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Estimation of the Uncontrolled Cat Population within the Framework of Neutering Campaigns in Switzerland

VETERINARY PUBLIC HEALTH INSTITUT

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Zusammenfassung

Eine unkontrollierte Vermehrung von Katzen führt zu grossen Tierschutzproblemen. In der Schweiz ist weder die Kennzeichnung noch die Kastration von Katzen gesetzlich vorgeschrieben. Entsprechend gibt es auch keine Daten zur unkontrollierten Katzenpopulation in der Schweiz. Das Ziel der vorliegenden Studie war eine Schätzung der Anzahl unkontrollierter Katzen (dazu zählen sowohl verwilderte Hauskatzen als auch Bauernhofkatzen, welche unkastriert sind und nicht ausreichend versorgt werden). Zunächst wurden Tierschutzorganisationen befragt, welche Kastrationsaktionen durchführen. Anhand der wissenschaftlichen Literatur wurden Daten zur Populationsdynamik von verwilderten Katzen zusammengestellt. Anschliessend wurde mithilfe eines Populationsmodells der Einfluss der Kastrationsaktionen und der Aufnahmekapazität des Lebensraums auf die Populationsgrösse abgeschätzt.

Drei Tierschutzorganisationen stellten Daten zu Kastrationsaktionen zur Verfügung. Dabei wurden innerhalb eines Jahres (2022 bzw. 2023) insgesamt 12'281 Katzen eingefangen und kastriert. Gemäss Schätzung einer Organisation werden bei Kastrationsaktionen in einer Region ca. 10% der Population eingeschlossen.

In der Modellierung zeigte sich, dass für die Grösse der Gesamtpopulation weniger der Erfolg der Kastrationsaktionen als die Aufnahmekapazität des Lebensraums der unkontrollierten Katzen entscheidend ist. Anhand der Anzahl Bauernhöfe in der Schweiz und der Angabe, dass rund zwei Drittel der unkontrollierten Katzen Bauernhofkatzen sind, wurde diese Aufnahmekapazität zwischen 290'000 und 725'000 geschätzt. Kastrationsraten unter 5% haben praktisch keinen Effekt auf die Reduktion der Population. Wenn jährlich 10% der weiblichen Tiere kastriert werden, sinkt die Population je nach Modellparametern auf 50-67% der Aufnahmekapazität des Lebensraums.

Anhand der ausgewerteten Daten und Modellierungsergebnisse liegt die Anzahl der unkontrollierten Katzen in der Schweiz zwischen 125'000 und 700'000. Der wahrscheinlichste Wert liegt bei ca. 225’000. Der erfolgversprechendste Ansatz für die Reduktion dieser Anzahl liegt gemäss den Ergebnissen dieser Studie in der Reduktion der Aufnahmekapazität des Lebensraums für unkontrollierte Katzen. Kastrationen sind als begleitende Massnahme sinnvoll, reichen aber für eine Kontrolle nicht aus, solange genügend Futterquellen und Lebensraum zur Verfügung stehen.

Introduction

Uncontrolled cat populations repeatedly pose problems in animal welfare enforcement. These include inadequate care provided for groups of cats by their owners and free-roaming cats without owners. Unlike in some surrounding countries, there is neither a registration nor a compulsory sterilization requirement for cats in Switzerland. For planning possible control measures, it is essential to understand the extent of the problem. The Association for Pet Food provides a relatively reliable population estimate for cats kept as pets. According to this, there were 1,853,759 cats in Switzerland in 2022 [1]. Compared to 2012, the cat population has increased by 25%. However, there are no reliable estimates for the number of uncontrolled cats not kept as pets. Animal welfare organizations such as the Swiss Animal Protection (STS) and the Network for Animal Protection (NetAP) conduct sterilization campaigns for such cat populations. However, more information is needed on how many animals per year are involved and what proportion of the affected population is covered by these actions. In the media, an estimate of 100’000 to 300’000 animals has been cited repeatedly, but no reliable source was found for this number.

Estimation of the Uncontrolled Cat Population within the Framework of Neutering Campaigns in Switzerland

This report aims to estimate the number of uncontrolled cats in Switzerland. By modeling the population dynamics of uncontrolled cats, the impact of measures such as sterilization on the population is explored.

Methods

A survey was conducted among animal welfare organizations in Switzerland, including Swiss Animal Protection (SPS), Zurich Animal Protection, Susy Utzinger, and NetAP, to gather data on the number of annual sterilizations performed on unowned cats and information on the age, gender, and health status of treated animals. The available literature on the topic was reviewed to estimate missing parameters for modelling the cat population. These factors included the average birth rate, sterilization rates among uncontrolled cats, and survival rates of cats of different age classes. Finally, with the data collected on population dynamics and age structure, a compartmental model was created in R to simulate the development of uncontrolled cat populations with and without interventions. The effect of different sterilization rates as well as the effect of reduction of the carrying capacity of the environment was explored.

