Exploring Sustainable Urban Coexistence in Umeå, Sweden

Citizens' Preferences Regarding Policy Interventions to Improve Dogs, Wildlife, and Human Welfare

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Exploring Sustainable Urban Coexistence in Umeå, Sweden. Citizens' Preferences Regarding Policy Interventions to Improve Dogs, Wildlife, and Human Welfare

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Abstract

Pets and wildlife are overlooked in sustainable urban planning. At the same time, densification and expansion of cities increase pressure on green spaces and their users. Urban green spaces (UGS) can be planned to support the welfare of humans, and potentially the welfare of wildlife and pets. Here, we used a discrete choice experiment (DCE) to explore citizens' preferences and willingness to pay (WTP) for several policy interventions that can potentially improve dogs, wildlife, and human welfare, in Umeå, northern Sweden. We document that Umeå citizens value the connectedness of UGS as much as implementing compulsory dog owner education expressed in terms of tax on gross income (i.e. 1.688% vs 1.669%). Additionally, we report a similar positive WTP for increased UGS coverage, as for including dogs' needs in UGS planning (0.396% for 24% of UGS coverage, vs 0.393%). We found an overall WTP for the tested interventions equivalent to an additional yearly tax of 4.146% for 10 years (22,479 SEK per person per year) when citizens were not asked to increase the level of engagement in the decision-making process for UGS planning. Otherwise, if asked to participate more, the overall WTP was 3.568% (19,266 SEK per person per year). This sums up to a total WTP of 1.8 billion SEK per year, which would according to a preliminary assessment, be enough to construct 155 ha UGS. Our case study suggests that Umeå citizens were willing to pay for policy interventions that can improve their welfare but also for policies that can potentially improve animal welfare, indicating a willingness to coexist. Hence, we contribute to the literature that explores more-than-human-tailored urban environments. Ultimately, this study aims to move us one step forward toward a sustainable urban coexistence between dogs, wildlife, and humans.

Keywords: Sustainable Urban Coexistence, Citizens' Preferences, Urban Green Spaces, Dog Welfare, Wildlife Welfare, Human Welfare

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Abbreviations

aic	Akaike information criterion
bic	Bayesian information criterion
CL	Conditional logit
DCE	Discrete choice experiment
MXL	Mixed logit
nsq	Non-status quo
ll	Likelihood function
RUM	Random utility model
r2_p	Pseudo-R-squared
sq	Status quo
UGS	Urban green spaces

1. Introduction

Pets and wildlife welfare are overlooked in planning for sustainable cities (Rock *et al.*, 2014; Carter, 2016b), and their well-being is not explicitly mentioned in the Sustainable Development Goals (e.g. SDG11 Sustainable Cities and Communities) (Keeling *et al.*, 2019, 2022). Nowadays, cities often focus on densification, rather than expansion. As cities become densified, pressure on green spaces increases and green spaces are likely to be compromised. This has detrimental effects on i) dog well-being (Pueffel, Haase and Priess, 2018; Ugolini *et al.*, 2020); ii) habitats for urban wildlife (Grimm *et al.*, 2008; Seto, Güneralp and Hutyra, 2012); and iii) human well-being (Dawson *et al.*, 2023).

Even though these detrimental effects are relevant to pets, wildlife, and humans, urban planning is often approached from a human-centered perspective (see e.g. (Carter, 2016b; Douglas, Lennon and Scott, 2017; Jia *et al.*, 2023)). Recently, urban planning that includes spaces for wildlife has become a topic of study (Aronson *et al.*, 2017; Apfelbeck *et al.*, 2020; Kay *et al.*, 2022). However, pets are often completely overlooked (Rock and Degeling, 2015; Carter, 2016b; Felappi *et al.*, 2020). This can be problematic, considering that when cities grow and densify, the growing human population is accompanied by an increase in the number of pets. As a direct result, more people and animals use the same spaces (Mohajeri, Gudmundsson and Scartezzini, 2015; Dawson *et al.*, 2023). This increases interactions and potential conflicts between humans, their pets, and wildlife in urban areas (Grimm *et al.*, 2008; Bowes *et al.*, 2015; Schell *et al.*, 2021).

We can therefore ask ourselves: While urban planning is getting ready for an increase in human inhabitants, and somewhat for allowing wildlife into cities, what should we be planning to account for a rise in the number of pets, and its consequences for coexistence with humans, other pets, and wildlife?

Urban green spaces (UGS) have been introduced as a policy intervention to create healthy city environments for people, that can potentially also benefit biodiversity, wildlife, and dogs (Beninde, Veith and Horchkirch, 2015; Carter, 2016a; Aronson *et al.*, 2017; Douglas, Lennon and Scott, 2017; Dawson *et al.*, 2023). However, UGS are introduced in urban planning primarily for humans: i.e.

to improve mental health, physical health, and social cohesion (Douglas, Lennon and Scott, 2017; Lafrenz, 2022; Dawson *et al.*, 2023; Jia *et al.*, 2023).

Nonetheless, UGS can potentially promote biodiversity and wildlife distribution throughout a city (Beninde, Veith and Horchkirch, 2015). Cities are acknowledged as hotspots for endangered animal species and therefore have a vital role in preserving global biodiversity (Ives *et al.*, 2016; Aronson *et al.*, 2017; Spotswood *et al.*, 2021). Urban green spaces, such as small urban forests and cemeteries, can contribute to biodiversity conservation (Croci *et al.*, 2008; Villaseñor and Escobar, 2019). UGS planning is seen as an important tool to maintain and improve biodiversity and wildlife presence in urban areas (Aronson *et al.*, 2017).

Additionally, UGS are important areas for dog walking in the urban environment (Pueffel, Haase and Priess, 2018; Ugolini *et al.*, 2020, 2021). UGS are therefore crucial for meeting the needs of dogs in cities (Rock *et al.*, 2014; Rybakova *et al.*, 2021). Hence, UGS planning can potentially facilitate dog welfare in urban environments.

Besides UGS planning, dog owner education has been introduced in several places to ease conflicts between dogs and other beings in an urban environment. For example, some cities in Europe, e.g. Berlin, have introduced a mandatory dog handler permit for owners who would like to walk their dog without a leash[1], while a similar educational program has been suggested in other countries[2]. For such policies about dog management to be successful, it is important to include local initiatives and participation of the community (see e.g. (Doherty *et al.*, 2017; Keeling *et al.*, 2019)). This could be done through consulting and allowing citizens to be included in the decision-making[3] regarding the planning and design of UGS.

The importance of UGS for humans, dogs, and wildlife, and the overlooking of dog and wildlife welfare in their designs, emphasize the need to explore the potential for multipurpose UGS. Previous studies have explored citizens' preferences for more-than-human-tailored urban environments. However, they have not explored willingness to pay (WTP) (Bjerke and Østdahl, 2004). Nor have they included a landscape architecture perspective, or dog welfare in their research agenda (Bjerke and Østdahl, 2004; Rupprecht, 2017). Hence, there is a knowledge

[1] Read more about the dog handler permit in Berlin on the webpage of All About Berlin (2024). The dog handler permit is granted when passing a theoretical and practical exam (All About Berlin, 2024).

[2] In the Netherlands, the minister of Agriculture, Nature and Food Quality has requested implementation of compulsory dog owner education, as a mitigation measure for dog bites, and to improve dog welfare (Adema, 2023).

[3] E.g. using guidance from the ladder of participation by Arnstein (1969) and Lockwood *et al.* (2010) principles for governance of natural areas (Santander, Lorenzini and Martinez-Cruz, 2024).

gap that connects the existing literature on dog and wildlife welfare in urban areas, and studies citizens' preferences and WTP for the matter. In particular, we lack knowledge about potential budgets for creating urban environments that facilitate urban coexistence between dogs, wildlife, and humans.

In this thesis, we therefore estimate Umeå citizens' preferences and WTP regarding policy interventions aiming to improve dog, wildlife, and human welfare. Umeå is a middle-sized growing city, where the municipality has planned to grow from 133,091 inhabitants (SCB Statistikdatabasen, 2023a) to 200,000 inhabitants in 2050 (Helmersson *et al.*, 2018). To facilitate this population growth, the municipality focuses on city densification (Helmersson *et al.*, 2018). We focus on dogs in our study because UGS planning affects dog welfare directly. Umeå municipality's dog population is likely to grow as a result of the growing number of human inhabitants. Currently, there are 12,487 dogs registered in Umeå municipality (Jordbruksverket, 2023), respectively about 1 dog per 10 citizens. If the ratio of dog-citizen stays the same, the dog population will grow to 21,316 dogs by 2050.

The growing dog and human populations increase pressure on UGS in Umeå. At the same time, the UGS are crucial for coexistence with wildlife. Hedblom (2007) for example, studied birds in urban areas in Southern Sweden, and found species that breed in urban forests were strongly influenced by how the surrounding urban landscape is shaped. Urban areas not only provide habitat for local species but also migratory species (e.g. bird species), which depend on these green spaces for either year-round or for a part of the year. Increased pressure on UGS therefore affects species beyond the local level. This emphasizes the need for research on the potential of multipurpose UGS and highlights why it is important to do so in Nordic cities.

The general research question addressed here is as follows: *What possible policy interventions aiming to improve dog, wildlife, and human welfare, do Umeå citizens prefer and are they willing to pay for these?* This question helps to explore Umeå citizens' preferences for UGS planning and investigates their attitudes on how non-human needs should be integrated into the urban environment.

We first conducted a literature review on possible challenges for the welfare of dogs, wildlife, and humans in urban settings, and potential interventions that can improve their welfare. This literature review informed the survey with a discrete choice experiment (DCE)[4]. The attributes arising from this literature search were i)

[4] DCE is a non-market valuation tool, has been used to explore people's preferences and willingness to pay for matters that do not have a market (Mariel *et al.*, 2021).

UGS coverage as a percentage of the city surface – affecting human and wildlife welfare, ii) UGS connectivity – affecting wildlife and human welfare, iii) focus of UGS on dog and human welfare – impacting dog and human welfare, iv) implementation of compulsory education for dog owners on dog behavior and welfare – which has implications for the welfare or dog, wildlife and humans, and v) citizens' engagement in decision-making regarding UGS governance – affecting human welfare. Additionally, we added a monetary attribute to allow for testing citizens' WTP. This attribute affects human welfare and was used to calculate the value citizens assigned to the tested policy interventions. Additionally, this WTP was used to calculate potential budgets for the implementation of the tested UGS design.

Per attribute, we constructed a research question, elaborating on the general research question.

- *How much do Umeå citizens value the amount of UGS as a percentage of the city surface?*
- *How much do Umeå citizens value connected UGS over the current status of fragmented UGS?*
- *How much do Umeå citizens value UGS's focus on both dog and human welfare over the current status of mostly human-focused UGS?*
- *How much do Umeå citizens value implementing compulsory education for dog owners on dog behavior and welfare?*
- *How much do Umeå citizens value engagement in decision-making regarding UGS planning?*

The general hypothesis this study holds is that we expect an overall positive WTP for the tested UGS design. For UGS coverage as a percentage of the city surface, we foresee that Umeå citizens have a positive WTP (hypothesis 1). We expect this because previous studies have shown the benefits of UGS for human well-being (Beyer *et al.*, 2014; Liu *et al.*, 2019), and because UGS facilitate habitat for wildlife and biodiversity (Beninde, Veith and Horchkirch, 2015). For UGS connectivity we expect Umeå citizens to report a positive WTP (hypothesis 2). Connectivity can positively impact wildlife (Beninde, Veith and Horchkirch, 2015), as well as human well-being (Ta and Levrel, 2022), and respondents are therefore expected to report a positive WTP. Next, we foresee Umeå citizens value UGS user focus that is dog and human-oriented over solely human-oriented UGS to a lesser extent (hypothesis 3). We expect this because dog and human-oriented UGS planning would affect dog well-being positively, but can have positive, neutral, or negative effects on humans depending on their attitude towards dogs. Furthermore, we expect a positive WTP for the implementation of mandatory dog owner education (hypothesis 4). We foresee that the majority of respondents are non-dog

owners. Since dog owner education can potentially mitigate conflicts in human-dog-wildlife interactions – in all directions, we expect a positive WTP. Additionally, we expect a proportion of dog owners to also report a positive WTP, considering the potential increased risk of negative dog-dog interactions in a denser urban environment. Lastly, we foresee a preference for increased engagement in UGS governance (hypothesis 5). However, we expect Umeå citizens are not willing to pay for this in monetary terms, considering this would be a double payment – both in money and time.

The results from our study have implications for future urban planning in Umeå. In addition, our study contributes to the exploration of more-than-human-solidarity in urban areas (Rock and Degeling, 2015), and to the concepts of 'One Health' (Lerner and Berg, 2015) and 'One Welfare' (Colonius and Earley, 2013). Furthermore, our findings are relevant for municipalities to decide on what level they should include animal well-being in urban planning. We provide insights into how citizens would like to be engaged in the measures that can potentially improve pets, wildlife, and human well-being in urban areas. This study sets a first step in exploring the potential for sustainable urban coexistence in Umeå, and potentially for similar growing middle-sized cities in the North Scandinavian countries.

2. Methods

We created an online survey with DCE to explore citizens' preferences for policy interventions that can potentially improve dog, wildlife, and human welfare, in Umeå, Sweden.

2.1 Literature Review

To inform the DCE, we first conducted a literature search on the following topics: i) welfare concerning pets, wildlife, and humans in urban areas; ii) conflicts that arise between pets, wildlife, and humans in an urban context; iii) UGS design for easing these conflicts; iv) other policy interventions for balancing welfare and easing conflicts, and v) UGS governance. This literature search was used to create the survey and inform the DCE.

2.2 Survey

Using the knowledge gathered in the literature search, we created a 15-minute online survey. The survey included three parts. Respondents were briefly introduced to the topic and were directed to the first part of the survey. The first part consisted of eleven background questions to explore citizens' attitudes, perspectives, and beliefs on dogs, wildlife, and human welfare in an urban environment (see Appendix 1). In this part, we also explained the definition of UGS we used[5]. In the second part, respondents were exposed to the DCE (see Appendix 2). Here, we first presented the respondents with a scenario in which we wished to explore respondents' preferences and WTP for presented alternatives. After, an explanation of the illustrations in the DCE was shown. After explaining the scenario and illustrations, the respondent was presented with five choice sets. In part three, respondents were asked to answer ten sociodemographic questions (see Appendix 4). Socio-demographic questions were included to analyze whether our sample was

[5] Definition UGS in the survey: *Urban green spaces refer to all green spaces that encompass the total green structure within the defined city area, are open for public use, and are managed by the municipality. These urban green spaces include smaller spaces, such as green lawns and sidewalks, and larger green spaces such as parks, and provide ecosystem services for pets, humans, and wildlife.*

representative of the human population in Umeå. Both a Swedish and English version of the survey was provided. Respondents could choose their preferred version to fill out the survey.

2.3 DCE Design

We used a DCE to test respondents' preferences and willingness to pay (WTP). WTP outputs were used to illustrate how citizens valued the tested interventions, as well as to explore potential budgets for the realization of the interventions. DCE is a commonly used stated preference method and non-market valuation tool, which can be used to test people's preferences regarding matters that do not have a market. In a DCE, respondents are exposed to a simulated market, where they can choose their preferred option from several presented options. DCEs have been used to address people's WTP in various lines of research, among which animal welfare-related topics[6]. To the best of our knowledge, there are only a few papers studies that discuss dog welfare-related topics using DCE (Simonsen, Fasenko and Lillywhite, 2014; Bebrysz *et al.*, 2021; Joo *et al.*, 2023; Samper, Rowe and Williams, 2023). For example, WTP for different kinds of dog food (Simonsen, Fasenko and Lillywhite, 2014), dog owners' preferences regarding antiparasitics for their dogs (Bebrysz *et al.*, 2021), the level of interest of US cat and dog owners in participating in a donation program for pet cadavers as an instrument for veterinary medicine education (Samper, Rowe and Williams, 2023), and pet owners' WTP for pet-friendly holiday accommodation (Joo *et al.*, 2023).

