result in continuous suffering [5]. It is important to find effective population control strategies to decrease the risk of malnutrition, injuries, pathogen transmission, and abuse. Therefore, proper stray animal management are highly essential for the welfare of stray animals throughout the world.

### 2.2.2: Public Health

Stray animals can threaten the public health through the transmission of zoonotic diseases. There are many infectious diseases which can be spread from stray dogs and cats to humans. The pathogens can spread to humans indirectly through contaminated secretions such as saliva, feces, and urine, or an infection can be obtained through direct contact with the animal [5].

Veterinary care are often not provided to stray dogs and cats, and there is a lack of proper vaccinations and antiparasitic treatments in the population. In comparison with pet animals, stray animals are also of higher risk to consume infected feed. For instance, they may go scavenging around slaughterhouses consuming contaminated meat, and if they are left untreated, the spread of the infectious agents will continue. Thus, it is important to have proper disposal sites for the slaughterhouses to minimize consumption by stray or wild animals [2].

Dogs are responsible for transmitting over 300 zoonoses. Among these different zoonotic agents, the transmission of rabies virus is the most important pathogen. There are approximately 60 000 deaths annually due to this virus, while another 15 million are given post exposure treatment to avoid the deadly consequences. 95% of rabies cases occur in Asia and Africa, and 99% of incidences are due to dog transmission. Other significant zoonotic diseases are cystic echinococcosis caused by *Echinococcus granulosus*, leishmania caused by *Leishmania* parasites, and toxoplasmosis caused by *Toxoplasma gondii*. Further zoonosis can be brucellosis, campylobacteriosis, cat scratch disease, cheyletiellosis, cryptosporidiosis, dermatophytosis, dirofilariasis, giardiasis, leptospirosis, and pasteurellosis [9, 10].

Many stray animals can also cause harm to the public health through disease-transmission to livestock, attacking domestic animals, causing bite and scratch injuries on humans, and by creating road accidents [10]. In areas with increased densities such as cat colonies, the competition for food, space and mating opportunities are higher. There are several public complaints concerning cats' behavior in district habiting cat colonies regarding conspecific aggressive behavior, mating calls and urine-spraying [16]. Therefore, it is necessary to decrease the stray animal population to lower the risk of disease transmission, attacks, road accidents and nuisance behavior.

### 2.2.3: Wildlife

Stray animals can become a threat to the wildlife by becoming opportunistic predators [2]. The olfactory sense is less developed in domestic cats in contrast to dogs. This means that a cat can surpass a nest on the ground without smelling it. The domestic cat is also bad climbers in comparison to other felids, making it harder to reach the bird nests. However, if there is even a minor motion in range on the ground, the animal will quickly pounce towards the pray animal and eventually kill it. The preferred diet consists of young rabbits and rodents, as well as lizards,

grasshoppers, centipedes, and spiders. These predators may alter the wildlife population. For instance, reports indicate that cats have a severe impact on the desert biome in Australia, as well as being one of the largest concerns to the American ecosystem. They kill 1.4–3.7 billion birds and 6.9–20.7 billion mammals yearly, and the majority of killings are caused by the stray cats [11, 1]. In some areas, stray cats can also hybridize with wild cats (*Felis silvestris*) and pollute their genome [16]. The dogs on the other hand have a more developed smelling ability, making them able to sniff out nests on the ground and thereafter destroy it [11]. There are several studies reporting feral and free roaming dogs attacking wildlife in the Andes of Chile [6]. Despite this, dogs are likely to injure the prey without killing and consuming it, and they also need to be a pack of dogs for successful hunting [11]. In addition to predation and hybridization, stray dogs and cats can also harm the native species through competition of food sources and spreading of diseases [2]. Subsequently, regulating the stray animal population around the world is also necessary for the conservation of wildlife.

## 2.3: METHODS TO CONTROL POPULATION

There are various methods existing to control stray animal population, and the applied strategy varies between countries. Population management can be narrowed down to reproductive and lethal methods. Reproductive control involves controlling the reproductive ability through either surgical sterilization such as gonadectomy or through non-surgical sterilization including hormonal, immunological or sclerotization methods. Another approach to decrease the number of animals is through lethal methods such as euthanasia drugs, shooting and poisoning. Besides reproductive and lethal methods, effective legislation along with educational courses may contribute to a lower stray animal population.

### 2.3.1: Reproductive Control

Desexing is often recommended in the literature for the controlment of population number, modification of behavior and as preventative healthcare. Empirical studies show no effects on the population control in shelter and companion dogs, but there is an effect in female free-roaming dogs [12]. There is a favorable effect of desexing in females as compared with males, although there is a strong variation between breeds thus further studies are required. Desexing can reduce diseases of the female reproductive system, for instance mammary tumors and pyometra. Conversely, desexing may increase the incidence of ruptured cruciate ligament,

various cancers, urinary incontinence, and obesity. Regarding behavioral changes in desexed animals, males show decreased libido, roaming, mounting on other dogs, urinary marking, and aggressive behavior towards other male dogs. However, there is little evidence related to other effects such as mounting on objects or humans, aggression towards humans, guarding of resources, and anxiety. More research is also required concerning behavioral changing in females or in different breeds [12].

#### *2.3.1.1: Surgical Methods*

Gonadectomy is a sex-neutral term for the surgical removal of the gonads, and it is the most common desexing method. Orchiectomy is the sex-specific term for gonadectomy in males, while ovariectomy is the sex-specific term for gonadectomy in females. If the uterus is removed in addition to ovaries, the surgical procedure is called ovariohysterectomy. There are also further surgical methods like salpingectomy, hysterectomy, and vasectomy, but these are rarely performed in practice [12]. Surgical removal is an effective method causing permanent results with one time intervention, but post-surgical infection or hemorrhages may appear. To prevent adverse effects following surgery, proper postoperative care should be provided. It is also a time consuming and expensive procedure which require an experienced surgeon to be performed [14].

Gonadectomy is often preformed in CNR programs. CNR is an abbreviation for Catch-Neuter-Release. In this program, stray colony animals are trapped, neutered, medicated, vaccinated, and then usually released back to their point of capture. This program is more frequently conducted in cats than in dogs, and has been used in America, Canada, Denmark, South Africa, and the United Kingdom. There is a debate whether further trials should be conducted in Australia, thus literature concerning CNR programs has been investigated by different researchers. For instance, Crawford et al. concluded CNR programs as unethical with low changes of resolving problems associated with stray cats [16]. In contrast, Wolf et al. regard it as an ethical alternative to euthanasia, also decreasing the emotional burden of staff performing euthanasia regularly [17].