The compartmental model is designed to simulate a cat population's dynamics over time. It tracks the populations of four compartments: kittens, non-neutered females, neutered females, and males. The population of kittens is influenced by births from non-neutered females, juvenile mortality, and kittens reaching adulthood. Non-neutered females contribute to the kitten population through births and experience mortality and castration. Neutered females result from the neutering of non-neutered females and are reduced by the adult mortality rate. Male populations are derived from the kitten population and are influenced by the adult mortality rate. Castration rates of males were not modelled, because only few uncastrated males are needed for female reproduction. The mathematical formulas describing the compartments are as follows:

Kittens' population (K) equation:

$$\frac{dK}{dt} = (F * B) - (K * \mu j) - \left(\frac{K}{12}\right) - \left(\frac{K^2}{CC}\right)$$

Non-neutered females' population (F) equation:

$$\frac{dF}{dt} = \left(\frac{K}{24}\right) - (F * \mu a) - (F * CR)$$

Neutered females' population (Fn) equation:

$$\frac{dF_n}{dt} = (F * CR) - (F_n * \mu a)$$

Males' population (M) equation:

$$\frac{dM}{dt} = \left(\frac{K}{24}\right) - (M * \mu a)$$

In these equations:

Populations: K: Population of kittens

F: Population of non-neutered females
Fn: Population of neutered females
M: Population of males

Parameters:

B: Birth rate
μj: Juvenile mortality rate
μa: Adult mortaliry rate
CR: Castration rate
CC: Carrying capacity

The parameters and their references are described in Table 1. The carrying capacity (CC) represents the maximum number of cats the environment can support, preventing unlimited growth of the population. The carrying capacity represents the point at which the population growth rate levels off as resources become limited. When the population size approaches or exceeds the carrying capacity, factors such as competition for resources (food and shelter), disease, and other limiting factors begin to exert pressure on the population, causing the growth rate to slow down or stabilize. The model uses Euler's method to simulate the population dynamics over time. It discretizes time into monthly intervals and updates the population compartments based on the specified differential equations. The simulation runs for 10 years, with monthly time steps. The model provides a means to visually track the population dynamics of each segment over time through line plots. This allows for the observation of trends and fluctuations in the cat population, as well as the impact of interventions such as neutering.

TABLE 1: PARAMETERS USED IN THE COMPARTMENTAL MODEL

Parameter	Value	Reference
Adult mortality rate monthly	0.04	[2]
Carrying capacity literature	0.15–4.88 cats/ha	[3]
Carrying capacity regional level	10 000 – 30 000	Estimation from surveys of Animal Protection Associations
Initial population	See Table 2	Data from surveys of Animal Protection Associations
Juvenile mortality rate monthly	0.1	[2]
Kittens per litter	4	Data from surveys of Animal Protection Associations
Litter per year	1.4	[4]
Percentage of cats caught in campaigns yearly (in regions with campaigns)	5%-15%	Data from surveys of Animal Protection Associations
Sterilization rate of free-roaming juveniles and adults yearly	0.05/0.125	[3]

Results

Summary of the survey of animal welfare associations

Schweizer Tierschutz (STS) reported that in 2022, a total of 9’477 were caught and neutered. 3’326 were wild cats (verwilderte Katzen) and 6151 were farm cats. There was no information given regarding castration status and age. The neutering process occurs throughout the year, with a total of 60 participating sections across all of Switzerland. The exact locations were not given. During large-scale operations for farmers, sometimes over 100 cats are neutered. Regarding the condition of the cats, specific numbers or details were not available. Cats are found in various states, including severely compromised conditions. Some cats can’t be neutered on the same day, as they may require initial

treatment. However, such cases are exceptions. Most cats receive on-site antiparasitic treatment for both internal and external parasites. Their nutritional condition varies greatly, ranging from poor to adequate and normal, depending on factors like age and gender. Regarding the re-trapping of cats, sections generally report that once a cat has been trapped, it usually doesn't re-enter the trap, at least not shortly afterwards. Occasionally, previously neutered cats are trapped again; however, these cats are either marked with an ear notch or microchipped and then released back into the wild.