In the DCE in our study, we used a split sample design. 50% of the respondents were exposed to block 1 and 50% to block 2. Block 1 and block 2 each contained five choice sets. In each of these choice sets, we asked the respondent to choose a single option between three presented alternatives: alternative 1, alternative 2, or the status quo. Alternative 1 and 2 presented attribute levels different than the current status. The third alternative represented the status quo, giving the respondent an option to deflect any changes. Each alternative contained six attributes: i) coverage of UGS as a percentage of the city surface, ii) UGS connectivity, iii) UGS focus on dogs' and human welfare, iv) implementation of compulsory education for dog owners on dog behavior and welfare, v) citizens' engagement in decision-making regarding UGS participatory governance, and vi) a monetary attribute in the form of an additional yearly tax for ten years, to test

[6] Including willingness to pay for improved farm animal welfare, for example willingness to pay for enhanced animal welfare labelled pet food (Pearce *et al.*, 2023), willingness to pay for enhanced animal welfare labelled chicken breasts (Gorton *et al.*, 2023), and willingness to pay for eggs from hens that live in an enriched cage environment (Doyon *et al.*, 2016).

WTP. In turn, each alternative had two or more levels, including the status quo (sq). The attributes and their levels are explained in Table 1.

Table 1. Tested attributes in the DCE, with description and their corresponding levels

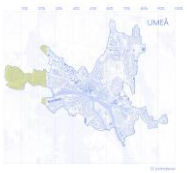
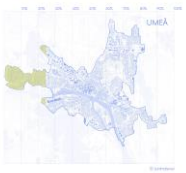
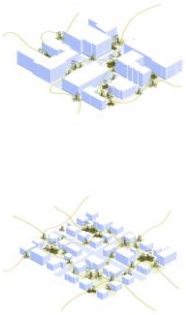
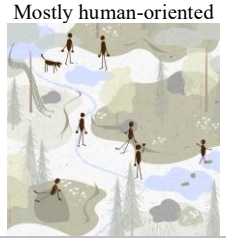
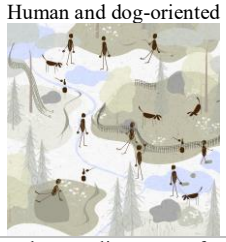
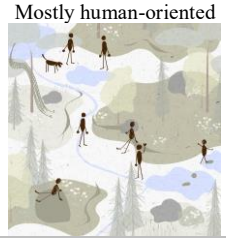
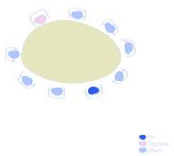
Attribute	Description and levels			
UGS coverage	Percentage of land cover of urban green space in Umeå overall city.			
	24% (sq)	35%	50%	
UGS connectivity	Connectivity describes the degree to which urban green spaces are connected. Connectedness increases the distribution of wildlife species and improves the accessibility of urban green spaces for people.			
	Fragmented (sq)		Connected	
UGS user focus	Urban green spaces can be designed for various purposes. In urban green space design, urban planners often have to choose different focus points, for example, mostly human-oriented or human and dog-oriented.			
	Mostly human-oriented (sq)		Human and dog-oriented	
Dog owner education	Umeå municipality would provide a compulsory course for dog owners in Umeå municipality. The course would be about dog behavior and well-being in an urban context and can enhance dog welfare, as well as improve the welfare of others who interact with dogs and mitigate potential conflicts.			
	No course (sq)		Compulsory online course	
UGS governance	Participatory urban green space design allows citizens to be involved in decision-making, establishment, and maintenance regarding these spaces.			
	Option to give feedback and attend lectures (sq)		Actively engaged in co-creation	
Tax	Percentage of monthly income before tax, that would yearly be contributed (per adult) for ten years. This is an additional tax on what one is currently paying.			
	0% (sq)	0.5%	1.0%	2.5%

Choice sets were designed using a randomized factorial design. The design was created using the software STATA (see Appendix 3). The ten choice sets in blocks 1 and 2 were picked randomly from the 96 possible alternatives. The randomized fractional design allowed for testing the weight of importance for each attribute in the decision the respondent made, without having to test all possible options[7].

We created illustrations to visualize each of the attribute levels in the DCE, shown in Appendix 2. Illustrations were added to the choice sets to help describe the attributes and their levels to respondents. An example of a choice set with its illustrations is presented in Table 2.

[7] If we were to present all options, there would be 96 alternatives, and since each choice set contained two alternatives different than the status quo, 48 choice sets. Presenting each respondent with all 48 choice sets (full factorial design) would be too much for the respondent to comprehend. The respondent would get tired after a while, respondent fatigue, as described by e.g. (Mariel *et al.*, 2021)). Respondent fatigue can be problematic as it might cause respondents to make less considerate choices or drop out halfway through the survey, decreasing the accuracy of the results. We therefore decided to use a factorial design, in which we presented each respondent with five choice sets. Since we created two choice blocks, we were able to test ten choice sets, thus twenty alternatives, plus the status quo.

Table 2. Example of a choice set (Choice set T11, English version)

Alternative 1	Alternative 2	Current
24% 	50% 	24% 
Fragmented 	Connected 	Fragmented 
Mostly human-oriented 	Human and dog-oriented 	Mostly human-oriented 
No course 	Compulsory online course for dog owners 	No course 
Citizens are actively engaged in co-creation of urban green spaces 	Citizens can give feedback in several stages of the decision-making process and Umeå municipality provides lectures about current plans 	Citizens can give feedback in several stages of the decision-making process and Umeå municipality provides lectures about current plans 
2.50% 	1.00% 	0% 
□	□	□

2.4 Sample

We distributed our survey in the middle-sized city of Umeå, Västerbotten, Northern Sweden. The survey was distributed online, among a sample of respondents in Umeå subscribed to a panel provided by the professional survey company Syno International[8]. Answers were collected between April 11 and April 26, 2024. A total of 508 answers were gathered.

A summary of the sociodemographics and socioeconomics of Umeå citizens and our sample is shown in Table 3. Data on Umeå citizens were calculated in Excel using SCB Population Databases and SCB Income Database (SCB Statistikdatabasen, 2023b, 2023c). A breakdown of these calculations is shown in Appendix 5. In Table 4-7, a more detailed summary of the socio-demographics of the respondents in our sample is shown.

Table 3. Summary of demographics Umeå citizens, and demographics of citizens in the survey sample. Data for Umeå collected from (SCB Statistikdatabasen, 2023b, 2023c).

Umeå		**Sample**	
Population size	133,091	N	508
Mean age	40	Mean age	48
Women	50.07%	Women	53.30%
Men	49.93%	Men	45.90%
Age 20-64	60.45%	Age 18-64	77.30%
Single age >20	50.25 %	Single age >18	29.30%
Married age >20	36.05%	Married age >18	37.20%
Foreign-born age 20-69	15.18%	Foreign-born age 18-64	5.70%
Mean yearly income before taxes in SEK age >20	542,141	Mean yearly income before taxes in SEK	383,065
Mean yearly income after taxes	357,000		

Table 4. Summary of basic socio-demographics of respondents (N = 508)

Basic sociodemographics		**Count**	**Percentage (%)**
Gender	Man	233	45.9
	Non-binary	4	0.8
	Woman	271	53.3
Age	18-24	42	8.3
	25-34	113	22.2
	35-44	82	16.1
	45-54	81	15.9

[8] Respondents in the professional panel are "professional respondents", so it is not transparent whether these are truly representative. Sandorf, Persson and Broberg (2020) describe how having a professional respondents answer choice experiment affects the results. They found that professional respondents are experienced in answering surveys, and can be seen as "hyperactive" since they are more often to choose the non-status quo option over the status quo option. Hence, this has a significant influence on the assessed WTP values (Sandorf, Persson and Broberg, 2020).

	55-64	75	14.8
	65+	115	22.6
Living location	Lives centrally	372	73.2
	Lives on the outskirts	136	26.8
Continent of birth	Africa	1	0.2
	Asia	5	1.0
	European country other than Sweden	22	4.3
	North America	1	0.2
	Sweden	479	94.3
Years in Sweden if not born in Sweden		479	94.3
	3 ~ 5	2	0.4
	6 or more	27	5.3

Table 5. Summary of income, employment, and education of respondents (N = 508)

Income, employment, and education		**Count**	**Percentage (%)**
Monthly income before taxes	>75 000	10	2.0
	0 ~ 19 999	113	22.2
	20 000 ~ 29 999	108	21.3
	30 000 ~ 39 999	165	32.5
	40 000 ~ 49 999	67	13.2
	50 000 ~ 75 000	45	8.9
Employment	Full-time employment	263	51.8
	Part-time employment	42	8.3
	Pensioner	123	24.2
	Self-employed	11	2.2
	Student	37	7.3
	Student and part-time employment	9	1.8
	Unemployed	23	4.5
Education	Doctoral degree or more	17	3.3
	Elementary school	21	4.1
	High school	168	33.1
	University education, 3 years	98	19.3
	University education, 4 years	76	15.0
	University education, 5 years	68	13.4
	Vocational training	60	11.8

Table 6. Summary of the family composition of respondents (N = 508)

Family composition		**Count**	**Percentage (%)**
Family composition	Married	112	22.0
	Married, with children	77	15.2
	Partner	114	22.4
	Partner, with children	51	10.0
	Single	149	29.3
	Would rather not say	5	1.0
Number of dogs	0	404	79.5
	1	72	14.2
	2	26	5.1
	3	4	0.8
	4 or more	2	0.4
Number of cats	0	377	74.2
	1	72	14.2
	2	49	9.6
	3	6	1.2

	4 or more	4	0.8
Other animals than dogs or cats	No	476	93.7
	Yes	32	6.3
Have had pets in the past 10 years?		219	43.1
	No	178	35.0
	Yes	111	21.9

2.5 Piloting

Piloting of the survey was done at three stages, in the form of semi-structured interviews. In the early stage, four dog owners were presented with a preliminary version of the survey. Two students from the Swedish University of Agricultural Sciences and two non-students were interviewed. Using insights from this pilot, we decided to create illustrations to help respondents understand the choice attributes and their levels (e.g. described by (Mariel *et al.*, 2021)).

After making these changes, the survey was piloted with 15 people (4 dog owners, and 11 non-dog owners) at the Swedish University of Agricultural Sciences (SLU) and Umeå University. Surprisingly, none of the interviewees reacted on monetary attribute levels. Monetary attribute levels (i.e. tax levels) were therefore tested twice more until a desired distribution of answers was found[9]. After, a third pilot session was conducted with the professional survey company Syno International. Here, the survey was tested with Umeå citizens (n=15). Preliminary analysis of the DCE was conducted, after which the full launch of the survey was implemented.

2.6 Data Processing

We used software R to process parts of the attitude questions in part 1, as well as the socio-demographic questions in part 3 (see Appendix 6). Statistical analysis of the DCE was conducted in the statistical software STATA (see Appendix 7). WTP was calculated in Excel, dividing the coefficient of each attribute by the monetary WTP coefficient. We calculated WTP in SEK per person per year, using the average mean income of citizens in Umeå. WTP calculations are explained in Appendix 8.

[9] First, the levels were tested with students in the Human Dimensions of Fish and Wildlife course. However, here people were exposed to all options, which might have given a bias. Therefore, monetary attribute levels were tested once more, to reach 80% saying yes to the lower bid, and only 20% saying yes to the higher bid, to ensure statistical power of the WTP values. We asked five SLU students or employees for each of the attribute levels if they would be willing to pay the given amount of taxes for the corresponding level (i.e. 0.5%, 1.0%, 2.5%), without showing them the other levels. Here we found that about 80% of respondents were willing to pay the lower bid (0.5%), while almost 20% were willing to pay the higher bid (2.5%).

These WTP numbers were used to relate our findings to earlier studies and to inform Umeå municipality.

2.7 Analytical Models

We used the conditional logit model to analyze the DCE. The conditional logit model is a variation of the logit model. Logit models are often used to analyze choice probabilities from a DCE (Train, 2009). It aims to explain observed choices, considering variables that describe the features of the presented alternatives (Mariel *et al.*, 2021). The model assumes the determined preference parameters to be set and does not allow for testing heterogeneity across individuals and choices in the studied parameters. The mixed logit model (MXL) adds to the conditional logit model, by acknowledging unobserved variation in the studied parameters (Mariel *et al.*, 2021). For learning purposes of this thesis, the conditional logit was used. In the future, the more complicated mixed logit model analysis will be used on the same data to test for individual heterogeneity.

The theoretical framework that is often underlying DCE analysis is the random utility maximization model (RUM) (Mariel *et al.*, 2021). Using this model, we assume that when presented with different alternatives, respondents will always choose the option with the highest utility (Mariel *et al.*, 2021). In addition, this model assumes we cannot know for certain the utility of the respondent making the choice. Therefore, the utility consists of a predicted part and an error term (McDonald *et al.*, 2018).

3. Literature Review: Balancing Welfare in Urban Areas

In this study, we identify people's preferences for UGS design and other policy interventions to improve pets, wildlife, and human welfare in an urban context. Literature on several relevant disciplines has been explored to inform the theoretical and empirical approaches in this endeavor. We addressed literature supporting each of the attributes in our DCE. This literature includes papers on i) welfare concerning pets, wildlife, and humans in urban areas; ii) conflicts that arise between pets, wildlife, and humans in urban environments; iii) UGS design that can potentially ease these conflicts; iv) other policy interventions aiming to enhance coexistence between humans, pets and wildlife; and v) participatory governance of UGS and its role in facilitating coexistence between pets, wildlife, and humans. 63 papers were explored. The relative weight of literature from these disciplines is summarized in Figure 1. The subtopic and content of the papers are discussed in Tables 8-11. An additional summary of the main findings per paper is shown in Appendix 9. The literature described in this chapter was used to construct the DCE.