Proponents of CNR programs regard this as an effective method requiring minimum effort as animals can quickly be trapped and treated. Also, releasing them back to their point of capture generates more space and resources for other animals. Furthermore, they state that neutering

will enhance body condition score, while diminishing conspecific fighting and disease transmission. They also claim that returning the cats back to the point of capture will stabilize the population by preventing a “vacuum effect”. This effect means that a vacuum is created when a cat is removed from the colony, which will be filled by other individuals entering the group. In contrast, opponents of these programs state that targeted adoption, early-age desexing and public education concerning responsible pet ownership have a higher chance of reducing euthanasia rate and population density along with resolving problems related to stray cats. They believe that the resources used for CNR programs would be better utilized in rehabilitation and adoption programs. If the cats are given time to adapt and receives positive attention, they may develop into suitable pets. For instance, 10 days with regular positive interactions resulted in increased happiness, mucosal immune defense and reduced the incidence of upper respiratory diseases of the anxious shelter cats [16, 19].

According to the literature reviewed by Crawford et al., it is estimated that it would take 12,8 years for neutered cats in colonies to become extinct. A colony of 155 cats was reduced to 23 cats in a period of 11 years, which means 75% reduction overall and 12 cats per year. This means that the extinction of colonies takes time, and the problems associated with stray cats will persist for years. The review indicates that there is a lack of evidence demonstrating the long-term success of CNR programs in relation to population control. According to modelling, the programs need to persistently neuter  $\geq 75\%$  of the fertile population for several years to obtain a reduced cat population. This high number of sterilizations may be difficult to achieve. Furthermore, the papers states that there are only 11 published CNR studies (USA, Canada, UK, Israel, Italy and Australia) which shows data from both initial and follow-up census. Most studies did not exceed 3 years, and there were no results showing extinction of the colonies. The percentage of reduced cat numbers varied from 78% decrease to 55% increase. Additionally, the majority had to euthanize a percentage of cats, since neutering of all cats were unmanageable. According to Crawford et al., the decreased density following CNR programs do not indicate success and suggests that adoption evidently influenced the result. The review also states that adoption may create a permanent state of flux, since adoption generate the “vacuum effect” the CNR programs tries to prevent. Moreover, opponents claims that stray cat colonies are seldomly closed colonies, given that in all 11 cases new cats joined the colonies. Furthermore, cat colonies are maintained by members of the community, but there is a great

variation in the degree and duration of care provided. This variation also undermines the implementation of CNR as a long-term strategy [16].

Crawford et al. further explains why the problems associated with stray cats persist during CNR programs. Colony cats usually live in private backyards of civilians and in public areas such as schools, parks, and shopping centers. Although care is provided in these areas, it does not prevent them from roaming. Radio-trackers placed on cats in CNR colonies demonstrated that cats were ranging in an area of 1,5-2,1 square kilometers. As a result of large roaming area, they can interact with pet cats, wildlife, and people. Although being regularly provided with food, a study demonstrated that they still hunt. Cameras were attached to collars of cats living in CNR colonies, and by this method they could quantify the activity of the cats. The footage revealed that 24 out of 29 cats were hunting, and 18 cats were recorded killing 174 animals. Stray cats can also interact with people increasing frustration in citizens which may lead to more acts of animal cruelty. Besides interaction between stray and pet cats due to roaming, pet cats can be attracted to where the colony cats are fed, facilitating spread of pathogens. As a possible solution to roaming and attraction, it might be an option to keep the colony fenced, but it is regarded as a costly alternative [16].

In addition to maintained roaming, CNR programs may induce stress in stray cats. Trapping, neutering, vaccinating, medicating are stressful events for all cats. It is even more stressful to stray cats that has not been a subject to human handling. Further recapturing may be required during parasite treatment and vaccination boosters. Not only does recapturing of stray cats result in more stress, but it is also costly requiring continuous fundings. Annual treatment of parasites in Australia using all-in-one 'spot-on' liquid application will cost around AU\$157/cat. It is not an easy task to recapture, for example a study showed that only 23 of 80 CNR cats could be re-trapped and receive vaccination booster. CNR advocates rather think that fighting will decrease following neutering, and therefore decrease spreading of FIV and FeLV [16].

Wolf et al. replied to Crawford et al., debating some of their listed statements. Regarding adoption creating "vacuum effect", the papers stated that most adoptions involve kittens, and that it occurs in the beginning of the program. Later adoptions are generally immigrated cats of the colony, and it is an integral part of the programs. Further, it is written that colonies tend to stabilize quickly in terms of both social dynamics and population size following a CNR

program. Proponents disagree with the statement regarding lack of evidence indicating successful results, stating that Crawford et al. did not include two Australian studies showing 30% reduction in population in 2-year period, and 50% over 5 years [17]. Several advocates for CNR programs also state that scavenging will decrease because of regular provided food. However, caretakers in the UK were surveyed regarding 339 colonies and found that although 92% of colonies was fed daily, garbage was a source of food for 66% of cats. Refuse may contain plastic and other non-edible items, and this may cause gastrointestinal problems [16]. Gonadectomy is often preformed in CNR programs, however further research is required to measure the effect of this reproductive control strategy.

#### *2.3.1.2: Non-Surgical Methods*

Another desexing alternative can be the use of non-surgical methods. These methods can be categorized into hormonal, immunological, and chemical or physical sclerotization methods [12]. Non-surgical methods as population control may be more cost effective in comparison to gonadectomy since neither surgery nor post-operative care is needed. Also, orchiectomy is not culturally accepted in some countries, and chemical castration can therefore be an alternative. On the other hand, it does not provide a permanent solution and repeated administration are required. The optimal reproductive method should produce permanent infertility and loss of sexual behavior, require only one administration, be safe for target and non-target animals, have proper efficacy and storability, and be cost effective [14].

Progestins are synthetic progestogen (megestrol acetate, medroxyprogesterone, proligestone), and are the most frequently used hormonal method. It can be used in both sexes resulting in reversible infertility and decreased libido, however this method is less reliable in males when it comes to infertility. Exogenous testosterone can decrease fertility in both sexes, but due to negative side effects it is not used in clinics. GnRH agonists like deslorelin have also been used to induce reversible infertility which can last months or years in both sexes. These are slow-release subcutaneous implants and are commonly used in practice in both Europe and Australia [12].

There are continuous investigations regarding the usage of immunological methods as desexing. Sperm, zona pellucida, GnRH and LH are the tested targets for immunization [12]. This method works as a vaccine, the immune system is stimulated to produce antibodies against

these targets. However, the main issue is the choice of appropriate antigen providing sufficient immunogenicity with the aim to achieve a contraceptive vaccine [14]. Currently there is no product used in clinical practice, but there are promising results in studies [12].