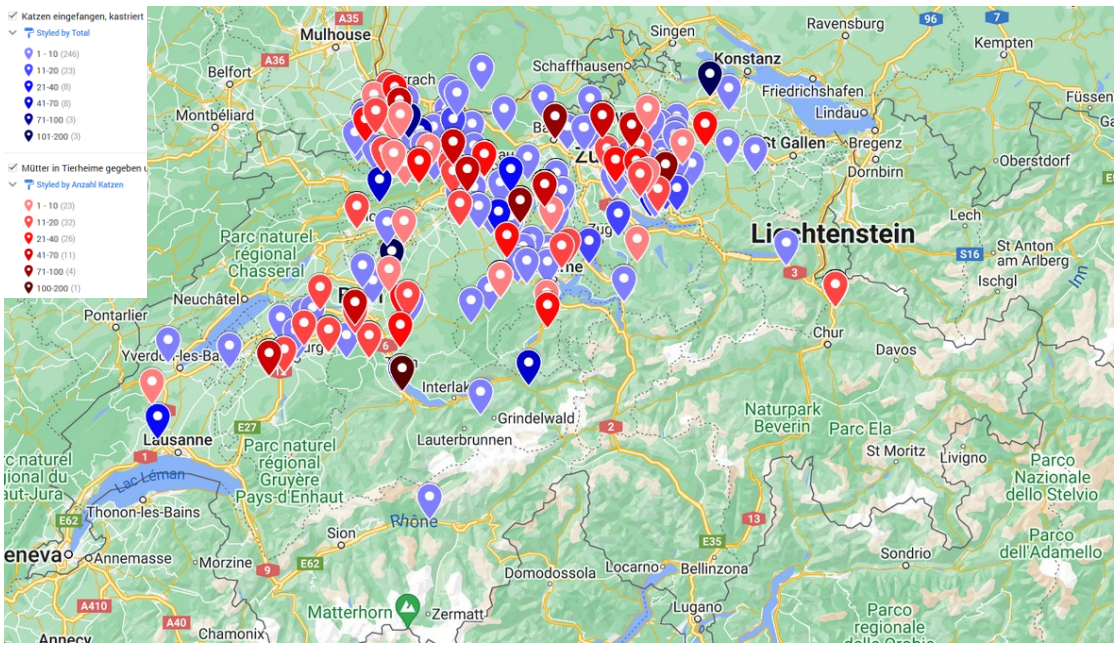

FIGURE 1: LOCATIONS OF CAMPAIGNS CONDUCTED BY NETAP

NetAP reported that they caught a total 1’151 cats in 2023. Additionally, 82 females were given into shelters with 320 kittens, with requests for sterilization. Cats caught and neutered receive anti-parasitic treatment and vaccine and are examined and marked. Around 300 interventions took place across central Switzerland (see figure 1), sometimes reaching up to 90 cats at the time. Most of the cats that were trapped were found on farms. According to NetAP, determining whether they are strays is often challenging. Some farmers claim the cats have wandered onto their property to avoid bearing the associated costs and responsibilities. It is also difficult to ascertain if these cats migrated from neighboring farms.

Even on farms where all cats have been neutered, new arrivals persist due to neighboring farms' reluctance to participate in neutering efforts. NetAP mentioned their willingness to compile data. However, their efforts are hindered by time constraints. They reported that the scale of the crisis is significant and that new cases emerge daily, presenting challenges in management. As they operate without paid staff, they are rapidly very limited in the absence of volunteers to trap cats. In addition to conducting around 1’400 neutering procedures, they rescued over 500 cats in poor condition last year. Finding suitable homes for these animals remains challenging as no-kill shelters are consistently full.