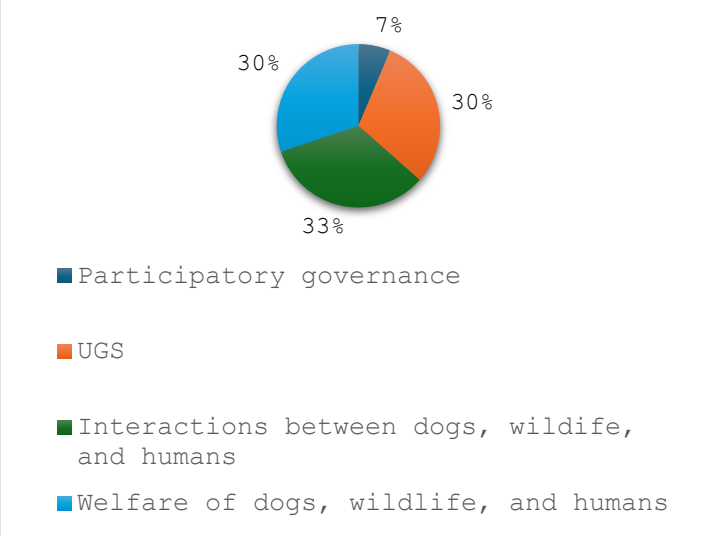


Figure 1. The relative weight of explored papers per literature topic in percentages (n= 63)

Table 7. Summary of literature – Welfare of dogs, wildlife, and humans (n= 19)

Reference	Subtopic	Content
Aspling, Juhlin and Chiodo (2015)	Dog-owner interactions	Study suitable ways to include animals and human-animal interconnections from the animal's perspective.
Carrier *et al.* (2013)	Dog welfare	Study hormone levels (cortisol), personality, and behavior of dogs in dog parks.
Carter (2016b)	Dog welfare	Examine why urban planners have not included dogs' needs in city plans.
Clarke (2007)	Human welfare	Discuss the relevance of dog owner education for reducing injuries to humans by dogs.
Colonius and Earley (2013)	Welfare	Propos the concept of One welfare, building on the concept of One Health.
Cutt *et al.* (2007)	Dog welfare	Investigate literature on how being a dog owner affects the owner's physical activity levels and policy-related aspects regarding this matter.
Gibbs (2014)	Welfare	Discuss the history of the One Health concept, explaining present challenges, as well as future opportunities.
Gómez, Baur and Malega (2018)	UGS-human welfare	Test if dog parks can generate social cohesion between people.
Letchford (2021)	Dog welfare	Enhance understanding of ways parks are used by dogs and their owners.
Keeling *et al.* (2019)	Animal welfare	Assess the degree of potential of UN sustainable development goals (SDGs) to enhance animal welfare.
Keeling *et al.* (2022)	Animal welfare	Use the map created by Keeling et al. 2019, to direct organizations on how animal welfare can be enhanced, working on sustainable development goals, and the other way around.
Lerner and Berg (2015)	Welfare	Assess some of the features of the One Health umbrella: individual, population, and ecosystem health.
Pinillos *et al.* (2016)	Welfare	Present the theory of One Welfare.
Rock and Degeling (2015)	Animal welfare	Build on the human-centered approach of solidarity, reflecting on the effect of implementing more-than-human solidarity on public health.
Rock *et al.* (2014)	Pet welfare	Present a conceptual framework regarding pets in urban areas, and the intertwines and linkages with humans in these areas.
Rock *et al.* (2016)	Pet welfare	Study participation of citizens in decision-making regarding a policy on off-leash dog areas.
Rock and Degeling (2013)	Pet welfare	Examine bylaws regarding pets in Calgary, Canada.
Toohey *et al.* (2017)	Pet welfare	Study points of view and opinions of community organizations on how relations between humans and pets influence experiences of aging-in-place.

Table 8. Summary of literature – Interactions between dogs, wildlife, and humans (n= 21)

Reference	Subtopic	Content
Beasley *et al.* (2023)	Dog, wildlife, human conflict	Investigate the relation between human and dog presence and activity of bird and mammal species in urban forests in Hampstead Heath, London.
Borrelli *et al.* (2022)	Dog-owner interactions	Literature review to investigate literature on the advantages of caring for a dog.
Degeling and Rock (2012)	Dog-owner interactions	Investigate similarities and varieties in different aspects of dog walking: where dogs are walked, when, and by whom, and how this can contribute to health.
Doherty *et al.* (2017)	Dog-wildlife conflict	Analyze the estimates of the number of threatened species that are impacted by domesticated dogs, documenting the type of impact, and in which regions most impact was prevalent.
Gaynor *et al.* (2018)	Human-wildlife conflict	Assess shifts in daily activity patterns of mammal species as a response to human presence.
Handlin *et al.* (2015)	Dog-owner interactions	Study heart rate and oxytocin, cortisol, and insulin levels in dog owners and dogs related to short-period contact.
Holderness-Roddam and McQuillan (2014)	Dog-wildlife conflict	Compare the impacts of dogs on wildlife with that of cats.
Hughes and Macdonald (2013)	Dog-wildlife conflict	Create a body of knowledge that can be used for future joint work between conservation biologists and other specialists, studying information on contacts between dogs and wild animals.
Kotrschal *et al.* (2009)	Dog-owner interactions	Study relations between dog owner character, attitude, and gender on the behavior of their dog, dyadic interaction, and cortisol levels in the dog's saliva.
Miller *et al.* (2015)	Dog-owner interactions	Investigate changes in the level of oxytocin of dog owners after spending time with their dog after being parted for a longer period.

Miller, Knight and Miller (2001)	Dog-wildlife conflict	Study the chance of reaction of several wild animal species in different circumstances on and off trails, in response to human and dog prevalence.
Ng *et al.* (2019)	Dog-wildlife conflict	Study dog husbandry exercises and the occurrence of disease canine distemper virus (CDV).
Odendaal *et al.* (2003)	Dog-owner interactions	Identify neurochemical changes during an interaction between people and dogs.
Rehn and Keeling (2016)	Dog-owner interactions	Examine the strong and weak points of current methods to study dog-human bonds.
Rehn *et al.* (2014)	Dog-owner interactions	Analyze the affectional bond of dogs to their owner, to investigate the strength of the bond from the dog's perspective. Assess whether there is a relation between this and the owner's perspective of the bond.
Schell *et al.* (2021)	Human-wildlife conflict	Identify how interactions between humans and animals in cities form the adaptation of wildlife to urban areas.
Toohey *et al.* (2013)	Dog-owner interactions	Study relations between dog ownership, features present in localities, neighborhood-based recreational walking, and experiencing community, for people older than 50.
van Herwijnen (2021)	Dog-owner interactions	Study how human caregiving style influences dog-dog owner interactions and can benefit dog welfare.
Vanak and Gompper (2009)	Dog-wildlife conflict	Review ways in which dogs and wild carnivores interact, and to what extent the presence of dogs in an area affects native carnivore communities.
Wedl, Schöberl and Bauer (2010)	Dog-owner interactions	Study how owner gender, dog and dog owner personality, dog-dog owner interactions, and the attachment of the owner to their dog influence dog-dog owner contact.
Williams *et al.* (2009)	Dog-wildlife conflict	Study dog owners' feeling of responsibility to conform to leash use obligation on shores in Victoria, Australia.

Table 9. Summary of literature – UGS (n= 19)

Reference	**Subtopic**	**Content**
Melo and Piratelli (2023)	UGS-wildlife	Study the relationship between functional diversity indices of bird species groups and community characteristics of urban green spaces (abiotic and biotic), in the megacity of São Paulo, Brazil.
Arnberger *et al.* (2022)	UGS-human welfare	Investigate how dog ownership influences the sense of place attachment.
Beninde, Veith and Horchkirch (2015)	UGS-wildlife	Review biodiversity in urban areas for a diverse set of taxonomic groups, worldwide.
Beyer *et al.* (2014)	UGS-human welfare	Study the relationship between green space and mental well-being in city and rural environments.
Cai and Duan (2022)	UGS-pet welfare	Study the effect of the Covid-19 pandemic on public spaces for companion animals.
Cameron *et al.* (2020)	UGS-human welfare	Study people's emotions regarding bird species diversity in UGS.
Douglas, Lennon and Scott (2017)	UGS-human welfare	Literature review to assist in site-specific planning for green spaces that improve the health of citizens in all life stages.
Felappi *et al.* (2020)	UGS-human welfare	Review aspects of UGS that impact mental health and urban wildlife, investigate potential synergies and trade-offs, and propose a framework in the scope of "One Health".
Ha, Jin and With (2022)	UGS-human welfare	Study the relations between the amount, design, and geographical distribution of UGS and the degree of psychological distress in inhabitants.
Jia *et al.* (2023)	UGS-human welfare	Propose a general framework with spatial parameters and criteria to evaluate the contribution of the importance of UGS on-site for human wellbeing, to aid multi-oriented UGS design.
Lafrenz (2022)	UGS-human welfare	Use a case study to show the use of a multidisciplinary, community-inclusive urban green space design framework, which integrates a public health approach.
Liu *et al.* (2019)	UGS-human welfare	Study biopsychological pathways between the exposure to green in the neighborhood and the mental well-being of the residents in the neighborhood.
Pueffel, Haase and Priess (2018)	UGS-human welfare	Analyze people's use of vegetated urban brownfields as a UGS, and analyze how these brownfields contribute to ecosystem services (ES), especially cultural ES.
Ta and Levrel (2022)	UGS-human welfare	Investigate trade-offs between UGS features and the amount of time inhabitants are willing to spend traveling toward an urban green space, compared to staying at home.
Ugolini *et al.* (2020)	UGS-human welfare	Investigate how people's behavior, perceptions, and attitudes on UGS changed due to COVID-19 restrictions. Analyze how content people are with UGS in their near surroundings, and give advice for improvement of these spaces.

Ugolini *et al.* (2021)	UGS-human welfare	Explore citizens' use and the extent to which they reported they missed UGS during the lockdown restrictive measures for COVID-19.
Yang *et al.* (2020)	UGS-human welfare	Study barriers to soft mobility, regarding a) urban planning, and b) tourism in the north, comparing Nordic and non-nordic inhabitants.
Zhao and Gong (2022)	UGS-human welfare	This pilot study explores how animals in urban green spaces affect mental restoration for people.
Zhu *et al.* (2023)	UGS-human welfare	Provides framework which can be used to evaluate cultural ecosystem services (CES) of UGS related to the design of the area (Union Square Park, New York), based on social media data.

Table 10. Summary of literature – Participatory governance (n= 4)

Reference	**Subtopic**	**Content**
Arnstein (1969)	Participatory governance	Present a ladder of citizen participation, and explain them using examples from existing governmental social programs.
Li *et al.* (2020)	Participatory governance	Create a community participation model and a workshop toolbox to work together for urban regeneration.
(Lockwood *et al.*, 2010)	Participatory governance	Introduce principles for good governance of natural resource management, to assist creation and assessment of natural resource management governance institutions.
Santander, Lorenzini and Martinez-Cruz (2024)	Participatory governance	Bridge work from (Lockwood *et al.*, 2010) and (Arnstein, 1969), highlights complementory factors and potential trade-offs between the two approaches.

3.1 Dog Welfare in Urban Areas

While dog welfare has been studied, it has primarily been focused on how dogs can benefit human well-being (Odendaal *et al.*, 2003; Cutt *et al.*, 2007; Degeling and Rock, 2012; Toohey *et al.*, 2013; Handlin *et al.*, 2015; Miller *et al.*, 2015; Zhao and Gong, 2022). Literature also addresses ways in which humans affect dogs (Wedl, Schöberl and Bauer, 2010; Rehn *et al.*, 2014; Rehn and Keeling, 2016). Despite the prominence of pets in modern urban areas, their welfare remains overlooked in urban planning (Rock *et al.*, 2014; Carter, 2016b).

Previous research has explored dogs' various abilities to benefit human well-being (Odendaal *et al.*, 2003; Cutt *et al.*, 2007; Degeling and Rock, 2012; Toohey *et al.*, 2013; Handlin *et al.*, 2015; Miller *et al.*, 2015; Borrelli *et al.*, 2022; Zhao and Gong, 2022). In turn, research has also found various ways in which humans can affect dog well-being (Wedl, Schöberl and Bauer, 2010; Rehn *et al.*, 2014; Rehn and Keeling, 2016). Dog owners may have increased levels of certain hormones, such as b-endorphin, oxytocin, prolactin, b-phenylethylamine, and dopamine, as a result of positive interactions with their dog(s) (Odendaal *et al.*, 2003; Miller *et al.*, 2015). Interaction with a dog might also decrease cortisol levels and heart rate for people, indicating stress relief (Odendaal *et al.*, 2003; Handlin *et al.*, 2015). Studies have identified that the personality of the dog and dog owner, and the attachment style, affect the dog's level of social behavior (Kotrschal *et al.*, 2009; Wedl, Schöberl and Bauer, 2010; Rehn *et al.*, 2014). Additionally, dog and dog owner personality, and attachment style, were found to affect the level of independent play of the dog (Kotrschal *et al.*, 2009; Wedl, Schöberl and Bauer, 2010; Rehn *et al.*, 2014). This has implications for the degree to which dogs seek contact with other

dogs, as well as their well-being. Additionally, the dog's personality and attachment style also affects how they interact with human beings and wildlife. Rehn and Keeling (2016) mention the importance of studying the dog-dog owner interrelationship from both the human and the dog perspective, to better understand relations and their implications for all parties involved.

Platforms such as One Health, and One Welfare have been established to mitigate problems regarding considering animal welfare in our society (Colonius and Earley, 2013; Gibbs, 2014; Lerner and Berg, 2015; Pinillos *et al.*, 2016). However, companion animals are hardly included in the "One Welfare" umbrella designed by veterinarians (Pinillos *et al.*, 2016).

In addition, experts on animal welfare reported that dog welfare is largely overlooked in the Sustainable Development Goals (SDGs) (Keeling *et al.*, 2019, 2022). Moreover, dog welfare is often rarely considered in urban planning and policies (Rock, 2013; Rock and Degeling, 2015; Toohey *et al.*, 2017).

Nevertheless, there is one often proposed way to include dogs' needs in urban areas; the implementation of dog parks. Though these dog parks might or might not be positive for dog welfare, depending on the individual, dog parks are recognized as important spaces for social interactions among citizens (Carrier *et al.*, 2013; Gómez, Baur and Malega, 2018; Vincent, 2019; Letchford, 2021). A study on dogs in a dog park in Newfoundland, Canada, found that for some dogs, cortisol levels increased when spending 20 minutes in the dog park, while for others, this was not the case (Carrier *et al.*, 2013). In addition, almost every observed dog showed some sort of stress-related behavior (Carrier *et al.*, 2013). Due to the contrasting findings, it is still under discussion whether dog parks are beneficial for overall dog welfare.

3.2 Wildlife Welfare and Biodiversity in Urban Areas

Wildlife welfare has been explored, mainly focusing on why and how we should create space for wildlife and biodiversity in urban environments (Beninde, Veith and Horchkirch, 2015).

Coexistence with humans in cities has caused wildlife (here: urban wildlife) to adapt and evolve (Schell *et al.*, 2021). Urban wildlife has been shown to continuously find solutions to adapt to human presence (Schell *et al.*, 2021). Schell et al. highlight the key role of these adaptations, in shaping evolutionary processes in urban wildlife on both a landscape level and a community level (Schell *et al.*, 2021). Some examples of urban wildlife adaptation strategies include shifting daily routines (Gaynor *et al.*, 2018). Strategies include becoming more nocturnal, and shifting behavior, such as increasing boldness (Gaynor *et al.*, 2018; Schell *et al.*,

2021). These adaptations cause a change in the animal's energy demand. Energy used for adaptation cannot be used for other activities such as growth, health maintenance, and reproduction. Having to adapt to humans can therefore deplete the welfare of urban wildlife. On the other hand, studies argue that this extra energy demand fueling evolutionary processes weighs up to the increased availability of food in cities, caused by human presence.

Accordingly, platforms such as ‘One Health’ and ‘One Welfare’ include wildlife in their frameworks, aiming to increase health for humans, as well as animals and the environment (Rock and Degeling, 2015). However, these frameworks are merely focused on disease control, have left out pets, and have yet to be applied to coexistence between pets, wildlife, and humans in the urban context.

3.3 Human Welfare in Urban Areas

The adaptive abilities of wildlife, and the conflicts arising between animals and humans in urban areas, have insisted humans come up with adaptive management strategies.

To create these adaptive management strategies, researchers have recently been looking at the potential of citizen engagement in decision-making (Lockwood *et al.*, 2010; Santander, Lorenzini and Martinez-Cruz, 2024). Involving citizens in decision-making can be relevant for the management of natural resources, e.g. having management plans that resonate with people makes it more likely for people to conform to the rules (see e.g. (Doherty *et al.*, 2017; Keeling *et al.*, 2019)). Additionally, it can improve people’s welfare by giving them a voice. Arnstein (1969) ladder of participation, as well as Lockwood, Davidson, Curtis, Stratford and Griffith (2010b) principles for the governance of natural resources, and Santander, Lorenzini and Martinez-Cruz (2024) efforts to combine these two frameworks have provided indications and management for “good governance” of natural resources, such as UGS.