There are both chemical and physical methods to attain sclerotization, and these methods are used in the testicles, epididymis, or vas deferens. Sclerotization has only been used in male animals and are not commonly performed. The chemical method utilizes chemical sclerotizing agents such as calcium chloride or zinc gluconate as intratesticular injection, chlorhexidine gluconate, zinc arginine or formalin as intraepididymal injection, and ethanol, silver nitrate, acetic acid, formalin, sodium tetradecyl sulfate, sodium morrhuate, or potassium permanganate as vas deferens injection. The physical method consists of an ultrasound beam aimed at testicle or epididymis but is not used in practice yet [12].

### 2.3.2: Lethal Methods

Euthanasia originates from the Greek words “eu” meaning “good”, and “thanatos” meaning death. It is the act of intentionally ending an individual’s life to relieve persistent pain and distress. According to AVMA Guidelines for the Euthanasia of Animals, acceptable methods of euthanasia in cats and dogs are intravenously injected barbiturates, injected anesthetic overdose of Tributame, or by injection of T-61. Methods acceptable with conditions are barbiturates through alternate administration routes, inhaled anesthetic overdose, CO, CO<sub>2</sub>, gunshot, and penetrating captive bolt for dogs. Institutional companion animals may have a different euthanasia protocol from those utilized in clinical practice due to situation-specific requirements. It can depend on the number of animals to be euthanized, and alterable access to euthanasian drugs and further equipment. Trained technical personnel instead of veterinarians usually performs euthanasia in shelters, animal control and rescue schemes. Employees may develop distress if euthanasia is performed frequently, hence strategies should be applied to decrease the level of stress associated with the procedure. This includes proper training programs with the aim of performing euthanasia correctly, alternating work tasks, sharing of responsibilities, having professional support system, shifting the focus towards adopted and returned animals, and receiving time off when the personnel require it [24].

Several countries have used euthanasia as a method to control their stray animal populations. For instance, trapping and euthanasia of stray cats has been the main method for population



control in Australia for several years. 118 000 out of 196 000 cats in New South Wales were killed over a period of 8 years (2008-2009 to 2015-2016; 60% euthanasia rate). Despite the attempt to reduce population number, there was only a minor change in the cat intake of shelters (25 000 in 2008–2009, 24 000 in 2015–2016) [17]. Yearly euthanasia rates for stray cats performed by animal shelters can be exceptionally high. For example, the RSPCA in Australia euthanized 27% of cats admitted nationally from 2016 to 2017, mostly due to infections and other medical causes or due to behavioral reasons [16].

#### *2.3.2.1: Lethal Injection and Inhaled Agents*

The preferred method of euthanasia in animal control, sheltering and rescue facilities are intravenously injected barbiturate or barbituric acid derivatives such as pentobarbital or pentobarbital combination products along with proper animal handling. It can be administered either as sole agent, or in combination with sedation or general anesthesia. If it is impractical to administer the drug intravenously (IV), then intraperitoneal (IP) routes can be used. Injectable anesthetic overdoses can also be utilized as euthanasia, such as combination of ketamine and xylazine can be given IV, IP or intramuscularly (IM), or propofol can be given IV. Tributame can also be administered IV in dogs and in cats if barbiturates are unavailable. Furthermore, T-61 can be administered as a slow IV injection for euthanasian use. Overdoses of inhalational agents are acceptable with conditions for euthanasia and may also be used as anesthetics prior to injectable euthanasia. However, the conditions that must be fulfilled preceding administration can be challenging and expensive. Carbon monoxide and carbon dioxide are both acceptable with conditions for utilization in institutional circumstances, where properly maintained equipment and trained staff are present. Although several agents for euthanasia exist, barbituric acid derivatives are the preferred method [24].

#### *2.3.2.2: Physical Methods*

In contrary to lethal injections which are generally used in high- and high-middle-income countries, shooting and poisoning are more frequently utilized in middle- and lower-income countries [9]. Shooting is a method of stray animal population control which efficiently and quickly kills the animal if the bullets hit the targeted animal. However, there is a significant risk of bullet hitting the wrong target such as other animals or hitting the target at an improper place leading to injured animal. This injured animal may run away with considerable amount of pain, substantially decreasing the welfare of the animal [2]. Therefore, pre-euthanasia sedation such

as medication added to food is advised, especially concerning cats since they may be challenging to shoot humanely [24]. Nevertheless, if the act is carried out by highly skilled staff trained in firearm usage and if the legislation allows it, this method is considered humane and beneficial for the reduction of stray animals [2]. The attitude people have regarding shooting of stray animals, varies according to demographics. Inhabitants of rural areas are commonly in favor of lethal methods of stray animals, and shooting is the preferable method. This may be attributable to the values of the citizens considering that they may view animals corresponding to their usefulness. For instance, stray and feral cats have been thought to be more detrimental than beneficial to the environment. In contrast to rural areas, CNR programs were preferred over euthanasia by citizens in urban districts [18].

#### *2.3.2.3: Poisoning*

Poisoning is another tactic that has been used to control the stray animal population. Sodium monofluoroacetate and different anticoagulants are the most frequently used chemicals for this purpose [2]. Cleaning agents, disinfectants, pesticides, and household chemicals are not acceptable for administration as euthanasian agents [24]. Clinical signs related to poisoning involve ptyalism, emesis, vocalization, diarrhea, nystagmus, tremor, facial spasm, tonic convulsions, respiratory and cardiac arrest. Depending on the type and quantity of the ingested agent, the animal risks experiencing a slow painful death. In addition, non-targeted free roaming animals may enter targeted environment, and accidentally be exposed to the toxic substances. Although poisoning can be an economical and efficient method with minimum labor required, this method may cause a painful slow death of both targeted and untargeted individuals [2].

#### 2.3.3: National legislation

A proper national regulatory framework is essential for an effective control strategy, and the Terrestrial Animal Health Code (2022) by OIE provides standards for the improvement of dog population management. Regulations on different topics contribute to a successful dog population management, for instance responsible dog ownership; animal welfare; registration and identification of dogs in an identification database; registration and authorization of sellers, breeders, shelters, rehoming centers and holding establishments; preventive measures against zoonotic diseases [20]. The improvement of cat population management is not addressed by the OIE.

There are no communal European directive or regulation dealing with stray animal control, and therefore it is controlled on a national level which results in different approaches between countries. The only existing international treaty concerning pet animals is “European Convention for the Protection of Pet Animals” introduced by the Council of Europe in 1987 [15]. The treaty is open for adherence of both member and non-member countries of the Council of Europe. The total number of signatures are 26, whereas 1 are not followed by ratifications. Countries such as Austria, Germany, Netherlands, and Norway have signed the treaty, however Netherlands has not followed by ratification [30]. The convention seeks to create a basic common standard of practice concerning pet ownership, stating general principles for the keeping of pet animals, and supplementary measures for stray animals. Chapter III of the convention includes supplementary measures for stray animals, and states that “when a Party considers that the numbers of stray animals present it with a problem, it shall take the appropriate legislative and/or administrative measures necessary to reduce their numbers in a way which does not cause avoidable pain, suffering or distress.” (Article 12, p. 5) [31].