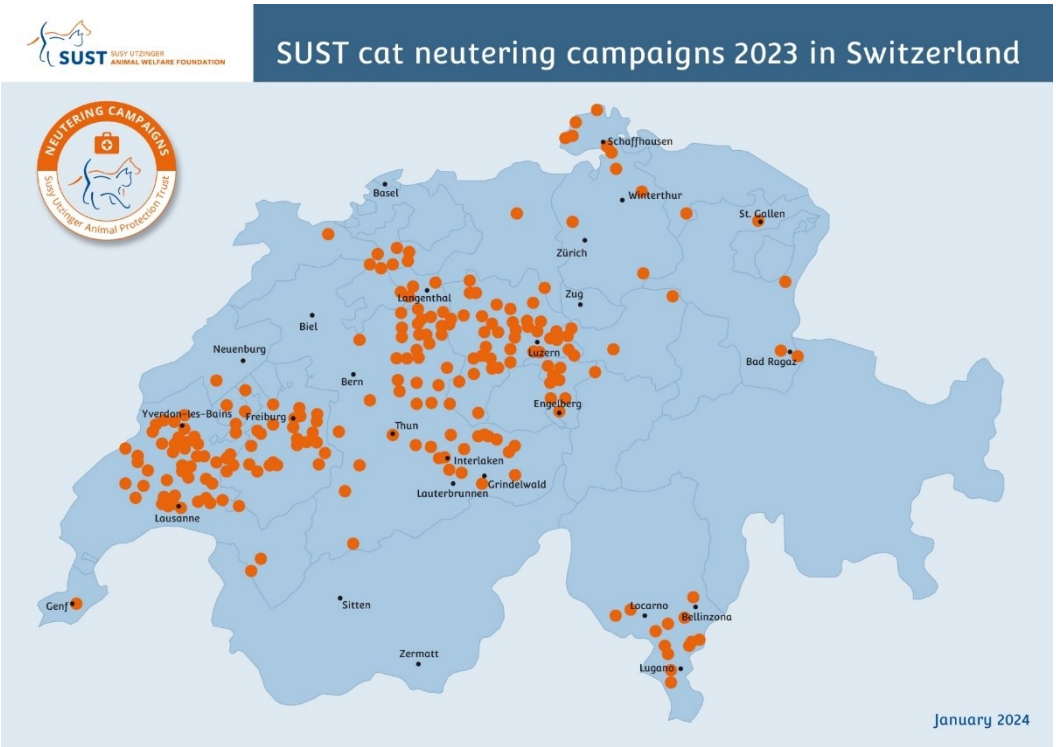

FIGURE 2: LOCATION OF CAMPAIGNS CONDUCTED BY SUSY UTZINGER

Susy Utzinger reported that their project has mainly focused on partially financing the neutering of farm cats and feral populations and advising animal lovers who wish to conduct neutering campaigns actively. They collaborate with various veterinarians who offer discounted rates. Additionally, they work with several animal welfare associations, whose neutering campaigns they partially finance. Last year, approximately 1'250 neutering procedures were conducted, financed as part of their project. Because most of these cats were either captured by animal welfare associations or the farmers themselves and brought in for neutering, they could not provide precise information regarding the campaigns' dates and duration, or the cats' health condition. Generally, they mentioned that many of the cats were in a bad state. Many suffered from respiratory diseases (Katzenschnupfen), including some extreme cases, parasites, and tumors. They received relatively little feedback regarding cats who tested positive for FIV/FeLV. They mentioned that we could get in contact with the associations they collaborate with for more details. In general, their partners place importance on capturing and neutering all animals in a population (e.g., on a farm). Sometimes, a long time is taken until the last cat is caught in the trap. New arrivals are reported by cooperating farmers, who are then also captured or brought directly to the veterinarian. It is assumed that more neutering could occur if sufficient resources were available (money, traps, helpers, time). The amount of cats neutered in the past years has increased. The increase in the past year is suspected to be partly due to the growing awareness of the (partial) financing offer among veterinarians and the intensification of collaboration with them and other animal welfare organizations over the years. Additionally, a more animal-friendly option for population control (instead of euthanizing unwanted animals) is increasingly appreciated by more and more farmers of the new generation. Their annual budget for cat neutering was fully utilized and even slightly exceeded last year. Susy Utzinger reported that the enthusiasm for donating for neutering is not particularly high. It is not an issue that touches many people probably because the positive impact of neutering on animal welfare is not immediately apparent. Therefore, raising the necessary funds is difficult, and it would be welcome if the issue were recognized and addressed in politics as well.

In summary, the animal welfare associations participating in the survey caught and neutered 11'878 cats. An additional 403 cats were brought to an animal shelter. While the largest animal welfare organisations participated, these organisations do not cover all geographic areas equally well, with the South of Switzerland underrepresented in the data for which geographic information was available. It was not possible to quantify which percentage of the geographic area of Switzerland is covered by neutering campaigns.

TABLE 2: NUMBER OF CATS CAUGHT IN CAMPAIGNS AS REPORTED BY ANIMAL WELFARE ASSOCIATIONS

Association	Year	Males	Females	Total	Comments
STS	2022	3948	5529	9477	3326 wild cats and 6151 farm cats
NetAP	2023	545	606	1151	In addition, 403 (82 female + 320 kittens) brought in animal shelter
Susy Utzinger	2023	500	750	1250	
Total		**4993**	**6885**	**11878**	

Compartmental model

In a first step, the cat population for the geographic area which is covered by the neutering campaigns was modelled (localized models). To calibrate the model, it was preferable to start with the population for which more reliable data was available. In a second step, model input parameters were extrapolated to Switzerland.