Despite this increasing body of literature, the inclusion of humans in decision-making regarding urban green spaces has often been overlooked in urban planning. Even though cities aim to include the opinions and desires of their residents, citizens are not always consulted, nor are their opinions binding for decision-making (Santander, Lorenzini and Martinez-Cruz, 2024).

3.4 Conflicts Between Dogs, Wildlife, and Humans in Urban Areas

Research has shown that conflicts arise between dogs and wildlife in urban areas, yet they have largely overlooked the scope of these conflicts, and are not by standard taken into account while designing future city plans.

Dogs can negatively affect wildlife (Miller, Knight and Miller, 2001; Doherty *et al.*, 2017; Beasley *et al.*, 2023; Melo and Piratelli, 2023). Nevertheless, people often do not recognize dogs as a potential threat to wildlife (Holderness-Roddam and McQuillan, 2014), due to our emotional attachment to dogs and the difficulties and complexity of studying dogs' effects on wildlife (Williams *et al.*, 2009). Doherty *et al.* (2017) studied the number of threatened species that are impacted by domestic dogs, on a global scale. They found that domestic dogs are partly responsible for the extinction of 11 vertebrate species, as well as have threatened at least 188 threatened species. They also state that the amount of species that are negatively affected by domestic dogs is way higher than the proposed studies[10]. These findings show that the impact dogs pose on wildlife worldwide is largely underestimated (Doherty *et al.*, 2017). Besides predation, dogs also threaten wildlife in other ways. Dogs can cause behavioral changes, disturbance, harassment, and hybridization, as well as facilitate the distribution of diseases and compete with native wildlife for resources (Miller, Knight and Miller, 2001; Vanak and Gompper, 2009; Williams *et al.*, 2009; Doherty *et al.*, 2017; Ng *et al.*, 2019).

In urban areas, dogs have been found to pose a threat to bird populations (Melo and Piratelli, 2023). This is especially prevalent in areas where dogs are considered endemic species, e.g. in Australia (Doherty *et al.*, 2017). However, other studies showed different findings. Beasley *et al.* (2023) for instance, found a change in daily activity patterns in only one of the studied species, the European hedgehog (*Erinaceus europaeus*). There was no significant impact found on other species in this study, indicating that other species might be differently, or less impacted by dogs (Beasley *et al.*, 2023).

Another way by which dogs can impact other species is by their ability to spread diseases (see e.g. (Doherty *et al.*, 2017)). Contact rates are amplified in denser areas, which is concerning for dog welfare, as well as for wildlife and human welfare.

A pilot study in a middle-sized city in China highlights that off-leash dogs in UGS can decrease the mental restoration capacity of urban green space users (Zhao and Gong, 2022). Researchers therefore argue for banning dogs from these places (Zhao and Gong, 2022). In addition, urban wildlife can have a negative effect on people's mental health, increasing stress levels (Felappi *et al.*, 2020). In contrast,

[10] The number of species that are globally negatively impacted by domestic dogs was found to be nine times larger than the numbers in a literature study by Hughes and Macdonald (2013), and 30 up to 50% higher than proposed by other studies (Doherty *et al.*, 2017).

other studies report human well-being to increase with greater species diversity (e.g. bird diversity) and exposure to these species in UGS (Cameron *et al.*, 2020).

Human presence and use of spaces where wildlife exists can cause conflicts (Schell *et al.*, 2021). Previous research has touched on the capacity of UGS in mitigating these conflicts. Though, this literature has mainly taken an anthropogenic point of focus, rather than focusing on more-than-human solidarity (Rock and Degeling, 2015).

The current trend of densification of cities, results in more people, and their dogs, using the same spaces for mobility and recreation, from which conflicts arise between dogs, wildlife, and humans (Doherty *et al.*, 2017; Felappi *et al.*, 2020; Schell *et al.*, 2021; Zhao and Gong, 2022; Melo and Piratelli, 2023). For example, in Nordic cities such as Umeå, it has also not explicitly been taken into account while designing future sustainable cities, e.g. it is excluded from the city plan (Helmersson *et al.*, 2018). The potential conflicts between dogs, wildlife, and humans arising in growing cities, and the overlooking of these conflicts, highlight the importance of finding solutions to mitigate and balance the needs of pets, wildlife, and humans in urban areas.

3.5 Policy Interventions for Balancing Welfare of Dogs, Wildlife, and Humans

Attempts have been made that use UGS planning to mitigate balance and improve welfare in urban areas. Additionally, policies around dogs have been created to mitigate conflicts arising from dogs.

Research has shown that UGS planning and design can potentially contribute to animal and human health (see e.g. (Beninde, Veith and Horchkirch, 2015; Douglas, Lennon and Scott, 2017)). Nevertheless, research has mostly been focused on UGS and design to benefit human well-being. Sometimes it has been planned to facilitate habitat for wildlife. However, research has overlooked strategies for UGS planning that potentially balance the well-being of all: humans, wildlife, and animals.

UGS have frequently been introduced in urban areas to improve human well-being (Douglas, Lennon and Scott, 2017; Ha, Jin and With, 2022; Lafrenz, 2022; Jia et al., 2023). However – even if mentioned to be a “multifunctional urban green space” – the welfare of animals, in particular pets, is often overlooked in the planning of green spaces, and in urban planning in general (Rock and Rock, 2013; Rock and Degeling, 2015). There is potential for UGS to balance the welfare of different groups and ease conflicts. In this chapter, we introduce several aspects in which UGS promotes the well-being of humans, pet dogs, and wildlife.

3.5.1 UGS Coverage

The amount and cover area of UGS as a percentage of the city surface in urban areas has a positive association with human well-being, e.g. mental health (Beyer *et al.*, 2014; Liu *et al.*, 2019). In addition, research has shown UGS to be important places for dog walking (Pueffel, Haase and Priess, 2018; Ugolini *et al.*, 2020). In turn, dog walking can also enhance a sense of community for people, benefitting their well-being (Toohey *et al.*, 2013). When we look at biodiversity, the amount of UGS (i.e. habitat patch area available for wildlife), is considered one of the most important factors to have a positive effect on biodiversity in cities (Beninde, Veith and Horchkirch, 2015). Therefore, a larger amount of UGS in cities seems to be beneficial for the well-being of humans, wildlife, and dogs.

3.5.2 UGS Connectedness

Along with the amount of green space, UGS connectivity is found to be an important factor for the well-being of especially wildlife, and can also promote human and dog well-being. Beninde, Veith and Horchkirch (2015) found that the creation of corridors – i.e. connecting several urban green spaces via corridors is together with the size of the green spaces, the most effective strategy to improve biodiversity. The connectivity of urban green spaces has also been proven important for human activities, for example, the geographical connection between urban green spaces might affect inhabitants' preferences to do certain activities (e.g. running, and biking) (Ta and Levrel, 2022). Ha, Jin and With (2022) support this, highlighting the importance of the geographical distribution of urban green space for human well-being. In a study on Chicago residents, they found that the degree of psychological distress was lower in areas where UGS were less concentrated together; i.e. having multiple smaller connected UGS rather than having few big fragmented UGS (Ha, Jin and With, 2022). Also, other studies highlight people's preferences for having a variety of greenery types in urban environments, i.e. having different sizes of UGS (e.g. large parks as well as small green corridors) (Ugolini *et al.*, 2020). We did not find any studies that support that connected UGS improves dog well-being. However, since dog-walking is one of the main reasons to use UGS, we can infer that connected UGS is of vital importance for dog-walking, thus dogs' well-being (see e.g. (Pueffel, Haase and Priess, 2018; Ugolini *et al.*, 2020)).

3.5.3 UGS User Focus

Apart from the amount of urban green space and the connectivity of these spaces, the user focus one uses while planning for a UGS can impact the benefits of urban green spaces for human, pets, and wildlife welfare. Here, we discuss the potential of UGS user focus for dog and human well-being.

As mentioned earlier, several studies found dog walking as one of the main reasons to use UGS (Pueffel, Haase and Priess, 2018; Ugolini *et al.*, 2020, 2021)[11]. This highlights the importance of UGS for dog walking and also highlights the rising demand for UGS to support these activities, especially during crisis times such as the COVID-19 pandemic (Ugolini *et al.*, 2021; Cai and Duan, 2022). In a brainstorming session on how increasing animal welfare can promote realizing the SDGs, researchers suggest designing urban areas more pet friendly and mention the option of including dog parks (see e.g. (Keeling *et al.*, 2019)).

Management strategies for UGS can affect human user satisfaction, looking at the sense of place and place attachment (Ugolini *et al.*, 2021; Arnberger *et al.*, 2022; Zhu *et al.*, 2023). This was especially revealed during COVID-19 lockdowns when residents were not allowed or were restricted to use UGS. For example, respondents in a survey by Ugolini *et al.* (2021) to explore residents' use of UGS during the COVID-19 lockdown in Italy, mentioned that during the lockdown, they missed spending time in UGS. Arnberger *et al.* (2022) explored how dog walking influences a person's place attachment in Vienna (Austria) and the Minneapolis-St. Paul metropolitan area (US). They concluded that dog walkers in UGS mentioned having a higher place attachment than walkers who did not own a dog. This implies that dog walkers might be more attached and conscious about how management interventions may affect their recreation (Arnberger *et al.*, 2022). In a study about users' perception of design of the Union Square Park and its relations to cultural ecosystem services, Zhu *et al.* (2023) found that interactive activities, aesthetics, and health benefits are important cultural ecosystem service indicators. Educational values of cultural ecosystem services of the park were perceived as significantly absent (Zhu *et al.*, 2023). These factors highlight the importance of UGS not only as a place to be in nature but also highlights UGS importance for cultural reasons.

Needs for design and management of UGS seem to be different for people with different socioeconomic backgrounds (Douglas, Lennon and Scott, 2017; Ta and Levrel, 2022). Douglas, Lennon and Scott (2017) for example, highlighted that people in different life stages have different needs for urban green space design. Ta and Levrel (2022) studied inhabitants' preferences regarding UGS in the city area of Paris, and how these preferences differed between people living in densely populated areas and less densely populated areas. They found that people living in densely populated areas tend to value small, easily accessible UGS, whereas people

[11] A study on UGS use in several countries in Europe during the global pandemic found that dog walking was a secondary reason for UGS use (Ugolini *et al.*, 2020). This is supported by a survey on the use of brownfields as a type of UGS, in which the most often mentioned ecosystem service of brownfields for the users was dog walking (Pueffel, Haase and Priess, 2018). In another survey on UGS use by citizens during the lockdown due to COVID-19, citizens in areas with the strictest lockdown reported using UGS primarily to walk their dog (28%) and for relaxation (24%), while in areas where the lockdown was less strict, people would use the space most to do physical exercise (32%) (Ugolini *et al.*, 2021). The pandemic largely impacted the usage of public spaces for pet dogs in Beijing, China, and caused a rise in demand for urban green spaces (Cai and Duan, 2022).

living in less populated areas preferred larger UGS, and were willing to travel longer to reach these areas (Ta and Levrel, 2022). This is supported by Jia *et al.* (2023), who proposed a framework for effective design of UGS, that can contribute to human wellbeing. Two important criteria they introduced here were the accessibility and usability of the UGS (Jia *et al.*, 2023). Findings from these studies highlight the importance of taking into account different opinions of inhabitant groups on planning for UGS.

In planning for UGS, it can also be argued that dog's needs should be included. Even though dogs' needs might be different from human needs (Aspling, Juhlin and Chiodo, 2015), there are UGS plans in which needs for both dogs and humans can be targeted to come together, e.g. in dog parks (Gómez, Baur and Malega, 2018; Vincent, 2019). Several studies in the US and Canada support that dog parks can enhance social capital, and social interactions in urban areas (Gómez, Baur and Malega, 2018; Vincent, 2019; Letchford, 2021). Gómez, Baur and Malega (2018) for example, interviewed adult dog park users in Virginia (US), to study the social capital of a dog park and found that dog parks can contribute to social interaction between people from different ethnic backgrounds. Another study that conducted semi-structured interviews with dog owners and non-dog owners about dog parks found that participants would go to dog parks on purpose, to meet other people (Letchford, 2021). These findings show the potential of creating UGS that targets multiple UGS user groups, including animals.

3.5.4 UGS Governance

These different views and opinions on how UGS should be managed could be expressed and consulted using participatory governance of UGS.

Resident surveys can help the municipality's urban planning to correspond to residents' needs (see e.g. (Li *et al.*, 2020; Yang *et al.*, 2020)). Investigating citizens' needs can not only benefit people but can potentially have a positive effect on animals in urban environments, as some people take into account the well-being of animals (e.g. their pets) while answering surveys. According to Keeling *et al.* (2019), promoting participatory decision-making can help to increase the appropriateness and enforceability of rules around animal welfare. They studied how working on the SDGs, can help enhance animal welfare, as well as in turn can show how enhancing animal welfare can facilitate working towards SDGs (Keeling *et al.*, 2019). This was later repeated in a global study with a larger panel of stakeholders in the field of animal welfare, which supported the earlier findings (Keeling *et al.*, 2022). Santander, Lorenzini, and Martinez-Cruz (2024) made an effort to combine these two frameworks and that for meaningful engagement to be present, governance should at least be inclusive, integrative, and fair. Higher degrees of engagement (higher levels on Arnstein's ladder), mostly include enhanced implementation of the good governance principles. This, in return, can

facilitate moving towards more meaningful engagement of citizens (reaching higher levels on Arnstein's ladder) (Santander, Lorenzini, and Martinez-Cruz, 2024). Other studies, stated that citizens' engagement in decision-making is crucial for creating effective policies on pet management in urban areas (Rock *et al.*, 2016). These findings highlight the importance of including citizens in decision-making regarding UGS, which is currently largely overlooked.

3.5.5 Previous Efforts in UGS Planning for Balancing Welfare

To mitigate and balance the needs of different users of urban green spaces, multi-oriented UGS are often suggested (Douglas, Lennon and Scott, 2017; Lafrenz, 2022; Jia *et al.*, 2023)[12]. In addition to this, Douglas, Lennon and Scott (2017) worked on inclusiveness in UGS planning, reviewing papers on health-improving UGS design interventions for each life-stage cohort, and came up with different policy interventions needed for the specific groups. For example, they conclude that one of the interventions that should be included to improve adults' health is including a variety of walking paths, with a variety of environments, to promote walking (Douglas, Lennon and Scott, 2017). These papers show the relevance of targeting different population groups in UGS design, and how this affects the benefits of UGS.

Besides multi-oriented UGS frameworks, another way to look at multifunctionality is using the 'One Health' approach, which aims to integrate the health of the environment, humans, and animals (Felappi *et al.*, 2020). However, in this environmental health e.g. wildlife, is often overlooked. Felappi *et al.* (2020) studied how UGS impacts human mental health and urban wildlife, and investigated whether there are possible synergies between these two aspects. They found several synergies and using a 'One Health' framework approach can be effective in increasing understanding of socio-ecological systems regarding UGS (Felappi *et al.*, 2020).

Interestingly, dogs or other pets are also not mentioned in either of these suggested policy interventions to balance human and animal needs in urban areas. This highlights the importance of finding solutions that fit all groups: pets (e.g. dogs), wildlife, and humans.

[12] Multi-oriented UGS are suggested in several studies. Lafrenz (2022) studied multifunctional UGS in Scappoose (Oregon, US), and highlights that introducing multifunctional UGS facilitates possible health improvement for the largest number of citizens since it targets multiple groups of people. This study proposes a multifunctional design for the park, including three main purposes: sports and recreation, wellness in nature for people in every age group, and ecosystem enhancement and sustainability (Lafrenz, 2022).