The Norwegian legislation regarding animal welfare is the Animal Welfare Act (lov om dyrevelferd). The aim is to promote good animal welfare and respect for animals including mammals, birds, reptiles, amphibians, fish, decapods, squid, octopi and honeybees [32]. Furthermore, Norway also has the Dog Law (hundeloven) regulating dog keeping and safety aspects associated with dogs [33]. According to the Animal Welfare Act, animals have an intrinsic value unrelated to their functional value for humans, require to be treated properly and be protected from danger. Following paragraphs also indicate the duty to help an injured/sick/helpless animal, and duty to alert Food Safety Authority or the police about suspicion of mistreatment or serious neglect of animals. The law also mentions that it is forbidden to abandon animals in helpless condition. Furthermore, the animal keeper shall ensure that competent personnel look after the animals. Children less than 16 years of age may not be allowed to have independent responsibility for an animal. The King may also issue specific regulations concerning education, approval of personnel etc. [32].

The subject of surgical interventions is covered in article 9 of the Act, prohibiting removal of body parts unless there is a justifiable reason. There is no specification concerning permission of sterilization for the management of overpopulation of dogs and cats. Killing of animals are also addressed in the regulations, but excludes which animals qualifies for the termination of

life. The keeping of animals is further detailed in later chapters of the Act and involves subjects such as general keeping conditions for animals, the animal's living environment, attention, care and feeding. Article 25 of the Animal Welfare act regulates breeding of animals. The intention is to breed robust animals with good health. Therefore, alteration of genes resulting in deteriorated physical or mental function of the animal or offspring are prohibited. Article 27 of Act regulates the trading and professional care of animals belonging to others. Any person who sells or transfers animals to someone else shall provide the person who receives the animal with necessary information regarding conditions which are of relevance to the animal's welfare [32].

There are no legislation concerning registration of dogs and cats, but section 13 of the Dog Act states that private organizations can establish and run an identification and registration scheme of dogs. Additionally, there are no section including stray animals, animal shelters or collection of strays. Nevertheless, the Dog Law section 10 concerns "løse hunder" which can be translated to "stray dogs". It states the right to collect dogs which are loose in violation of section 4, 6, 7 or 9. The dog should be brought to the dog keeper or the police depending on the circumstances. If the dog keeper does not collect the dog within one week of alert, the police can sell, relocate, or euthanize the dog. It further states that the collected dog should be treated in accordance with the legislation of the Animal Welfare Act [33].

#### 2.3.4: Education

Educational programs about responsible pet ownership have been undertaken in several countries. Different animal welfare organizations are developing these courses which results in different content of the programs depending upon the responsible organization. This inconsistency can be caused by the high expenses associated with nationwide programs, and animal welfare organizations rely on donations. The sum of donations differs between countries and regions causing inequalities. Besides dissimilarities, the effect of the programs may not be immediately obvious. In most cases, animal welfare organizations are not able to directly measure the program's success in reducing stray animals. Only one WSPA member society in Hungary had monitored stray animal numbers and discovered reduction due to educational programs targeting school children [2].

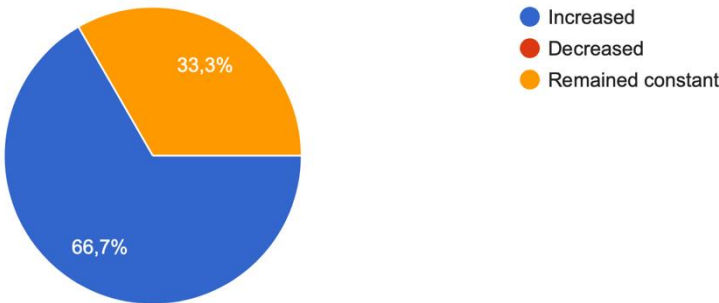
### 3. MATERIAL AND METHODS

38 animal welfare organizations located in Norway were contacted from October to November 2022 regarding national stray animal control, and whether they would like to participate in extended research. The written study contained 57 questions related to the stray dog and cat situation in Norway, including population number, stray animals, knowledge of present legislation, registration, neutering, animal shelters, education, social status, and population increase following Covid-19 and the inflation surge. Since animal welfare organizations participate in the management of overpopulation of dogs and cats, this study was designed to be completed by them. Google search engine was used to search for animal welfare organizations working with dogs and/or cats with search words such as “Dyrevelferdsorganisasjoner Norge”. Organizations working for increased welfare of farm animals were excluded from this study. The content of the research is based upon “Stray Animal Control Practices (Europe)” created through surveys completed by Member Societies and Associated Organizations of WSPA and RSPCA International in 2006 – 2007. The diagrams are constructed through Google Form and Excel.

### 4. RESULTS

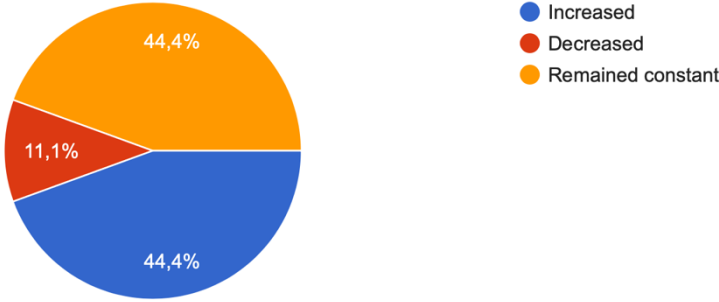
23,68% of the contacted animal welfare organizations participated in the research regarding the stray dog and cat situation in Norway. The first part of the survey concerned general information about the partaking organizations. In the case of annual workload of the organizations, the answers indicated a high variability in the number of animals the different organizations work with yearly. The number varied from approximately 100 to 500 animals, with an annual average of 252,22 animals. Furthermore, they were asked about their field of activities, and the tasks mainly consisted of capturing, rehabilitating and rehoming stray cats. Additionally, one organization also wrote that they take care of stray rabbits. It was further stated that the activities performed by the animal welfare organizations are volunteer based, and that they rely on the support from members of the community. Another organization replied that their fields of activity included all common domestic animals, however mostly cats and dogs are supervised. Besides rescuing stray animals, one organization wrote that public information and policy change are within their scope of work. In addition to organization data, they were asked to estimate the number of dogs in Norway according to their experiences. Five respondents did not provide estimates due to lack of knowledge regarding dogs, two organization wrote 500 000 dogs, while the remaining two answered 560 000 dogs. Furthermore, they were asked whether

the number of dogs has increased/decreased/remained constant the last 10 years according to their experiences (Figure 2).