Localized models

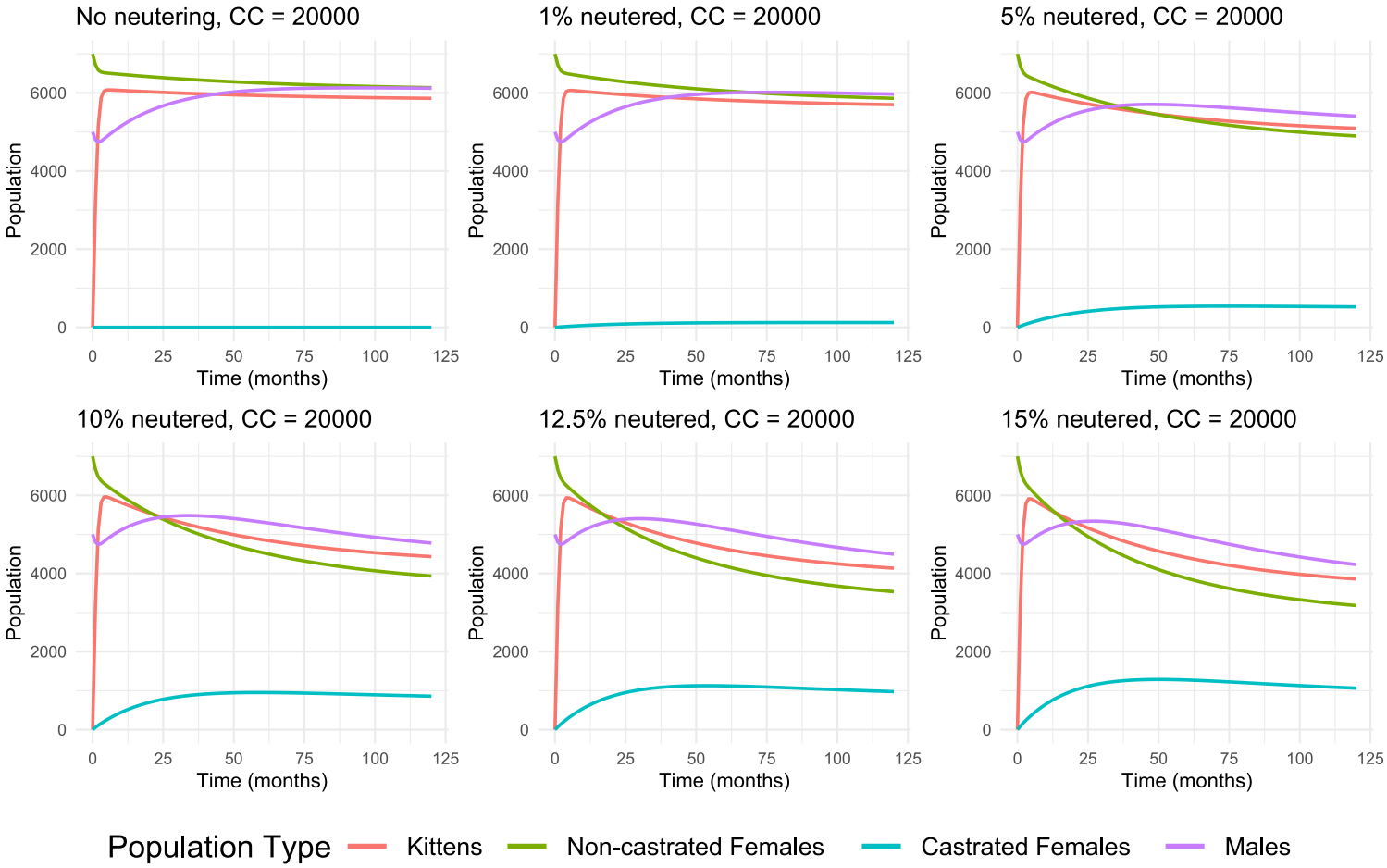

FIGURE 3: MODELLING OF DIFFERENT NEUTERING RATES

Figure 3 presents the results of the compartmental model, where each colored line depicts a compartment of the cat population. The x-axis illustrates population size, while the y-axis represents a timeline spanning 10 years in months. Initially, the model was simulated using local data from animal welfare associations, with a starting population of 12'000 (as detailed in Table 2) and a carrying capacity of 20'000. The model ran with the parameters outlined in Table 1. Various neutering rates were modeled to assess their impact on populations, ranging from 0 to 15%. These rates were chosen based on information from animal welfare associations and data reported in the scientific literature.

In scenarios with no neutering, the model rapidly reaches carrying capacity, becoming the primary factor prohibiting cat population growth. As neutering rates increase, the population decreases below carrying capacity. Notably, a 1% neutering rate has almost no effect, whereas at least a 5% neutering rate is necessary to observe a population decrease.