3.5.6 Dog Owner Education for Easing Conflicts

Besides creating multifunctional UGS, introducing dog owner education could be another policy intervention to ease conflicts between dogs and other urban space users.

As mentioned earlier, educating dog owners about dog behavior and dog welfare can improve dog owners understanding of interactions with their dog (Rehn *et al.*, 2014; Rehn and Keeling, 2016). Improving dog owners' understanding of interactions with their dog can improve dog welfare as well as reduce conflicts and risks for possible injuries due to attacks (Clarke, 2007; Rehn and Keeling, 2016).

Results from previous studies on dog-owner dyadic relations imply that it might be beneficial to educate dog owners about owner-dog interactions (Kotrschal *et al.*, 2009; Wedl, Schöberl and Bauer, 2010; Rehn and Keeling, 2016). When dog owners become aware of their caregiving style, and how their dog is attached to them, they might become more aware of points of conflict that arise. This may help them establish a more positive relationship with their dog (Rehn and Keeling, 2016; van Herwijnen, 2021). Enhancing understanding between dog and dog owner can improve the welfare of the dog, e.g. have a calming effect in a stressful situation (Rehn and Keeling, 2016). On the other hand, misunderstanding between the dog and dog owner can lead to a mismatch in interactions, increasing the risk of conflict and the risk that the dog cultivates abnormal behavior (Rehn and Keeling, 2016). A pilot study found that when a dog owner finds it more important to spend time with their dog, the dog is likely to stay in closer proximity to the dog owner (Wedl, Schöberl and Bauer, 2010). This might reduce conflict with humans, dogs, and wildlife when dogs are off-leash e.g. in the suggested dog parks. Kotrschal *et al.* (2009) mention for example that dog training that is dog-only focused might not be sufficient to capture the complex relationship between dogs and their owners. These findings support that responsible pet ownership can potentially decrease the negative impacts of pets on other pets and humans, as well as on wildlife. Research is starting to address this need, e.g. research projects have started to arise that argue for educating dog owners on how to manage dogs in urban environments (e.g. the IN-HABIT project, see (Borrelli *et al.*, 2022)).

The described literature in this chapter has led us to identify a gap in understanding what policy interventions we can integrate for the well-being of all three groups: humans, dogs, and wildlife in urban areas. Specifically, we identified a gap in knowledge around citizens' preferences regarding policy interventions on this matter. Here, we set out to provide a first step in filling this gap. We present a survey with a DCE on Umeå citizens' preferences and WTP for the attributes UGS amount, UGS connectivity, UGS user focus, UGS participatory governance, and dog owner education.

4. Results

We found that for each of the tested policy interventions, Umeå citizens preferred options other than the status quo and expressed a positive willingness to pay (WTP), except for engagement in decision-making regarding UGS.

The conditional logit output of the DCE and WTP coefficients are presented for each of the explored attributes in Table 12. Table 13 shows these WTP values in percentage increase in monthly tax over ten years. This is an additional tax on top of the 34.15% local tax citizens are currently paying (SCB Statistikdatabasen, 2024).

Table 11. Conditional logit specification of the DCE, with 7620 observations (N). WTP coefficients are shown for each attribute, with standard error in parentheses. Obtained from 508 respondents, exposed to 5 choice sets, each containing 3 alternatives, one of which was the status quo (sq).

	(I)	(II)	(III)
Choice			
UGS Coverage	0.00588**	0.00365	0.00365
	(0.00250)	(0.00314)	(0.00314)
Connected UGS	0.601***	0.580***	0.580***
	(0.0503)	(0.0530)	(0.0530)
Human dog-focused UGS	0.140**	0.117**	0.117**
	(0.0517)	(0.0548)	(0.0548)
Dog owner education	0.594***	0.575***	0.575***
	(0.0497)	(0.0522)	(0.0522)
Engaged in decision-making	-0.211***	-0.223***	-0.223***
	(0.0519)	(0.0526)	(0.0526)
Tax	-0.356***	-0.365***	-0.365***
	(0.0336)	(0.0343)	(0.0343)
sq		-0.105	
		(0.0910)	
nsq			0.105
			(0.0910)
Respondents	508	508	508
Number of choice sets	5	5	5
Alternatives	3	3	3
N	7620	7620	7620

r2_p	0.0756	0.0758	0.0758
ll	-2579.5	-2578.8	-2578.8
aic	5171.0	5171.6	5171.6
bic	5212.6	5220.2	5220.2

Standard errors in parentheses
* $p < 0.10$, ** $p < 0.05$, *** $p < 0.001$

Table 12. Percentage increase in taxes for the tested policy interventions

WTP	**Percentage increase in taxes**
WTP for 1% UGS	0.017
WTP for connected UGS	1.688
WTP for human and dog-focused UGS	0.393
WTP for compulsory dog owner education	1.669
WTP for engagement in UGS decision-making	-0.593
Total WTP for UGS design with increased participation*	3.554
Total WTP for UGS design without increased participation*	4.146

*WTP for UGS planning in the city that covers 24% of the overall city surface area, is connected, is tailored towards human and dog needs, and comes accompanied by compulsory online education for dog owners.

Conditional logit was used for analysis (model (I), Table 11). All WTP coefficients were statistically significant, respectively with a standard error of $p < 0.001$, expressed with ***, or $p < 0.05$, expressed with **. WTP coefficients were accompanied by a standard error, written in parentheses.

We find the following from our DCE and conditional logit analysis, answering the research question:

Results in Tables 12 and 13 showed a positive WTP coefficient for each of the policy intervention options other than the status quo, except for engagement in decision-making regarding UGS, where a negative WTP coefficient was found. This means that Umeå citizens prefer policy interventions that can potentially improve dogs, wildlife, and human welfare in the city, except for increased engagement in decision-making.

A positive WTP coefficient was found for connected UGS (0.601 (0.0503), 1.688% in taxes) and implementation of compulsory dog owner education (0.594 (0.0497), 1.669% in taxes). This means that respondents valued connected UGS as much as the implementation of compulsory dog owner education, corresponding to 1.688% in taxes.

WTP for an increase in the cover area of UGS was also positive (0.588 (0.250), 0.017% in taxes, for a 1% increase in UGS). The WTP for the current cover of 24% UGS (0.396% in taxes) was similar to the WTP expressed for human and dog-

focused UGS planning (0.140 (0.0517), 0.393% in taxes). This means that respondents expressed to value of a UGS of 24% of the city surface as much as human and dog-focused UGS in taxes.

In contrast, a negative WTP was found for the higher level of participation in the decision-making regarding UGS (-0.211 (3.364), -0.592% in taxes). This means that if respondents were to be engaged more in decision-making, they would need to be compensated as much as 0.592% of their monthly income in taxes.

5. Discussion

In this study, we found that for the tested policy interventions, Umeå citizens reported a positive willingness to pay (WTP) for several options that can potentially improve the welfare of dogs, wildlife, and humans. An overall positive WTP was found, which was in line with our general hypothesis. More specifically, we found six results answering the general and specific research questions.

5.1 Discussion of Findings

First of all, we found that for the tested policy interventions, Umeå citizens preferred and were willing to pay for options that could potentially improve dogs, wildlife, and human welfare, except for increased engagement in decision-making. An overall WTP for the tested measures was a 4.146% increase in tax over ten years –as long as citizens are not asked to increase their level of involvement in the decision-making process, and the UGS coverage would remain the same (24% of city surface). Otherwise, if asked to increase participation, the overall WTP is 3.554%.

Using the average mean income (see Table 3), we calculated how much this would be in SEK per person per year (see Appendix 8). This results in a yearly WTP per tax-paying person equivalent to 22,479 SEK (without increased participation in decision-making), and 19,266 SEK (with increased participation in decision-making)[13]. This positive WTP is in line with the general hypothesis.

Each tested intervention had a different welfare focus, as shown in Table 14. Hence, the overall positive WTP can be interpreted as reflecting the demand of citizens in Umeå for UGS planned with the following characteristics: i) demand for increased UGS as a cover of the city surface – benefiting human welfare, as well as wildlife welfare, ii) an emphasis on connectivity – which benefits human welfare, as well as wildlife welfare and biodiversity -, iii) incorporating the needs of dogs in addition to human needs, iv) providing compulsory online education for dog owners

[13] Note that here we assume all citizens between age 20-64 are tax-paying citizens. We used WTP reported arising from all respondents, age >18.

– benefiting dog, human, and wildlife welfare, and v) increasing engagement in decision-making for UGS planning – impacting human welfare.

Table 13: Tested policy interventions in the DCE and their welfare focus

Tested policy intervention	**Welfare focus**
UGS coverage	- Human welfare - Wildlife welfare
UGS connectedness	- Human welfare - Wildlife welfare
UGS human and dog-focused design	- Dog welfare - Human welfare
Compulsory dog owner education	- Dog welfare - Human welfare - Wildlife welfare
Increased engagement in decision-making	- Human welfare

Supporting hypothesis 1, we found a positive WTP for UGS coverage of the city surface. Respondents expressed to value of 1% of UGS as much as 0.017% in taxes. We suggest this could be due to the numerous well-being benefits for humans that come with introducing more greenery in cities. Previous studies emphasize an association between the amount of greenery in cities for people's well-being (Douglas, Lennon and Scott, 2017; Liu *et al.*, 2019; Ha, Jin and With, 2022; Lafrenz, 2022). However, further research would be needed to say whether this is the underlying reason.

The positive WTP for UGS connectedness was in line with our expectations (hypothesis 1). Respondents might have picked this option because they care about wildlife welfare and biodiversity. In the information pages describing the attributes, we explained that UGS connectedness can have a positive effect on wildlife (Beninde, Veith and Horchkirch, 2015). On the other hand, human welfare could have been another motivation for respondents to be willing to pay for connectedness. Citizens are directly affected by UGS connectivity, since they regularly use UGS, e.g. for dog-walking, as well as for transportation and recreational purposes (Pueffel, Haase and Priess, 2018; Liu *et al.*, 2019; Ugolini *et al.*, 2020, 2021; Lafrenz, 2022). Even though we did not emphasize any association between human welfare and increased connectedness in the scenario of our DCE, human welfare could have been a driver for choosing connected UGS over fragmented UGS. Whether the positive WTP arose for purposes of facilitating wildlife and biodiversity or for purposes of their people's welfare and their dog's welfare has yet to be determined in further explorations.

Interestingly, respondents reported a similar WTP for the current amount of 24% UGS coverage (0.396% in taxes) as for human and dog-focused UGS (0.393% in taxes).

This positive WTP for human and dog-focused UGS could be seen as surprising, considering that 79.5% of the respondents were non-dog owners. Since individuals are expected to choose the option that maximizes their utility (see (Mariel *et al.*, 2021)), we assumed non-dog owners would not be willing to pay for a UGS design that is tailored towards both dog and human needs. However, research on dog parks has shown that non-dog owners can also benefit from being in dog-tailored environments (see e.g. (Letchford, 2021)). The positive WTP for human and dog-focused UGS suggests a sign of willingness to coexist.

The positive WTP for compulsory dog owner education was in line with our hypotheses (hypothesis 2). We expected non-dog owners to report a positive WTP for dog owner education, because of its potential to mitigate conflicts between humans and dogs and reduce risks of injuries caused by dogs. We found that 79.5% of the respondents were non-dog owners (Table 2c). Hence, the positive WTP for dog owner education was to be expected and suggests that Umeå citizens might want to avoid negative effects arising from interactions with dogs. This could be linked to the conversation on banning certain dog breeds, and the concept of 'dangerous dogs' (Lodge and Hood, 2002; Webster and Farnworth, 2019). Even though Sweden does not ban any dog breeds, this has been a precaution over the past decades in several other European countries - e.g. UK, and Germany (Lodge and Hood, 2002). A study on the public's identification skills for banned dog breeds in the UK showed that a very low proportion of the respondents could identify banned dog breeds (Webster and Farnworth, 2019). This is concerning, since it may mean that citizens may have negative beliefs about dogs that are not considered among the 'dangerous dogs' (Webster and Farnworth, 2019). This is an example where education could potentially improve the situation. Another suggestion is that non-dog owners value dog owner education, because of the negative effects dogs can pose on wildlife. Even though dogs are often not seen as potential threats to wildlife (see e.g. (Holderness-Roddam and McQuillan, 2014; Marshall *et al.*, 2023)), the potential interest among people for conservation in continuously densifying urban environments might cause citizens to be more interested in measures that mitigate dog-wildlife conflicts. Hence, the positive WTP for human and dog-focused UGS might be a sign of willingness to coexist. However, further research is needed to explore whether this is the case.

Lastly, the negative WTP found for increased citizen participation in decision-making regarding UGS was in line with our hypotheses (hypothesis 5). The negative WTP means that respondents prefer not to be more engaged in decision-making. We suggest this could stem from trade-offs people make between investing time and money. Here, we asked respondents to pay in the form of a monetary tax and found that if we do so, citizens do not want to pay with their time. In addition,

our findings are in line with a recent study that combined Arnstein's (1969) ladder of participation and (Lockwood *et al.*, 2010) principles for good governance of natural resources (Santander, Lorenzini and Martinez-Cruz, 2024). Santander, Lorenzini and Martinez-Cruz (2024), describe that we first need to reach a participation threshold for people to feel like they want to participate more in decision-making, which is currently not reached.

5.2 Model Evaluation and Limitations

We used conditional logit to analyze our DCE results (model (I), Table 12). This has several implications for our results. Here, we discuss the relevant assumptions and biases, arising from the used model.

We chose the conditional logit model (model I) for our analysis. Due to a lack of significance between the status quo (sq) and non-status quo (nsq) options (see Table 11), model I was chosen over model II and model II. This lack of significance in the sq and nsq options can be explained by the fact that the sq option was embedded in the nsq options, in some of the tested policy interventions. For example, we presented respondents with the status quo option of 24% UGS cover of the city surface, as well as two non-status quo options: 35% and 50%. Here, the 24% UGS is embedded in the 35% and 50% UGS.

Conditional logit models are often used in discrete choice analysis, however come with some limitations. A limitation of the conditional model compared to another commonly used model, - mixed logit -, is the bias that arises when working with conditional logit (Martinez-Cruz, 2013). Conditional logit consistently gives a slightly wrong value (bias). Mixed logit, in turn, gives unbiased values. However, it has relatively large confidence intervals (Martinez-Cruz, 2013). While mixed logit output is less biased, it might give more precise values further away from the average value, making it more sensitive to errors. In addition, mixed logit analysis is computationally more complicated to conduct and comprehend. Due to time constraints and for learning purposes, we chose to present conditional logit here. Additionally, Martinez-Cruz (2013) found that conditional logit outputs are often statistically indifferent from mixed logit outputs. This validates the use of conditional logit models here. In the future, mixed logit could be used to further explore the data. This would also allow for examining heterogeneity across respondents and their choices, which was not possible using conditional logit (Mariel *et al.*, 2021).

Another limitation of the present study is that we tested WTP for policy interventions that are relatively far from the market. To illustrate, respondents are

not used to assigning a monetary value to the UGS coverage of the city. The same goes for the other tested policy interventions: UGS connectedness, UGS design focus for either humans or humans and dogs, dog owner education, and engagement in decision-making for UGS planning. WTP estimates are more likely to be an accurate representation of respondents' actual WTP if respondents are used to assigning a monetary value to the goods or services they are valuing. McPherson (1992) for example, mentions that people likely undervalue green spaces in terms of monetary contribution. The reason for this is that people are not used to paying for nature and the facilities it offers (McPherson, 1992). In the next section, we therefore compare WTP arising from our DCE with available data and literature related to our findings. Here, we attempt to account for difficulties that arise when testing WTP for UGS options and show the relevancy of our results to inform policy in Umeå.