**Figure 2:** Changes in dog population the last ten years according to the organizations (N=9).

In addition to the dog population statistics, they were asked to provide estimates on the Norwegian cat population. One respondent wrote 500 000, another respondent wrote 500 000-600 000, two respondents wrote 750 000, another respondent wrote 800 000, and the last estimate was 1 000 000 cats. The remaining organizations did not provide an estimated number on the national cat population. Furthermore, they were asked whether the number of cats has increased/decreased/remained constant the last 10 years according to their experiences (Figure 3).

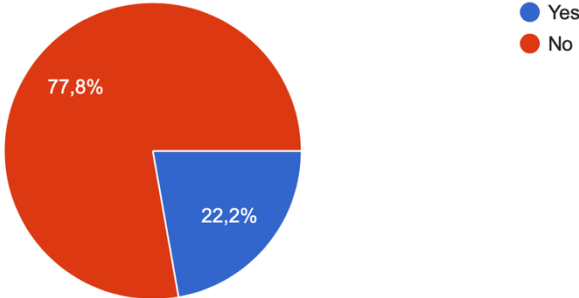


**Figure 3:** Changes in cat population the last ten years according to the organizations (N=9).

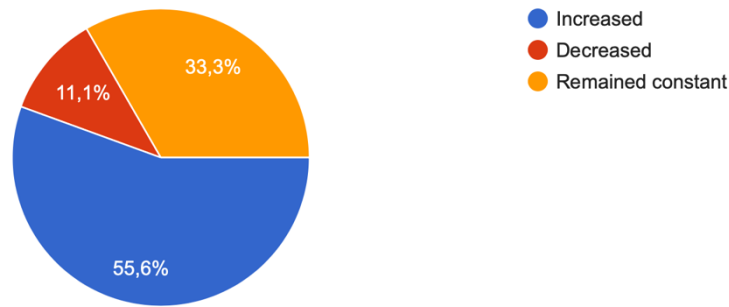
Following questions concerning the general cat and dog population, they were questioned about the stray cat and dog population. The organizations were asked if the number of stray dogs are monitored in Norway and what the estimated number is according to their experiences. Six of the respondents wrote that no stray dogs exist in Norway. Therefore, whether the number has increased/decreased/remained constant the last 10 years, was not applicable in the case of dogs.

The same applies whether the number of stray dogs have increased/decreased/remained constant following Covid-19 and the inflation surge; what percentage (%) of stray dogs are "lost but owned", "owned, but allowed to roam freely", "abandoned" and "never owned"; how stray dogs are controlled in Norway; which methods are used to capture stray dogs; the euthanasia methods of dogs used at shelters; how many days dogs are allowed to stay in shelters prior to relocation; adoption rate for dogs in Norway; and the euthanasia rate for dogs in Norway.

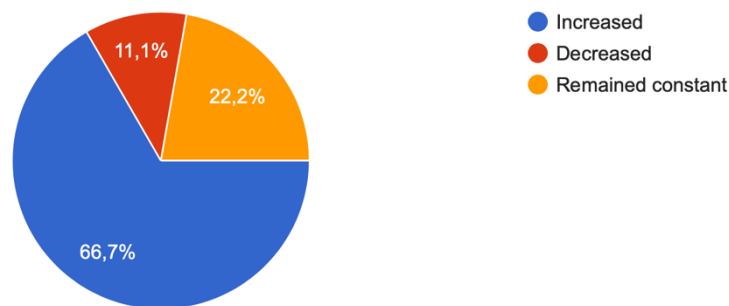
The organizations were further asked about the stray cat population, and whether the number of stray cats are monitored in Norway (Figure 4). They were asked to estimate the number of stray cats according to their experiences, however only three respondents replied. The first respondent wrote an estimate of 10 000, the second respondent wrote 100 000, and the last replied that the number of stray cats is over 100 000. Following population estimation, they were asked whether the number of stray cats has increased/decreased/remained constant the last 10 years (Figure 5). In addition to population change of the last ten years, the respondents were asked if the number of stray cats has increased/decreased/remained constant following Covid-19 and the inflation surge (Figure 6).



**Figure 4:** *Whether the stray cat number are monitored in Norway according to the experiences of the organizations (N=9).*



**Figure 5:** *Changes in stray cat population the last ten years according to the organizations (N=9).*

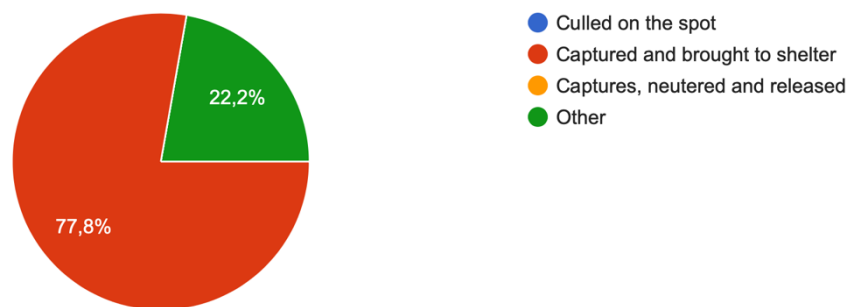


**Figure 6:** *Changes in stray cat population following Covid-19 and the inflation surge according to the organizations (N=9).*

Furthermore, the participants were asked which percentage (%) of stray cats are "lost but owned", "owned, but allowed to roam freely", "abandoned" and "never owned" according to their experiences. Only four of the respondents provided percentages. One respondent stated that 100% of stray cats exist because the owners do not neuter their pets which results in several litters each year. Another organization wrote that 1% are lost but owned; 90% are owned but allowed to roam freely; 1% are abandoned; 8% have never been owned. Next organization wrote that 20% are lost but owned; 30% are owned but allowed to roam freely; 10% are abandoned; 40% have never been owned. Another respondent stated that 10% are lost but owned; 65% are owned but allowed to roam freely; 10% are abandoned; 15% have never been owned. Last organization replied that 20% are lost but owned; 30% are owned but allowed to roam freely; 10% are abandoned; 40% have never been owned.

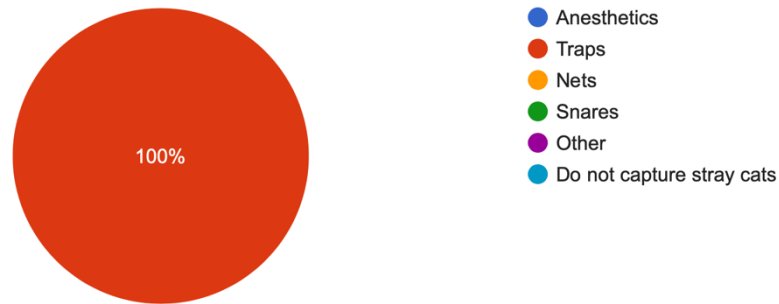


The organizations were also questioned about the stray cat management in Norway according to their experiences (Figure 7). The respondents replying “other” were asked to specify. One organization wrote that the stray cats are not controlled by the government or legislation, but that non-governmental organizations helps the cats through capturing, rehabilitation, and rehoming. They further stated that the cats are placed in foster homes, and not in shelters. The second respondent wrote that cats are either taken in by the organization, euthanized, or neutered and released.