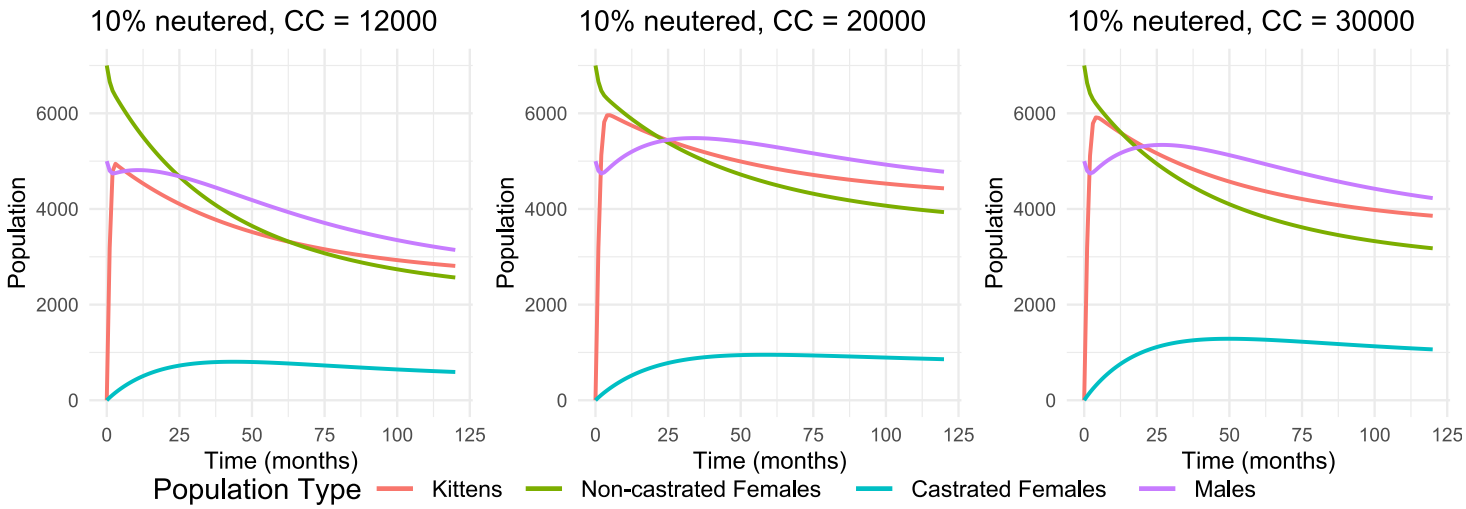

FIGURE 4: MODELLING OF THREE DIFFERENT CC

Figure 4 illustrates the effect of different carrying capacities on the population. Three different carrying capacities (12'000, 20'000, and 30'000) were modeled to explore this further. Employing a constant 10% neutering rate, simulations revealed a rapid population decrease, with negligible differences observed between carrying capacities of 20'000 and 30'000. Modeling a carrying capacity close to the original population of 12'000 demonstrates rapid population reduction from the start, ultimately stabilizing close to the carrying capacity. Carrying capacity is crucial for estimating population growth, yet accurately determining it proves challenging due to environmental variability and lack of data.

Extrapolation to Switzerland

For obtaining an estimate of the uncontrolled cat population in Switzerland, several additional assumptions had to be made. NetAP estimated to cover 10% of the areas they are active in (see Figure 1). Using this estimate, it can be assumed that the total population cannot be less than 10 times the number of cats caught in a year (120'000). Accounting for regions not covered by animal welfare associations, we used an estimate of 200'000 as the starting point for our model (table 1).
For an estimation of the carrying capacity for Switzerland, we used the number of farms in Switzerland in 2022: 48'344 [5]. NetAP reported an average of 4 cats per farm. Because farms participating in campaigns are likely to be more aware of controlling the cat population than non-participating farms, a capacity of 10 cats per farm was chosen for the initial model. According to the data of STS, two out of three uncontrolled cats are farm cats, and one out of three are wild cats. Which results in a capacity of 483'440 cats for the farm cats plus 241'720 for the wild cats for Switzerland. This would mean that the maximum total carrying capacity for all of Switzerland would be 725'160 (high estimate). This would be the maximum possible number of cats without any neutering or control campaigns. Assuming 4 cats per farm, the respective numbers are 193'376 farm cats and 96'688 wild cats. This estimate assumes some private control measures such as neutering, killing of offspring or restriction of food

and shelter. Assuming that 50% of the farms in Switzerland control their cat population completely, the carrying capacity could be reduced to 145'032. The initial input parameters for the model are summarized in table 3. Regarding the control campaigns, we estimate that they cover around 50% of Switzerland and that each campaign neuters around 10% of the cats. Therefore, around 5% of the cats in Switzerland are neutered annually.

TABLE 3: INPUTS PARAMETERS OF MODEL FOR SWITZERLAND

Parameter	Value
Initial population	100'000 males and 100'000 females
Coverage of neutering campaigns in Switzerland	50%
Carrying capacity for all of Switzerland	High estimate: 725'160, Most likely: 290'064
Neutering rate for all of Switzerland	5%