5.3 Implications for Urban Planning

The overall budget for UGS planning which covers 24% of the overall city surface area, where UGS are connected, is tailored towards human and dog needs, and comes accompanied by compulsory online education for dog owners, – if citizens were not engaged more in decision-making was found to be 4.146% additional tax on what citizens are currently paying. This is respectively 22,479 SEK per year per person. If asked to participate more, an additional tax of 3.568% was reported. This corresponds to 19,266 SEK per person per year. An overview of WTP in percentage increase in tax, WTP in SEK per person per year, and the total WTP per year of all tax-paying citizens combined are shown in Table 15. For a specification of the calculations, see Appendix 8.

Table 14. Respondents WTP in percentage increase in taxes, WTP in SEK per person per year, and total WTP per year in Umeå

	WTP in % increase in taxes	**WTP in SEK per person per year**	**Total WTP per year Umeå****
WTP for 1% UGS	0.017	90	172,892,859
WTP for connected UGS	1.688	9,152	736,313,833
WTP for human and dog-focused UGS	0.393	2,132	171,520,693
WTP for compulsory dog owner education	1.669	9,046	727,737,798
WTP for increased engagement in UGS decision-making	-0.593	-3,213	-258,506,187
Total WTP for UGS design with increased participation	4.146	19,266	1,549,958,995
Total WTP for UGS design without increased participation	3.554	22,479	1,808,465,182

*WTP for UGS planning in the city that covers 24% (current status) of the overall city surface area, is connected, is tailored towards human and dog needs, and comes accompanied by compulsory online education for dog owners.
**We assume tax-paying citizens are all citizens in age group 20-64

To put these numbers into perspective, we compared our results to i) other current taxes in Umeå, ii) health gained per percentage increase in greenery in the living environment, and iii) studies that estimate the monetary value of green in cities. Lastly, we calculated the potential cost for building UGS in Umeå, to see whether the found WTP would be constructive for this.

First, we compare our general findings to current tax rates in Umeå. 7.98% of tax money in Umeå is allocated toward health care (Appendix 8) (SCB Statistikdatabasen, 2024; Umeå kommun, 2024a, 2024b). Additionally, the current church fee for the members of the Swedish church is 1.05% tax of before-tax income (Skatteverket, 2024). The WTP we report in our study is lower than the amount of tax money that is allocated for health care, while approximately four times as high as the current church fee.

Next, we can compare our findings with other studies that have also explored the monetary value of UGS. A study in Oslo (Norway) on WTP for urban green spaces valued the total green spaces at 1 billion Norwegian kroner, respectively 1985 kr per inhabitant per year (Barton *et al.*, 2015). We report a total WTP of 1.8 billion SEK without extra participation, which is close to the number presented by Barton *et al.* (2015). Nevertheless, they also mention that nature in Oslo is worth much more than this, considering other ecosystem services that the spaces provide (Barton *et al.*, 2015).

Additionally, a study in Sheffield (UK), found that respondents were willing to pay 2% more rent if their property was surrounded by high-quality green infrastructure (Mell *et al.*, 2016). We report a WTP of 0.396% increase for a 24% increase in UGS and a 1.688% increase in tax for UGS connectedness. Assuming the amount of UGS stays the same, people are willing to pay 1.688% of their income for having connected green spaces, a combined 2.084%. This is higher than the 2% increase in rent, assuming that rent approximately takes up half of the before-tax income. Mell *et al.* (2016) also reported a higher WTP if the green infrastructure facilitated different purposes, i.e. multi-purpose green space. This is in line with the positive WTP we found for having human-dog-focused UGS over human-focused UGS.

Furthermore, a study on forests, agricultural pastures, and green in urban areas in Uppsala municipality reported a total value of the services provided by green of 1.81 billion SEK, of which 1% arose from urban green (Nikodinoska *et al.*, 2018),

which is 18 million SEK. This is a lot lower than the WTP for the tested UGS design we present for Umeå (1.8 billion SEK per year). The comparisons described above show the complexity of putting a value on nature. Even though these numbers are all lower, we cannot know what this means for the relevancy of the numbers presented in our study. Further comparison and analysis of our results should validate our results.

Lastly, we searched for construction costs of urban green space per square meter. A study on 94 green infrastructure projects in Europe, found that the average cost per green infrastructure project was 8.15 million euros (Naumann *et al.*, 2011). They also found that per ha costs for green infrastructure projects were around 250 to 1 million euros and that urban green infrastructure projects had very high costs compared to other urban green infrastructure projects (Naumann *et al.*, 2011). 1 million euro per ha is equivalent to almost 11.6 million SEK. The total WTP in the scenario in our study is 1.8 billion SEK per year in Umeå for the scenario described earlier. This allows for a construction budget equivalent to creating about 155 ha UGS (equivalent to 63 football fields). However, these numbers need to be taken with precaution since they arise from estimates from data from just two studies. Currently, 870 ha is UGS in Umeå. Nonetheless, this WTP is only valid if the other preferences for connected UGS, human and dog focus in the design, implementation of dog owner education, and no extra engagement in decision-making is respected.

These findings have implications for the urban planning of Umeå. Earlier studies highlight that for constructing successful policy interventions and management for dogs, it is important that decided plans are supported by the local community (Doherty *et al.*, 2017). WTP and preferences described here could be considered in the municipality's urban planning. City plans, such as the comprehensive plan of Umeå (Helmersson *et al.*, 2018) could include information and considerations of citizens' preferences regarding integrating animal welfare in the urban environment, which is currently not specifically integrated present in the plan.

Here, we presented a case study on Umeå citizens' preferences regarding policy interventions aiming to improve dogs, wildlife, and human welfare in the city of Umeå. We presented a preliminary dataset (number of respondents = 508), and therefore our results should be taken with caution.

We identified two aspects regarding sampling bias (see Table 3). Firstly, our sample included a smaller percentage of foreign-born citizens (5.70%) – compared to the overall population in Umeå (15.18%). This likely has implications for the preferences of UGS that were reported. Elbakidze *et al.* (2022) for example,

mention the importance of increasing our understanding of how cultural background affects people's preferences and needs for urban green space design, and how we can take this into account. Since our sample included a relatively low number of foreign-born respondents, our sample is likely biased toward the preferences of Swedish-born citizens. Secondly, the yearly mean income before taxes of respondents in our survey seemed to be low (383,065 SEK) compared to that of the overall population in Umeå (542,141 SEK). The mean income before taxes of respondents in our survey was more in line with the mean income after taxes of the overall population in Umeå (383,065 SEK in the sample vs 357,000 SEK in the total population). This suggests that citizens might have reported their mean income after taxes, instead of that before taxes. Hence, when repeated, we recommend sampling include a better representation of the cultural groups present and asking respondents to present their after-tax income.

Furthermore, the findings presented here, are likely not only relevant to Umeå. They could potentially be useful for other middle-sized growing cities in other Scandinavian countries. Cities such as Luleå (Sweden), Vaasa (Finland), and Trondheim (Norway), could potentially benefit from this study, considering their similarities regarding city size, climate, culture, latitude, and growing and densifying nature. A similar study could be conducted and compared with the findings in the present study, to find to what extent results can be translated to other cities. Hence, future studies in other cities may find whether the data presented here is to be extrapolated to other cities.

5.4 Implications for Further Research

In this study, we created linkages between the research fields in environmental economics, animal welfare, urban wildlife, urban planning, and governance of UGS.

We added to the literature of environmental economics, introducing an interdisciplinary DCE, as well as in the way we included relatively complex illustrations to illustrate the different attributes and levels. In addition, we build on the literature on DCE on dog welfare-related topics (Simonsen, Fasenko and Lillywhite, 2014; Bebrysz *et al.*, 2021; Joo *et al.*, 2023; Samper, Rowe and Williams, 2023), by adding a perspective on people's preferences regarding the inclusion of dog's needs in an urban environment. Furthermore, we build on work on DCE for urban green space planning (Arnberger and Eder, 2011; Bertram *et al.*, 2017), expanding the perspective from a human-focused DCE to a DCE on sustainable urban coexistence. Our findings also contribute to the literature on animal welfare in the urban environment (Rock and Degeling, 2015; Toohey *et al.*, 2017), and the inclusion of animals in SDGs (Keeling *et al.*, 2019, 2022).

Additionally, we expand on the literature of (Beninde, Veith and Horchkirch, 2015) that discusses the needs of wildlife and biodiversity in the urban environment. Furthermore, we also build on the literature on 'One Health', since we are looking at the ecosystem from three angles: dogs (representing pets), wildlife and biodiversity (animal and environment), and humans. We specifically contribute to 'One Health' and 'One Welfare' platforms and research which have been established to mitigate problems regarding the consideration of animal welfare in our society (Colonius and Earley, 2013; Gibbs, 2014; Lerner and Berg, 2015; Pinillos *et al.*, 2016). We added a companion animal perspective in an urban environment, which has previously been overlooked in the 'One Health' concept (Pinillos *et al.*, 2016). We hence also further explore more-than-human solidarity, as introduced by Rock and Degeling (2015). Our contribution shows the importance of accounting for the needs of animals in our urban living environments, to allow for sustainable urban coexistence. Lastly, we build on the literature on citizen engagement in decision-making regarding natural resource management. Our findings on preferences for governance can be seen as a case study in the light of Arnstein's (1969) ladder of citizen participation, Lockwood, Davidson, Curtis, Stratford and Griffith's (2010) governance principles for natural resource management, and Santander, Lorenzini and Martinez-Cruz (2024) work to integrate these two theoretical frameworks. Our study provides a real case study that highlights the importance of studying to which degree people would like to be engaged in decision-making regarding UGS design and planning.

Especially interesting for further research is our finding of positive WTP for compulsory dog owner education. Further research could investigate what should be included in dog owner education, to maximize the benefits for coexistence.

We are aware that in our study, we used a generalized way to present wildlife's needs. Due to wildlife's and biodiversity's complexity and limited time, we could not focus on specific wildlife species, and solutions that might be beneficial for them. We used UGS connectedness as a measure that could potentially benefit wildlife, as several studies have supported this (Beninde, Veith and Horchkirch, 2015; Ta and Levrel, 2022). Future studies are needed to explore the direct effect of the different options presented here e.g. the realization of connected UGS, to study its effect on biodiversity, as well as on the welfare of individuals.

Additionally, we are aware that in our survey, we introduced UGS as an intervention that can improve the welfare of humans, wildlife, and dogs. Nevertheless, introducing UGS comes with challenges that can also negatively affect wildlife, dog, and human welfare. One identified hazard arising from including more green spaces in cities is the increased risk of zoonotic disease spread (e.g. through the occurrence of rats, see (de Cock *et al.*, 2023)). Future research is

needed to integrate this dimension and identify its impact on citizens' preferences for UGS.

In addition, there is a need for future research on the potential of indoor pet-friendly spaces for balancing the well-being of dogs, wildlife, and humans in growing and densifying cities. For example, indoor green pet areas could be created in housing facilities. This is especially relevant for cities in the Northern part of the world, considering the long, cold winters, where going outdoors with your pet can be challenging for at least half of the year. Future studies can explore pets' needs for these indoor spaces. Additionally, citizens' preferences could be tested. Both animal and human preferences can be used to inform potential design of these spaces.

Ultimately, we intend to repeat the presented study using virtual reality. Using virtual reality scenarios potentially increases the certainty of answers, compared to the here used online survey with illustrations (Matthews, Scarpa and Marsh, 2017; Mokas *et al.*, 2021). Mokas et al. found the certainty of respondents to be higher in virtual reality scenarios, compared to text-only DCEs or videos. In addition, they found WTP to be significantly affected by the way the alternatives are presented (Mokas *et al.*, 2021). Exploring citizens' preferences and WTP when they are immersed in a virtual environment, can therefore potentially increase the accuracy of the results. Improved accuracy of results can help to better tailor future UGS planning.

Particularly interesting for further research is our finding of positive WTP for compulsory dog owner education. Further research could investigate how, when, and towards whom this intervention should take place, and how it fits in society (e.g. identifying responsible authorities, educational systems, and stakeholders).

To summarize, the findings presented in this thesis are instrumental in the sense that i) they inform UGS planning in Umeå, northern Sweden, ii) bridge and add on literature from environmental economics, animal welfare, urban wildlife, urban planning, and governance of UGS, and iii) open up further research agendas for incorporating animals' needs in urban environments, working towards sustainable urban coexistence between pets, wildlife, and humans.

6. Conclusion

Here, we studied citizens' preferences and WTP for policy interventions that can potentially benefit sustainable urban coexistence – between dogs, wildlife, and humans –, in the city of Umeå, northern Sweden. With our DCE, we report an overall positive WTP for the tested policy interventions, except for increased citizen participation in UGS planning. Hence, our results emphasize the potential willingness to coexist with animals, balancing the welfare of dogs, wildlife, and humans. Future studies may investigate whether i) our findings are relevant to and can be compared with citizens' WTP for policy interventions aiming to improve and balance pet, wildlife, and human welfare in other cities, ii) results would be similar when conducted in a virtual reality environment, and iii) how, when, and towards whom dog owner education could be presented to enhance coexistence. The present study was the first to connect existing literature on dog and wildlife welfare in urban areas, while at the same time exploring citizens' preferences regarding this topic. In particular, we set a step in bridging the gap of knowledge on budgets potentially available, and needed, to create more-than-human tailored UGS. Hence, we set one step forward in the exploration of sustainable urban coexistence between dogs, wildlife, and humans.

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Popular Science Summary

In this master's thesis, I wanted to find out what people in Umeå would like to see to improve the well-being of dogs, wild animals, and people in the city. We looked at previous studies that made suggestions to create more animal-friendly cities. We especially searched how green spaces could be designed to improve dog, wild animals, and human well-being. We then created a survey to ask people in Umeå their opinions.

We asked people about:

1. How much money they are willing to spend on parks and green spaces.
2. If they preferred parks and green spaces to be connected or not connected.
3. If they wanted parks and green spaces just for people or also for dogs.
4. If they thought dog owners should take classes on dog behavior.
5. If they wanted to be involved in planning parks and green spaces.

We found that on average, people in Umeå were willing to pay 4.146% of their income on green spaces that included both animals' and people's needs. This extra tax would raise about 1.8 billion SEK per year. Preliminary calculations, using data from another study, suggest this would be enough to make about 155 ha of green space (this is as much as about 63 football fields). Most people were willing to pay for green spaces that were connected and made to meet people's and dogs' needs. They were also willing to pay for dog owner education. They did not want to be involved in planning the parks.

These findings help us evaluate how to include animals' needs in cities. They can also help Umeå's city planners to create green spaces that people and animals will enjoy. This study is a step toward a sustainable city life for dogs, wildlife, and human welfare.

Acknowledgments

My sincere thanks go out to all my past, present, and future four-legged companions for teaching me what it is like to feel loved, and cherished, beyond words. Rhanna, Amaruk, Timber, Tibar, Kaipo, and all future dog friends, you inspired me, and always will, to be an advocate for compassion for all beings.

Thank you, Adan, for the inspiring conversations, for your honest and constructive guidance and supervision, and for all the opportunities you have given me during the past year.

Thank you to everyone who has helped us to conduct this project. Thank you, Emelie, for helping with the illustrations for our DCE, and for the inspiring conversations and research ideas. Thank you, Pedro, for your feedback, for sharing your experiences, and for the fun times teaching. Thank you, Nicole, for helping translate our survey, and for all the exciting innovation adventures. Thank you, Linda and Therese, for your co-supervising efforts, and for giving me constructive feedback and encouragement.

My special thanks go out to all the friends I got to know over the past two years in Umeå. And to my family, who have always been supportive of my endeavors. I am truly grateful for the countless lessons you taught me.