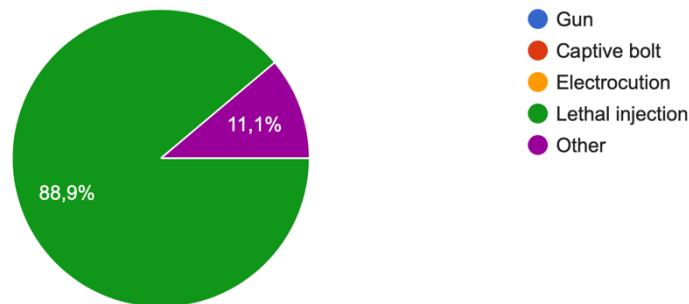


**Figure 7:** *Stray cat management in Norway according to the experiences of the organizations (N=9).*

The organizations were asked regarding which method are used to capture stray cats by their organization (Figure 8). They were also asked to answer which method is used to euthanize cats at the shelters (Figure 9), and if they replied “other”, a specification was requested. For the specification, one respondent replied that euthanasia is performed by veterinarians, while another organization wrote that there are no shelters in Norway and the cats are euthanized at the vet clinic. They were also asked if the animals receive sedatives prior to euthanasia, and all organizations answered “yes”. 89,9% of participating organizations replied that the veterinarian performs the euthanasia at the shelters, while 11,1% answered “other” which was further specified. The organization replying “other” wrote that there are no shelter existing in Norway.

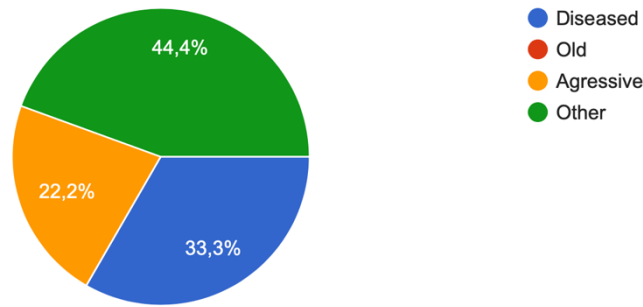


**Figure 8:** *Methods used to capture stray cats by the organizations (N=9).*



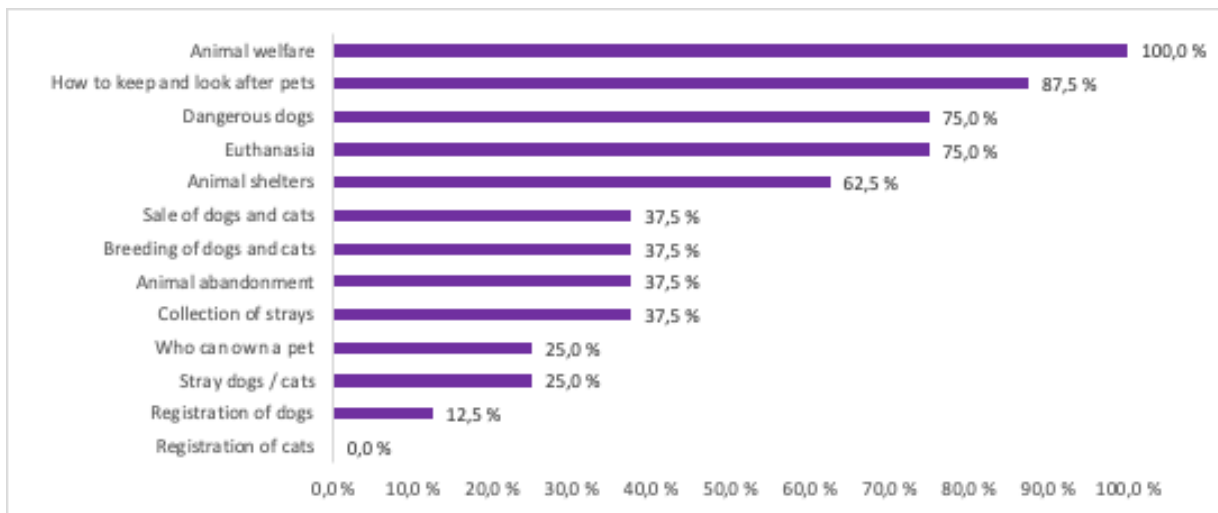
**Figure 9:** *Method of euthanasia at the shelter according to the organization’s experiences (N=9).*

The final questions concerning stray animals included which animals are euthanized according to their experiences (Figure 10). The organizations which answered “other” were asked to specify. They wrote that feral cats require several years to become comfortable living among humans, therefore it is considered to be bad animal welfare to put a cat through this process. Both a physical and mental checks are conducted by a veterinarian, which decides the outcome of the check. If the animal is deemed healthy, they receive a microchip and vaccinations. However, if the animal experiences severe illness or exhibit aggressive behavior, euthanasia may be performed. A respondent also wrote that old animals may be euthanized, and that stray cats are occasionally killed if there are no room for them.



**Figure 10:** *The animals euthanized according to the organizations (N=9).*

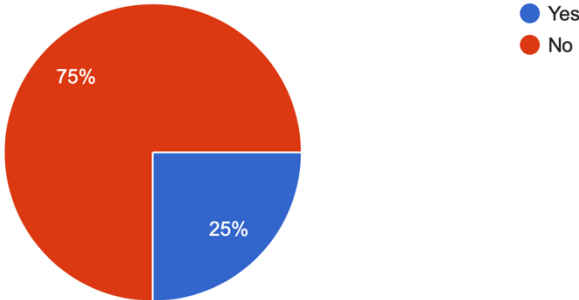
In addition to stray animal data, the organizations were questioned about the Norwegian legislation (Figure 11). They were asked to mark the topics they thought were included in the Norwegian legislation. Furthermore, the participants were asked about the registration of dogs and cats. In the case of dogs, all the participating organizations believed that a registration system existed. 77,8% of the respondents thought that the registration is voluntary, while 22,2% thought it was compulsory. In contrast to dogs, only 66,7% believed a registration system existed for cats. 87,5% out of these believed that the registration was voluntary, while 12,5% thought it was compulsory.