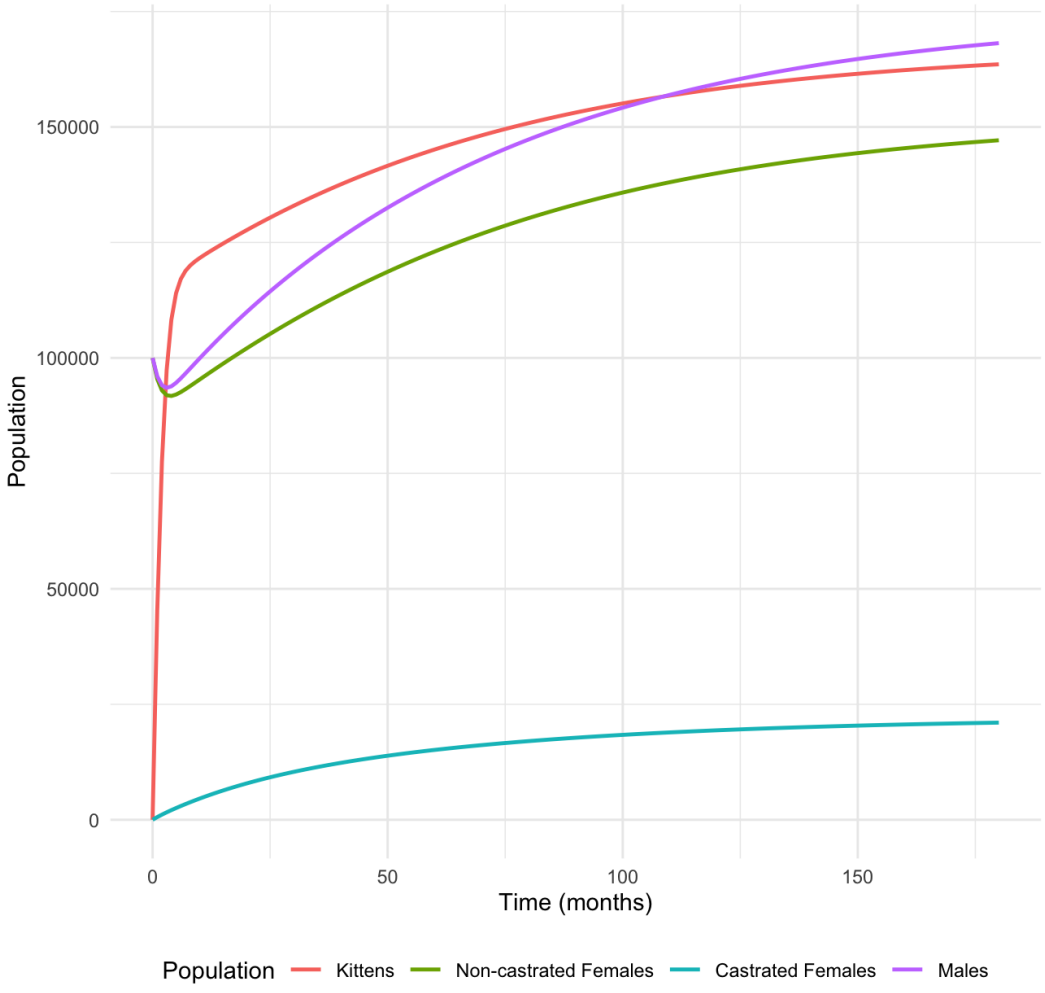

FIGURE 5: MODELLING OF THE UNCONTROLLED CAT POPULATION OF SWITZERLAND WITH A HIGH CARRYING CAPACITY

As shown previously, a 5% neutering rate only slightly reduces the population (figure 5). The model, initialized with 100'000 males and 100'000 females, stabilizes after 15 years under the carrying capacity, at **530'246 cats**. If the campaign coverage across Switzerland were to be only 30%, the total

number of cats would increase to 562'829. With a higher coverage of the campaigns of 70%, the total population would decrease to 499'645.