Finally, I am thanking the universe for opening this door for me. I am grateful that with this thesis, I set another step in contributing to a compassionate, green planet.

Appendix 1: Part 1 Survey: Introduction and Background Questions

First, respondents were presented with the following introduction.

Hi!
Thank you for taking the time to participate in this survey.

We are a team of researchers at the Swedish University of Agriculture (SLU) and are interested in human-animal interactions in relation to city design.

This project focuses on Umeå because Umeå is a medium-sized yet growing city, with corresponding implications for human-animal interactions and conflicts.

Exploring human-animal interactions in the city, and citizens' opinions on this matter, is key to facilitating sustainable urban growth.

Your answers are therefore important, and the findings from this project will be communicated to Umeå municipality officials.

The survey will take about 15 minutes to complete. Your contribution will be anonymous and your answers will not be distinguishable when the results of the survey are reported. You can participate until **April 30**. The findings of this project will be posted, among other places, on the website of SLU Urban Futures.

If you have questions, please write us at suvt0002@stud.slu.se (Suze van der Zwet, Master student), therese.rehn@slu.se (Therese Rehn, Researcher) or adan.martinez.cruz@slu.se (Adan L. Martinez-Cruz, Senior Lecturer).

Thank you for your contribution!

After, they were directed toward part 1 of the survey, where the respondents were asked to answer the following questions (here presented in the original language Swedish).

CONTROL2 Vilket land bor du i?
Danmark Finland Frankrike Tyskland Italien
Norge Spanien Sverige Storbritannien Annat

DEM1 Kön Man Kvinna Icke-binär Föredrar att inte säga

DEM2A Alt

DEM3A_SE Var i Umeå kommun bor du?
Bor centralt Bor i utkanten av kommunen Bor inte i Umeå kommun > utesluten från undersökningen

B1A Vilken av följande meningar representerar din nuvarande situation? Jag har en eller flera hundar och gillar hundar
Jag har en eller flera hundar och gillar inte hundar
Jag har ingen hund men överväger att skaffa en eller hade en hund nyligen (inte mer än 5 år sedan)
Jag har aldrig haft en hund men gillar hundar
Jag har aldrig haft och är inte så förtjust i hundar
Annat. Förklara

B2 Vilken av följande meningar representerar din syn på vilda djur och natur i Umeå bäst?
Jag gillar vilda djur och natur och tycker det är viktigt att vi garanterar utrymme för vilda djur och natur inom hela Umeås stadsområde

Jag gillar vilda djur och natur och tycker det är viktigt att vi garanterar utrymme för vilda djur och natur utanför - i omgivningen av - Umeås stadsområde
Jag gillar vilda djur och natur och tycker det är viktigt att vi garanterar utrymme för vilda djur och natur inom och utanför Umeås stadsområde
Jag är inte särskilt intresserad av vilda djur och natur och tycker inte att vilda djur är en prioritet varken inom eller utanför Umeås stadsområde
Jag är inte särskilt intresserad av vilda djur och natur, men jag anser att det är viktigt och tycker därför att vi bör skapa utrymme för vilda djur och natur inom och utanför Umeås stadsområde

B3 Har du en bil som du kan använda för att åka till ett naturområde utanför Umeås stadsområde? Ja, men jag åker inte utanför stadsområdet för att besöka naturområden
Ja, jag åker regelbundet utanför stadsområdet med min bil för att besöka naturområden
Nej, men jag skulle vilja använda en bil för att åka utanför stadsområdet och besöka naturområden
Nej, och jag har inte lust att åka utanför stadsområdet för att besöka naturområden
Nej, och jag önskar att det fanns fler kollektivtrafikalternativ för att nå naturområden utanför staden

B4A Hur mycket håller du med om följande påståenden angående utformningen av urbana grönområden ?

B4Aa Människors välbefinnande bör beaktas vid utformningen av urbana grönområden Håller inte alls med
Håller inte med Har ingen åsikt Håller med Håller mycket med

B4Ab Hundars välbefinnande bör beaktas vid utformningen av urbana grönområden
Håller inte alls med Håller inte med Har ingen åsikt Håller med Håller mycket med

B4Ac Vilda djurs välbefinnande bör beaktas vid utformningen av urbana grönområden Håller inte alls med

Håller inte med		Har ingen åsikt		Håller med	Håller mycket med		
B4B	Om du skulle besöka ett urbant grönområde i Umeå, vad skulle du vilja se? Rangordna följande alternativ för allmänna grönområden från högsta prioritet till lägsta prioritet, baserat på din åsikt (1 - högsta betyg)						
B4Ba	Variation i utformningen av gångstigar	1	2	3	4	5	6
B4Bb	Sittplatser	1	2	3	4	5	6
B4Bc	Lekplatser för barn	1	2	3	4	5	6
B4Bd	Hundvänliga urbana grönområden	1	2	3	4	5	6
B4Be	Faciliteter där hundar kan gå utan koppel	1	2	3	4	5	6
B4Bf	Ett urval av växtarter och naturliga livsmiljöer	1	2	3	4	5	6
B4C	Är det något annat du skulle vilja se om du skulle besöka ett urbant grönområde i Umeå?				Nej	Ja. Förklara	

B5 Vad är dina åsikter om mängden urbana grönområden inom 20 minuters gångavstånd från ditt hem?

För lite urbana grönområden

Precis lagom med urbana grönområden För många urbana grönområden

Jag vet inte

B6 Vilket av följande alternativ representerar bäst din åsikt på graden av konnektivitet mellan urbana grönområden i Umeå?
Väl sammanlänkade
Inte väl sammanlänkade
Det finns inte mer än ett urbant grönområde

B7 Vad tycker du om mängden hundpromenadområden i ditt område (inom 20 minuters gångavstånd)?
Det finns för många områden lämpliga för hundpromenader
Precis lagom
Det finns för få områden lämpliga för hundpromenader
Jag vet inte

B8 Vilken av följande meningar beskriver bäst ditt perspektiv på förhållandet mellan hundar och vilda djur?
Hundar har ingen negativ effekt på vilda djur
Hundar har sällan en negativ effekt på vilda djur
Hundar har ibland en negativ effekt på vilda djur
Hundar har ofta en negativ effekt på vilda djur
Jag vet inte

B9A Äger du en hund? Ja Nej

B9B Vad är din åsikt om andra hundägares kunskap om hundars beteende och välbefinnande i ditt område? > om ja i fråga B9A
Andra hundägare har tillräckligt med kunskap om hundars beteende och välbefinnande
Andra hundägare har inte tillräckligt med kunskap om hundars beteende och välbefinnande
Jag vet inte

B9C Vad är din åsikt om din egen kunskap om hundars beteende och välbefinnande? > om ja i fråga B9A
Jag har tillräckligt med kunskap om hundars beteende och välbefinnande
Jag har inte tillräckligt med kunskap om hundars beteende och välbefinnande
Jag vet inte

B9D Vad är din åsikt om den kunskap hundägare i ditt område har om hundars beteende och välbefinnande? > om nej i fråga B9A
Hundägare har tillräckligt med kunskap om hundars beteende och välbefinnande
Hundägare har inte tillräckligt med kunskap om hundars beteende och välbefinnande
Jag vet inte

B10A Är du medveten om sätt att delta i beslutsfattandet angående grönområden i Umeå?
Ja, jag är medveten om hur jag kan delta i beslutsprocessen
Nej, jag är inte medveten om hur jag kan delta i beslutsprocessen
Jag vet inte

B10B Använder du sätt att delta i beslutsfattandet angående grönområden i Umeå?
Ja
Nej
Nej, men jag skulle vilja
Jag vet inte

B10C Vad är din åsikt om den nivå som Umeå kommun tillåter dig att delta i beslutsfattandet angående urbana grönområden i Umeå? > om ja, eller nej, men jag skulle vilja; eller jag vet inte i fråga B10B
Jag vill inte delta

Jag vill delta mindre
Jag är nöjd med nuvarande nivå av deltagande
Jag vill delta mer
Jag vet inte

Appendix 2: Part 2 Survey: DCE

In part 2, respondents were asked to express their preferred choices in the created DCE. First, they were presented to the DCE scenario, see text box below (her: English version).

Umeå municipality is planning for an increase in residents from the current 132 thousand (Opendata, 2022) to 200 thousand by the year 2050, as outlined in the municipality's comprehensive plan. Please click on this link for more information. To accommodate this growth, the municipality's plan involves city densification, i.e. increasing the number of inhabitants per area.

However, this strategy comes with challenges. As the city becomes more densely populated, urban green spaces, crucial for recreation and ecological balance, may face increased pressure. The simultaneous rise in the dog population is not considered in the current urban planning, which may increase conflicts between humans-pets-wildlife.

In this survey, we present alternative designs of urban green spaces and other policy interventions aiming to address the potential consequences of densification for humans, pets, and wildlife.

In the following section, you are invited to express your preferences in the presented choice sets that represent different policy interventions which can potentially balance the well-being of dogs, wildlife, and humans as Umeå becomes more densified. Each choice comes with a price tag. Please choose your preferred option, taking into account your opinion and resources. Your choices will contribute to understanding the preferences of Umeå's citizens in addressing the challenges posed by the human and pet population increase in growing cities.

The findings of this project will be communicated to Umeå municipality officials.

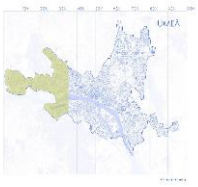
Thank you for participating in research regarding the future of urban planning in Umeå municipality!

After, they were exposed to the illustrations (one page per attribute), as shown below (here: English version). Note that the quality of the illustrations is low here, for purposes of reducing file size. In the actual survey, respondents were presented with high-quality illustrations. Illustrations were created in collaboration with Emelie Aktanius ((Architect and Urban Planner, Project assistant, The Department of Historical, Philosophical and Religious Studies, Umeå University).

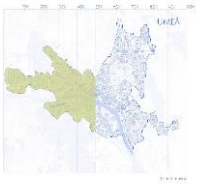
Green space amount: Percentage of land cover of urban green space in Umeå overall city.

24% (current)

35%



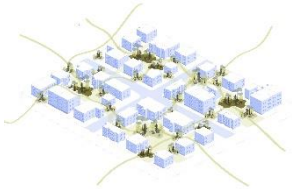
50%



Green space connectivity: Connectivity describes the degree to which urban green spaces are connected. Connectedness increases the distribution of wildlife species and improves the accessibility of urban green spaces for people.

Fragmented (current)

Connected



Green space user-focus: Urban green spaces can be designed for various purposes. In urban green space design, urban planners often have to choose different focus points, for example, mostly human-oriented or human and dog-oriented.

Mostly human-oriented (current)

Human and dog-oriented

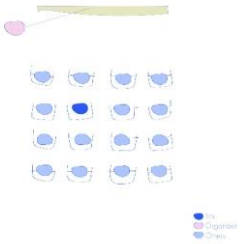
Dog owner education: Umeå municipality would provide a compulsory course for dog owners in Umeå municipality. The course will be about dog behavior and well-being in an urban context and can enhance dog welfare, as well as improve the welfare of others who interact with dogs and mitigate potential conflicts.

No course (current)

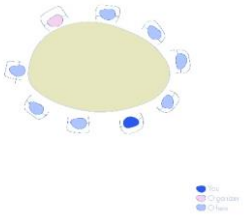
Compulsory online course

Governance: Participatory urban green space design allows citizens to be involved in decision-making, establishment, and maintenance regarding these spaces.

Option to give feedback and attend lectures (current)



Actively engaged in co-creation



Price: Percentage of monthly income before tax, you would contribute (per adult) over a period of ten years. This is an additional tax on what you are currently paying.

0.0% (current)

0.5%

1.0%

2.5%

Next, respondents were exposed to choice sets, with attribute levels described in Appendix 3. See Table 6 for an example of a choice set.

Appendix 3: DCE Design Creation

To create the DCE design, the following code was used in STATA.

```
ssc install dcreate

clear all
matrix levmat = 3, 2, 2, 2, 2, 3
* 2*2*2*2*2*3=96
genfact, levels(levmat)

rename x1 amount
rename x2 connectivity
rename x3 focus
rename x4 course
rename x5 participation
rename x6 price


matrix b = (0, 0, 0, 0, 0, 0, 0, 0)
dcreate i.amount i.connectivity i.focus i.course i.participation i. price, nalt(2) nset(10) bmat(b)
blockdes block, nblock(2)
list, separator (2)


corr amount connectivity focus course participation price
```

Here we present the output of the DCE design in STATA, from which we created the choice sets for block 1 and block 2.

amount	connectivity	focus	course	participation	price	set	choice_set	alt	block	t
1	1	1	1	2	3	1	2	1	1	t11
3	2	2	2	1	2	1	2	2	1	t11
0	0	0	0	0	0	1	2	3	1	t11
2	1	2	2	2	1	2	4	1	1	t12
3	2	1	1	1	3	2	4	2	1	t12
0	0	0	0	0	0	2	4	3	1	t12
1	1	2	2	2	3	3	5	1	1	t13
2	2	1	1	1	1	3	5	2	1	t13
0	0	0	0	0	0	3	5	3	1	t13
2	1	2	1	1	3	4	9	1	1	t14
1	2	1	2	2	2	4	9	2	1	t14
0	0	0	0	0	0	4	9	3	1	t14
2	2	2	1	2	2	5	10	1	1	t15
3	1	1	2	1	1	5	10	2	1	t15
0	0	0	0	0	0	5	10	3	1	t15
2	2	1	2	2	3	1	1	1	2	t21
1	1	2	1	1	1	1	1	2	2	t21
0	0	0	0	0	0	1	1	3	2	t21
3	1	1	1	2	1	2	3	1	2	t22
1	2	2	2	1	3	2	3	2	2	t22
0	0	0	0	0	0	2	3	3	2	t22
3	2	2	2	2	3	3	6	1	2	t23
3	1	1	1	1	2	3	6	2	2	t23
0	0	0	0	0	0	3	6	3	2	t23
1	2	2	1	2	1	4	7	1	2	t24
2	1	1	2	1	2	4	7	2	2	t24
0	0	0	0	0	0	4	7	3	2	t24
3	1	2	1	2	2	5	8	1	2	t25
2	2	1	2	1	1	5	8	2	2	t25
0	0	0	0	0	0	5	8	3	2	t25

Appendix 4: Part 3 Survey: Sociodemographic and Socioeconomic Questions

In part 3 of the survey, respondents were asked to answer sociodemographic and socioeconomic questions, as shown below.

S2A Vänligen välj var du är född
Sverige
Europeiskt land annat än Sverige
Asien
Afrika
Australien
Nordamerika Sydamerika

S2B Vänligen välj hur många år du har bott i Sverige fram till nu
0 ~ 2 3 ~ 5 6 eller mer

S4 Vänligen välj intervallen för din månatliga inkomst före skatt (i SE
0 ~ 19 999
20 000 ~ 29 999
30 000 ~ 39 999
40 000 ~ 49 999
50 000 ~ 75 000
>75 000

S5 Vänligen välj det alternativ som bäst speglar din nuvarande sysselsättning
Heltidsjobb
Deltidsjobb
Egenföretagare
Student
Student och deltidsjobb
Arbetslös

Pensionär

S6 Vänligen välj det alternativ som bäst speglar din utbildningsnivå

Grundskola
Gymnasiet
Yrkesutbildning
Universitetsutbildning, 3 år
Universitetsutbildning, 4 år
Universitetsutbildning, 5 år
Doktorsexamen eller mer

S7 Vänligen välj den del av Umeå där du bor.