**Figure 11:** *The participating organizations (N=8) marked the topics they believed are included in the Norwegian legislation. Figure made in Excel [37].*

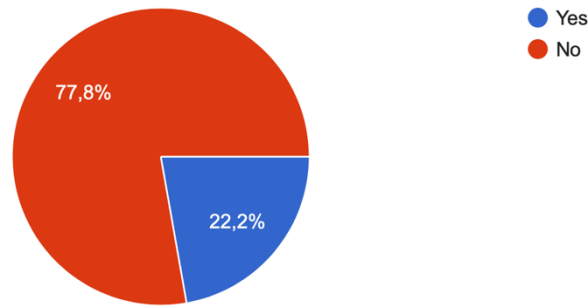
Moreover, they were asked about the neutering of animals. All respondents answered that dogs are not routinely neutered in Norway according to their experiences. On the other hand, 33,3%

of organizations stated that cats are routinely neutered. Concerning financial neutering schemes, 88,9% replied that they do not exist in Norway. Furthermore, 55,6% stated that there are no CNR programs conducted in Norway. The organizations answering “yes” were asked whether this program had any reductional effect on the population number according to their experiences (Figure 12).



**Figure 12:** *If the CNR programs conducted in Norway had any reductional effects on the population number according to the organizations responding “yes” on whether a CNR programs have been performed in Norway (N=4).*

The research further concerned the animal shelters in Norway, and how many shelters exist according to the organization’s experience. The answers received were 0, 5, 20, 20-40, above 25, 25-40, 60, 100 and 150 shelters. 77,8% replied that the shelters are operated by animal welfare organizations, while the remaining percentage answered “other”. They were asked to explain further and responded that no shelter exists in Norway. Additionally, they were asked how many days cats are allowed to stay in shelters prior to relocation. Four respondents wrote that no limit exists, one respondent wrote minimum 14 days, another wrote that there are no shelters in Norway, and the remaining organizations replied 7 days, 50 days, and 180 days. Furthermore, they were asked about the adoption rate for cats in Norway. Two respondents wrote 50%, one wrote 60%, two wrote 70%, and the others wrote “medium”, “6000 yearly”, “there are no shelters in Norway”, and “most cats that are taken in are adopted at some point ...”. They were also asked to give estimates on the euthanasia rate for cats, and different answers were provided. One organization replied that there are no shelters in Norway, two organizations said that they are unsure, another replied that the euthanasia rate is high, two wrote 20%, one wrote 25%, and last one replied 50%. In addition to shelter status in Norway, they were questioned about the existence of educational courses concerning responsible pet ownership (Figure 13).



**Figure 13:** *If there are any educational courses concerning responsible pet ownership in Norway according to the organizations (N=9).*

Finally, the organizations were asked what roles cats and dogs have in the society. The organizations wrote that cats have a low social status, and that owners seldomly look for the cats if they become lost. In contrast to cats, dogs have a high social status in Norway. They are also considered as a house pet, while many see cats as a mice hunter which survives outside on their own. Cats are often given away for free, while many people are looking for dogs to adopt. Furthermore, the organizations amplified the higher status of dogs because they served important roles in a historical perspective whereas cats were often only kept in barns to catch rodents. However, one organization stated that the status of dogs and cats are increasing as younger generations consider them family members.

In addition to the social status of dogs and cats, they were asked how stray animals are viewed by the society. The organizations wrote that stray animals are usually ignored by the members of the society. According to the answers, stray cats are normal in Norway while stray dogs are not. The stray cats which live in the cities are being taken care of by volunteers, while in the countryside people consider them “wild” and "living in the barn", therefore no one will claim them or give them medical attention. The respondents also stated that people usually only alert the animal welfare organizations if the cats become an issue for the neighborhood. Additionally, they replied that the Norwegian Food Authorities and the police consider cat related issues less serious in comparison to dog issues. They further wrote that there are no stray dogs existing in Norway, and that stray cats are often treated badly or being ignored.

## 5. DISCUSSION

The roles of dogs and cats in the society changes with both time and location. These days people usually acquire a dog or cat as a source of companionship and social support. For instance, the foremost reason for keeping a dog is companionship, along with contribution of shelter for the animal, and thereafter for utility reasons [27]. The Norwegian organizations underlined the low social status of cats exclaiming that cats often are given away for free, not searched for if disappeared, and only regarded as mice hunters. It is believed that they can live outside by themselves, and that some people even regard them as a problem. On the other hand, the respondents stated that dogs have a higher status, are more loved by people, and regarded as house pets. Additionally, more people are interested in the adoption of dogs in comparison to cats. However, it is thought that the social status of cats and dog are increasing as the younger generations consider them family members.

After capturing stray animals, they are reintroduced to the point of capture, relocated, adopted, fostered, or kept in shelters. According to the literature, developed countries usually have shelters where animals can be brought to following capture [15]. However, the organizations provided varied estimates on the number of shelters in Norway. One organization stated that there are no shelters in Norway, while remaining respondents replied 5, 20, 20-40, above 25, 25-40, 60, 100 and 150 shelters. Based on research papers, the animals may be euthanized, remain permanently in the shelter, or become adopted or fostered [9]. Giving the results of the research, no limits exist on how long cats are allowed to stay in shelters prior to relocation according to four respondents. However, others provided different answers such as 7 days, 14 days, 50 days, and 180 days. Based on the literature, no legislation exists on this matter [32]. The literature further describes the shelters as being a facility housing stray animals maintained by government or animal welfare organizations [9]. According to the results of the survey, 77.8% replied that the shelters in Norway are operated by animal welfare organizations.

The participants of the research were asked to give information concerning the population number of dogs and cats in Norway. Five organizations did not provide estimates on dog population due to the lack of knowledge. Remaining respondents wrote 500 000 dogs and 560 000 dogs. According to the literature, there are 490 000 dogs in Norway. They were also questioned about the Norwegian cat population, and six participants of the research provided estimates. These estimated numbers varied from 500 000 to 1 000 000. According to the

literature review, there are 783 000 cats in Norway [34]. The organizations were further asked to give estimates on the Norwegian stray dog and cat population. Six of the respondents answered that there are no stray dogs in Norway. In contrast, three organizations estimated the stray cat population to be 10 000, 100 000 and over 100 000 cats. According to the literature, there are no national statistics on the stray animal population which is strengthened by the results of the research. Additionally, there is an international lack of information about the stray animal population number [5].

According to the participants of the research, stray cats are controlled by being captured and placed in a shelter. They further wrote that neither the state nor law control the population, and volunteer organizations capture to rehabilitate and rehome the cats. If the cats are too sick, they may be euthanized. Others responded that cats are not placed in shelters, but in foster homes. Also, CNR programs were mentioned as a control method by one organization. According to the literature, the Norwegian legislation on surgical interventions prohibits removal of body parts unless there is a justifiable reason. There is no specification concerning permission of sterilization for the management of overpopulation of dogs and cats [32]. However, desexing is often recommended for the control of the population number [12]. CNR is a program where stray colony animals are trapped, neutered, medicated, vaccinated, and then usually released back to their point of capture. Some researchers view these programs as unethical with low chances of resolving problems associated with stray cats, while other regard it as an ethical alternative to euthanasia, also decreasing the emotional burden of staff performing euthanasia regularly [16, 17]. More research needs to be conducted concerning the effectiveness of this method.