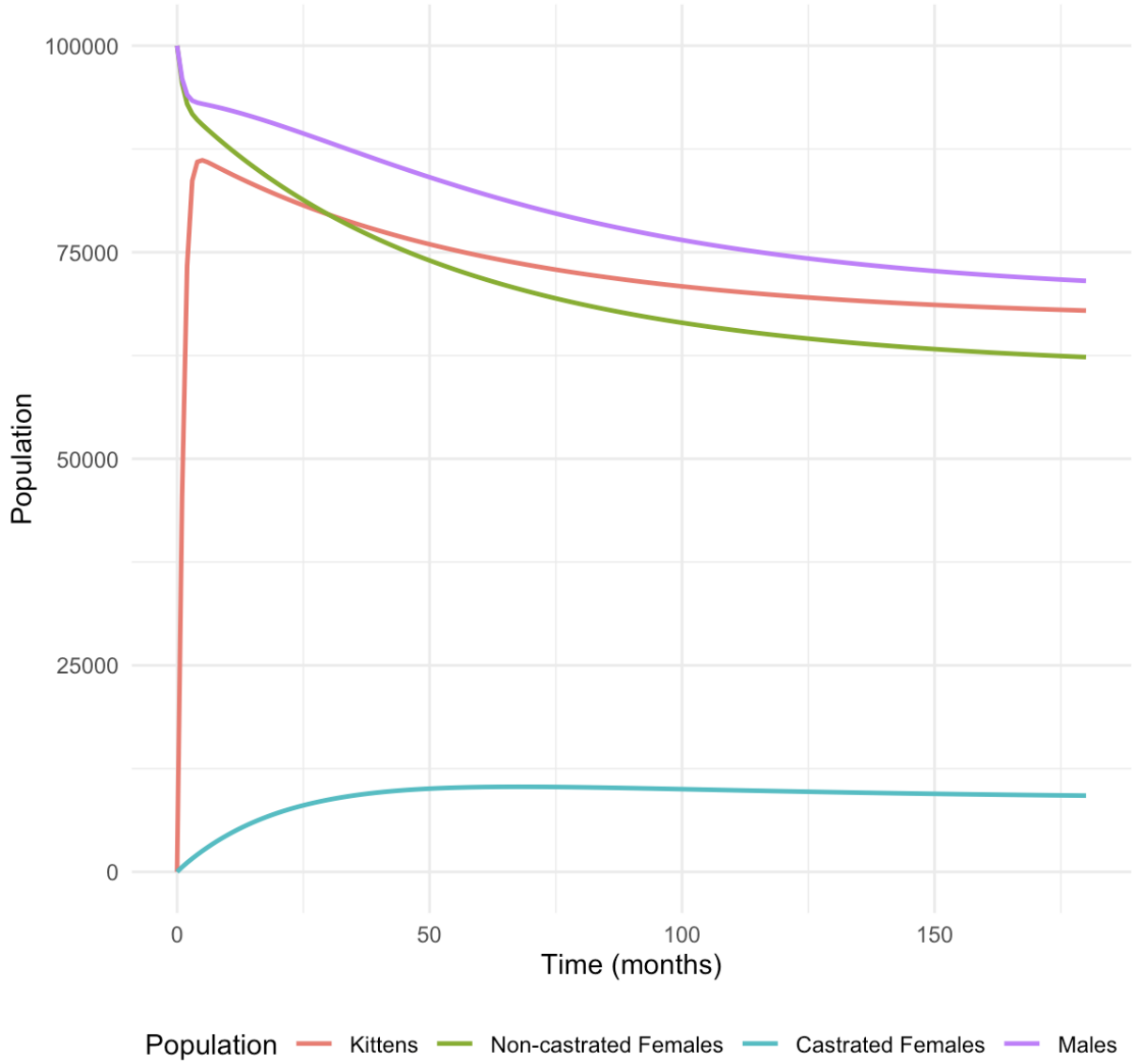

FIGURE 6: MODELLING OF THE UNCONTROLLED CAT POPULATION OF SWITZERLAND WITH AN AVERAGE CARRYING CAPACITY

The model was run a second time with an average capacity of 4 cats per farm. This results in a carrying capacity of 290'064 cats. The prediction after 15 years is that there is a total of **224'166 cats.**
If the campaign coverage across Switzerland were to be only 30%, the total number of cats would increase to 238'136. With a higher coverage of the campaigns of 70%, the total population would decrease to 211'084.

Discussion

Modelling the uncontrolled cat population in Switzerland showed that it is extremely difficult to achieve a substantial reduction of the population with neutering campaigns. If 10% of all uncontrolled

cats in Switzerland are neutered annually, the population can be reduced to about 50-67% of the carrying capacity of the environment. However, this is only possible if the population of uncontrolled cats is stable. In reality, a considerable amount of unwanted pet cats is abandoned annually, contributing to the problem of uncontrolled cats. This was not included in our model, because no data were available. A group of researchers modeled this effect for the UK. In this model, neutering rate and neutering age of pet cats was more important for limiting cat population growth than neutering rate of uncontrolled cats [2]. Another limitation of our model was that compensatory mechanisms such as an increase in kitten survival, higher number of pregnancies per intact cat or increase in litter size due to lower competition for food and shelter were not taken into account. In a recent intervention study in an urban area in Israel, neutering of >70% of all uncontrolled cats resulted in a 7% decrease of the population per year. Neutering 40% of the cats, on the other hand, resulted in a further increase in the population [6]. In the absence of an obligation of registration and neutering of cats, it is highly unlikely that it will be possible to achieve such high neutering rates.

The estimation of the uncontrolled cat population in Switzerland resulted in a most likely number of around 225'000, with a minimum and maximum estimate of 125'000 to 700'000, respectively. However, these estimations need to be carefully considered, as there is considerable uncertainty surrounding the real coverage of the neutering campaigns, as well as the actual percentage of cats caught in the campaigns, and the carrying capacity of the environment. In the absence of large-scale, nationwide control measures, the carrying capacity of the environment has the greatest influence on the size of the population. According to our estimate, the carrying capacity for Switzerland ranges from 290'000 to 725'000. For more accurate estimations, further research would be necessary. For example, surveys could be conducted with farmers to obtain better data regarding the number of cats on farms.

Nevertheless, the data provided in this study give an estimate of the number of uncontrolled cats in Switzerland. They also allow for an understanding of how neutering affects the population. In the future, these results can be used as the basis for control campaigns. The process also revealed that animal welfare associations were willing to collaborate and contribute with their expertise, suggesting a good potential for future collaborative action.

References

[1] 'Association for Pet Food'. Accessed: Mar. 12, 2024. [Online]. Available: https://www.vhn.ch/de/statistiken

[2] J. McDonald, L. Finka, R. Foreman-Worsley, E. Skillings, and D. Hodgson, 'Cat: Empirical modelling of Felis catus population dynamics in the UK', *PLoS One*, vol. 18, no. 7 July, Jul. 2023, doi: 10.1371/journal.pone.0287841.

[3] D. T. T. Flockhart and J. B. Coe, 'Multistate matrix population model to assess the contributions and impacts on population abundance of domestic cats in urban areas including owned cats, unowned cats, and cats in shelters', *PLoS One*, vol. 13, no. 2, Feb. 2018, doi: 10.1371/JOURNAL.PONE.0192139.

[4] F. B. Nutter, J. F. Levine, and M. K. Stoskopf, 'Reproductive capacity of free-roaming domestic cats and kitten survival rate', *J Am Vet Med Assoc*, vol. 225, no. 9, pp. 1399–1402, Nov. 2004, doi: 10.2460/javma.2004.225.1399.

[5] 'Federal statistical office'. Accessed: Mar. 13, 2024. [Online]. Available: https://www.bfs.admin.ch/bfs/en/home/statistics/agriculture-forestry/farming.html

[6] I. Gunthera, H. Hawlenab, L. Azriela, D. Gibora, O. Berke, and E. Klementa, 'Reduction of free-roaming cat population requires high-intensity neutering in spatial contiguity to mitigate compensatory effects, PNAS vol. 119, no. 15, Feb. 2022 e2119000119' doi: 10.1073/pnas.2119000119.