Based on the literature, various countries have used euthanasia as a method to control their stray animal populations. The preferred method of euthanasia in shelters and rescue facilities are intravenously injected barbiturate or barbituric acid derivatives combined with proper animal handling [24]. They are generally used in high- and high-middle-income countries, while shooting or poisoning are more frequently conducted in middle- and lower-income countries [9]. 88,9% of the organization replied that the method of euthanasia at Norwegian shelters are lethal injections. According to the literature review, killing of animals are addressed in the Norwegian regulations, but excludes which animals qualifies for termination of life [32]. Based on the responses of the organizations, animal deemed healthy by the veterinarian get

microchipped and vaccinated before being rehomed. If the health check concludes the animal to be too sick or feral, euthanasia will be performed.

Based on the literature, there are no communal European directive or regulation dealing with stray animal control, and therefore it is controlled on a national level [15]. The organizations were asked to answer whether they thought it existed legislation on animal welfare, stray dogs and cats, animal shelters, collection of strays, animal abandonment, who can own a pet, how to keep and look after pets, euthanasia, breeding of dogs and cats, sale of dogs and cats, dangerous dogs, and registration of dogs and cats. Based on the literature, animal welfare is addressed in Animal Welfare Act (lov om dyrevelferd) stating the intrinsic value of animals unrelated to their functional value for humans. It also includes the requirements of proper treatment of animals and protection from danger [32]. All participating organizations believed that there is an existing legislation regarding animal welfare. Additionally, the law mentions that it is forbidden to abandon animals in helpless condition [32]. Only three organizations thought that this topic was addressed in the legislation. Also, the Act states that an animal keeper should ensure that competent personnel take care of the animals, and that children less than 16 years of age may not be allowed to have independent responsibility for an animal. The keeping of animals is further covered in the law and involves topics such as general keeping conditions for animals, the animal's living environment, attention, care and feeding [32]. Two of the organization believed that there was legislation on "who can own a pet", while seven thought it existed for keeping and caring of animals. Euthanasia is also included in the Act, but excludes which animals qualifies for termination of life [32]. According to the research, six participants thought it existed regulation on euthanasia. The Animal Welfare act regulates breeding and selling of animals, and only three organizations believed it existed any legislation on these topics. It does not exist legislation about registration of dogs and cats, but the Dog Law states that private organizations can establish and run an identification and registration scheme for dogs [32, 33]. Only one organization believed that there were any legislation concerning registration of dogs, while no one believed there were any legislation on registration of cats. Furthermore, there are no section about stray animals, animal shelters or collection of strays. However, the Dog Law addresses "løse hunder" which can be translated to "stray dogs". The law states the right to collect dogs which are loose in violation of certain sections. The dog should be brought to the dog keeper or the police depending on the circumstances. In case of failed reunion with owner within one week of alert, the police can sell, relocate, or euthanize



the dog [32, 33]. Two organizations believed that it existed legislation on stray dogs and cats, while three thought legislation existed for collection of strays, and five for animal shelters. These results indicate a varied interpretation of the legislation, and that a proper and differentiated legislation are needed.

Based on the literature review, several countries have conducted educational programs concerning responsible pet ownership. These courses are drifted by non-governmental organizations; however, they have not been able to directly measure the program's success in reducing stray animals [2]. Based on the research, only 22,2% of the organizations replied that there are educational courses on pet ownership in Norway. According to the literature review, only one WSPA member society in Hungary had monitored stray animal numbers and discovered reduction due to educational programs targeting school children [2]. Further research on the effect of educational courses is needed.

## 6. CONCLUSION

Stray dog and cat overpopulation creates problems throughout the world concerning animal welfare, public health, and wildlife. Therefore, there are several methods existing regarding population management which further differs between the countries. The aim of the thesis was to provide information on definitions of stray dogs and cats, origin of stray animals, shelter definition, population number of pets, threats of stray animal overpopulation, strategies to control populations, legislation on stray animals, and educational courses on pet ownership. Further objectives included finding potential solutions for the stray animal problem, examining European practices which have an efficacious stray animal management. Therefore, Norwegian animal welfare organizations were contacted regarding participation in extended research on stray animals. Based on the literature and the research results, several approaches can be adopted to control the stray animal population. Controlment of reproduction could be achieved through sterilization of free roaming pets, and controlled breeding and selling through effective and enforced legislation. Chemical castration is a low-cost option for sterilization, easier to conduct, and cultural accepted in comparison to orchietomy. However, it does not provide permanent infertility and loss of sexual behavior. Optimal method should produce these effects, require only one administration, be safe for target and non-target animals, have proper efficacy and storability. To obtain these characteristics, further studies should be conducted. According to the literature, lethal methods are a short-term strategy because it does not reduce the population number permanently. To only apply lethal methods for stray management, will be the same as performing symptomatic treatment without addressing the underlying causes of the problem. Also, educational courses on responsible pet ownership could benefit the stray animal situation, however it should be monitored to document the effects. Additionally, mandatory registration and identification of both dogs and cats can contribute to a better management but are not successful without proper enforcement. The different actors such as the government, municipalities, veterinary agencies, non-governmental organizations, and owners should cooperate in the management of stray animals. Furthermore, the applied control strategies depend on the national economy. For instance, the use of shelters to house animals are expensive, and more common in high-income countries. Finally, the literature and the research imply that no single solution exist to solve the stray animal problem, and further research are required to record the effectiveness of different strategies.

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### Thesis progress report for veterinary students

Name of student: Mcli Svanhild  
 Neptun code of the student: F3HYV9  
 Name and title of internal supervisor: Dr. Szilvia Vetter PhD., Head of Center for Animal Welfare  
 Name and title of external supervisor: Dr. Bernadett Edelényi  
 Department: Center for Animal Welfare  
 Thesis title: International best practice: Possible solutions of the stray animal problem.

#### Consultation – 1st semester

	Timing			Topic / Remarks of the supervisor	Signature of the supervisor
	year	month	day		
1.	2021.	03.	08.		<i>[Signature]</i> §
2.	2021.	03.	14.		<i>[Signature]</i>
3.	2021.	04.	21.		<i>[Signature]</i>
4.	2022.	04.	29.		<i>[Signature]</i> §
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Grade achieved at the end of the first semester: ...5 (excellent).....

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	Timing			Topic / Remarks of the supervisor	Signature of the supervisor
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1.	2022.	08.	26.		<i>[Signature]</i> §
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The thesis meets the requirements of the Study and Examination Rules of the University and the Guide to Thesis Writing.

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