Ålidhemsområdet	Alvik	Backenområdet		Berghem
Centrala stan	Ersboda	Ersmark	Haga/Sandbacka	I20-området
Klockarbäcken	Marieområdet		Nydala	Ön
Regementet	Röbäck	Stadsliden	Teg	Tomtebo	Umåker
Universitets- och sjukhusområdet		Västerslätt/Rödäng		

Annat. Förklara

S8 Vänligen välj det alternativ som bäst speglar din familjesammansättning

Singel
Partner
Gift
Gift med barn
Partner med barn
Vill inte säga

S9 Hur många hundar har du?

0	1	2	3	4 eller fler

S10 Hur många katter har du?

0	1	2	3	4 eller fler

S11 Har du några andra husdjur än hundar eller katter?

Ja Nej

S12 Har du haft några husdjur de senaste tio åren?

Ja Nej

Appendix 5: Calculations Sociodemographics and Socioeconomics Umeå

For each of the sources, the date accessed: is May 21, 2024.

2022
2480 Umeå
Total population 133091
Source:
https://www.statistikdatabasen.scb.se/pxweb/en/ssd/START__HE__HE0110__HE0110A/SamForvInk3/table/tableViewLayout1/

2023
Mean age
2480 Umeå
Total 39.6
Source:
https://www.statistikdatabasen.scb.se/pxweb/en/ssd/START__BE__BE0101__BE0101B/BefolkningMedelAlder/table/tableViewLayout1/

2023
2480 Umeå
Women 66638
% 50.06950132
Men 66453
% 49.93049868
Source:
https://www.statistikdatabasen.scb.se/pxweb/en/ssd/START__BE__BE0101__BE0101A/BefolkningNy/table/tableViewLayout1/

2023
2480 Umeå
Population 20-68 of age 80450

% of the total population 60.44736308
Source:
https://www.statistikdatabasen.scb.se/pxweb/en/ssd/START__BE__BE0101__BE0101D/MedelfolkFodelsear/table/tableViewLayout1/

2023
2480 Umeå
Total population >20 of age 103860
% of the total population >20 78.03683194
Source:
https://www.statistikdatabasen.scb.se/pxweb/en/ssd/START__BE__BE0101__BE0101A/BefolkningNy/table/tableViewLayout1/

2023
2480 Umeå
Single total >20 years of age 52188.00
% of the total population >20 50.09
Source:
https://www.statistikdatabasen.scb.se/pxweb/en/ssd/START__BE__BE0101__BE0101D/MedelfolkFodelsear/table/tableViewLayout1/

2023
2480 Umeå
Married total >20 years of age 37441
% of the total population >20 35.93410337
Source:
https://www.statistikdatabasen.scb.se/pxweb/en/ssd/START__BE__BE0101__BE0101A/BefolkningNy/table/tableViewLayout1/

2023
2480 Umeå
Foreign-born 15770
% of the total population >20 15.13530115
Source:
https://www.statistikdatabasen.scb.se/pxweb/en/ssd/START__BE__BE0101__BE0101F/UtlmedbTotNK/

2023
Mean income
Net income 357000
>This represents 1-0.3415=0.6585 proportion of X before-tax income

Before-tax income 542141
>Average net income/0.6585
Source mean net income:
https://www.statistikdatabasen.scb.se/pxweb/en/ssd/START__HE__HE0110__HE0110A/SamForvInk3/table/tableViewLayout1/

Survey mean before-tax income

Monthly	Middle	Yearly	Percentage	Proportion
>75 000	75000	900000	2	0.02
0 ~ 19 999	9999.5	119994	22.2	0.222
20 000 ~ 29 999	24999.5	299994	21.3	0.213
30 000 ~ 39 999	34999.5	419994	32.5	0.325
40 000 ~ 49 999	44999.5	539994	13.2	0.132
50 000 ~ 75 000	62500	750000	8.9	0.089
Average	383064.648			

Appendix 6: Analysis of Background Questions in R

```
# Install packages
install.packages("dplyr")
install.packages("kableExtra")
install.packages("knitr")
install.packages("kableExtra")
install.packages("webshot2")
install.packages("magick")

# Load packages
library(readr)
library(utils)
library(dplyr)
library(knitr)
library(kableExtra)
library(webshot)


#Set directory
setwd("C:/Users/suzev/Documents/R/MSC_THESIS")

#I Data preparation
  #Read raw data, create data_raw
  data_raw <-
read.csv("Syno_SLU_UMEÅ_survey_II_Q1_2024_Raw_Data_26042024.csv",
fileEncoding = "latin1")

  #Delete the second row which contains column explanation, create data_process
  data_process <- data_raw[-1, ]

  # Add ID column to data_process using seq()
  data_process$ID <- seq(from = 1, to = nrow(data_process), length.out =
nrow(data_process))

  # Reorder the columns to have 'ID' as the first column
  data_process <- data_process[, c("ID", setdiff(names(data_process), "ID"))]

#Now we have a data set with ID tags
```

```
#II Create table 2: Summary of socio-economics
  # Recode options to English language
  data_process$DEM1 <- recode(data_process$DEM1, "Man"="Man",
"Kvinna"="Woman","Icke-binär"="Non-binary","Föredrar att inte säga"="Would
rather not say")
  data_process$DEM3A_SE <- recode(data_process$DEM3A_SE, "Bor centralt"
= "Lives centrally", "Bor i utkanten av kommunen" = "Lives on the outskirts")
  data_process$S2A <- recode(data_process$S2A, "Sverige"="Sweden",
"Europeiskt land annat än Sverige"="European country other than Sweden",
"Asien" = "Asia", "Afrika"="Africa", "Australien"="Australia",
"Nordamerika"="North America", "Sydamerika"="South America")
  data_process$S2B <- recode(data_process$S2B, "6 eller mer"="6 or more")
  data_process$S5 <- recode(data_process$S5, "Heltidsjobb"= "Full-time
employment", "Deltidsjobb"="Part-time employment", "Egenföretagare"="Self-
employed", "Student och deltidsjobb" = "Student and part-time employment",
"Arbetslös"="Unemployed", "Pensionär"="Pensioner")
  data_process$S6 <- recode(data_process$S6, "Grundskola"="Elementary
school", "Gymnasiet"="High school", "Yrkesutbildning"="Vocational training",
"Universitetsutbildning, 3 år"="University education, 3 years",
"Universitetsutbildning, 4 år"="University education, 4 years",
"Universitetsutbildning, 5 år"="University education, 5 years", "Doktorsexamen
eller mer"="Doctoral degree or more")
  data_process$S8 <- recode(data_process$S8, "Singel"="Single",
"Partner"="Partner", "Gift"="Married", "Gift med barn"="Married, with
children", "Partner med barn"="Partner, with children", "Vill inte säga"="Would
rather not say")
  data_process$S9 <- recode(data_process$S9, "4 eller fler"= "4 or more")
  data_process$S10 <- recode(data_process$S10, "4 eller fler"= "4 or more")
  data_process$S11 <- recode(data_process$S11, "Ja"="Yes", "Nej"="No")
  data_process$S12 <- recode(data_process$S12, "Ja"="Yes", "Nej"="No")

  #Select columns for table socio-demographics
  selected_columns <- c("DEM1", "DEM2", "DEM3A_SE", "S2A", "S2B", "S4",
"S5", "S6", "S8", "S9", "S10", "S11", "S12")

  # Initialize an empty list to store results
  summary_list <- list()

  # Loop through each column (question) in the dataset
  for (col_name in selected_columns) {
    # Extract answers for the current question
    answers <- data_process[[col_name]]

    # Calculate frequency counts for each unique answer
    answer_counts <- table(answers)

    # Calculate proportions for each unique answer
```

```
    answer_proportions <- prop.table(answer_counts) * 100

    # Create a data frame for the summary table
    summary_table <- data.frame(Question = rep(col_name,
length(answer_counts)),
                                Answer = names(answer_counts),
                                Frequency = as.numeric(answer_counts),
                                Proportion = round(as.numeric(answer_proportions), 1))

    # Store the summary table in the list
    summary_list[[col_name]] <- summary_table
  }

  # Combine all summary tables into a single data frame
  summary_df <- do.call(rbind, summary_list)

  # Write out in table and delete the row names from summary_df
  summary_df %>%
    kbl(caption="Table 2: Summary of Socio-Economics of Sample",
        format= "html",
        col.names = c("Question", "Answer", "Count", "Proportion"),
        align="r",
        row.names = FALSE) %>%  # Remove row names
    kable_classic(full_width = FALSE, html_font = "helvetica")
```

Appendix 7: DCE Analysis in STATA

```
cd "C:\Users\aduz0001\Google Drive\CERE\Administrative\SUPERVISOR\SuzeVanDerZwet\Data"

forval i=1/2 {
clear all

import excel "DCE_UGS_Design_260224.xlsx", sheet("block`i'") firstrow case(lower)

gen green=0
replace green=24 if amount==0
replace green=24 if amount==1
replace green=35 if amount==2
replace green=50 if amount==3

gen connected=0
replace connected=1 if connectivity==2

gen humandog=0
replace humandog=1 if focus==2


gen online=0
replace online=1 if course==2

gen engaged=0
replace engaged=1 if participation==2

gen tax=0
replace tax=0.5 if price==1
replace tax=1.00 if price==2
replace tax=2.50 if price==3
```

```
drop choice_set
order block set alt green connected humandog online engaged tax ///
    amount connectivity focus course participation price
save ChoiceCardsUGSDCEBlock`i'.dta, replace
}

clear all



import excel "Syno_SLU_UMEÅ survey II Q1 2024_Raw Data_26042024.xlsx", sheet("Data") firstrow case(lower)

gen temp1=_n
move temp1 guid
drop if temp1==1
drop temp1
gen block =0
replace block=1 if (t11=="Nuverande" | t11=="Alternativ 1" | t11=="Alternativ 2")
replace block=2 if (t21=="Nuverande" | t21=="Alternativ 1" | t21=="Alternativ 2")
move block t11

forval i=1/2{
forval j=1/5{
gen c`i'`j'=0
replace c`i'`j'=1 if t`i'`j'=="Alternativ 1"
replace c`i'`j'=2 if t`i'`j'=="Alternativ 2"
replace c`i'`j'=3 if t`i'`j'=="Nuverande"

}
}

keep id block c11 c12 c13 c14 c15 c21 c22 c23 c24 c25
order id block c11 c12 c13 c14 c15 c21 c22 c23 c24 c25
********** Setting up discrete choice experiment format **********
```

```
sort id

expand 15
sort id
egen set = fill(1 1 1 2 2 2 3 3 3 4 4 4 5 5 5 1 1 1 2 2 2 3 3 3 4 4 4 5 5 5)

egen alt = seq(), f(1) t(3)

order id block set alt

sort id block set alt

forval i=1/2{
merge m:m block set alt using ChoiceCardsUGSDCEBlock`i'.dta, update

rename _merge mergeblock`i'

}

table mergeblock1
table mergeblock2
table mergeblock1 mergeblock2

drop if mergeblock1==1 & mergeblock2==1
sort id block set alt
table mergeblock1 mergeblock2

tab block
tab set
tab alt

gen choice=0
forval block=1/2 {
forval card= 1/5 {
replace choice=1 if (alt==c`block'`card' & set==`card')
}
}
egen group=group(id set)
keep id block set group alt choice green connected humandog online engaged
tax
```

```
order id block set group alt choice green connected humandog online engaged
tax


gen sq=0
replace sq=1 if alt==3

gen nsq=0
replace nsq=1 if (alt==1 | alt==2)


save UGSDCEData.dta, replace


local choice "choice"

local atts "green connected humandog online engaged tax"

quietly  eststo: clogit `choice' `atts', group(group)
*wtp tax green connected humandog online engaged, krinsky reps(1000)
level(95)

quietly  eststo: clogit `choice' sq `atts', group(group)

quietly  eststo: clogit `choice' nsq `atts', group(group)

esttab  using clogit_models.rtf, replace se stats(N r2_p ll aic bic) star(* 0.10 **
0.05 *** 0.001) ///
varwidth(30) label nobaselevels interaction(" X ") ///
title(Conditional Logit specification) ///
nonumbers mtitles("(I)" "(II)" "(III)")
```

Appendix 8: WTP Calculations

WTP calculations were conducted in Excel. WTP in percentage increase in taxes was calculated dividing the WTP coefficient of each attribute by the WTP coefficient for tax (0.356).

	percentage increase in taxes	
		24% green
wtp for 1% of green	0.016516854	0.396404494
wtp for connectiveness	1.688202247	
wtp for human and dog focus	0.393258427	
wtp for online course	1.668539326	
decrease in wtp for engagement	-0.592696629	

wtp ugs design that contains 24% green (current), that is connected, has a human and dog focus, and comes accompanied with an online course for dog owners (and does not require more participation from respondents)	4.146404494
with increased participation	3.553707865

After, WTP in percentage increase in taxes for each attribute was multiplied by the mean income before taxes (542141 SEK, see Appendix 5), to calculate WTP per year per person in SEK. Total WTP was calculated assuming a 24% UGS coverage, connected UGS, human-dog focus, and an online course. Total WTP was calculated for a version with increased participation and a version without increased participation in UGS planning.

	taxes	WTP/year/person in SEK	
wtp for 1% green	0.017	90	
wtp for connectiveness	1.688	9152	
wtp for human and dog focus	0.393	2132	
wtp for online course	1.669	9046	
decrease in wtp for engagement	-0.593	-3213	
Total WTP with increased participation		3.554	19266
Total WTP without increased participation		4.146	22479

Next, WTP per year per person was multiplied by the number of people in Umeå between 20-64 years of age (tax paying people, 80,450).

	WTP/year/person in SEK	WTP/year/age20-64 in SEK
wtp for 1% green	90	7,203,869
wtp for connectiveness	9,152	736,313,833
wtp for human and dog focus	2,132	171,520,693
wtp for online course	9,046	727,737,798
decrease in wtp for engagement	-3,213	-258,506,187

WTP per year for a DCE design scenario of 24% UGS coverage, connected, human and dog focus, online course for dog owners was then calculated. This was calculated for a version without and a version with increased participation in UGS planning.

	WTP/year/person in SEK	WTP/year/age20-64 in SEK, 24% green	
wtp for 1% green	90	172,892,859	
wtp for connectiveness	9,152	736,313,833	
wtp for human and dog focus	2,132	171,520,693	
wtp for online course	9,046	727,737,798	
decrease in wtp for engagement	-3,213	-258,506,187	
Total WTP with increased participation 24%		19,266	1,549,958,995
Total WTP without increased participation 24%		22,479	1,808,465,182

We also calculated how much of people's tax money goes towards health care. We used the municipality's total revenue, local tax rates, and mean average income (see Appendix 5) to do so.

	2023
Local tax	34.15%
Local tax which goes to municipality	22.80%
Total revenue municipality	11,266,000,000
Revenue obtained from taxes	69%
Cost towards health care	35%
avg income/year	542,141
Before-tax income that goes to municipality	123,608
The tax used for healthcare per person	43,263
Equivalent to % tax	7.98
Church fee	1.05

Sources:

Local tax:
https://www.umea.se/kommunochpolitik/kommunfakta/ekonomiochbudget/skattesatser.4.533ba3d3171b940e900a6.html
Total revenue municipality:
https://www.umea.se/kommunochpolitik/kommunfakta/ekonomiochbudget/intakterkostnader.4.533ba3d3171b940e9009a.html
Church fee:
https://skatteverket.se/privat/skatter/arbeteochinkomst/askattsedelochskattetabeller.4.18e1b10334ebe8bc80005221.html

Lastly, we used upper-bound construction costs for green infrastructure from Naumann *et al.* (2011) to calculate how many ha could be created with the potential budget arising from the estimated total WTP (without increased participation, for 24% green).

Euro per ha	1,000,000
SEK per ha	11,669,000
Total budget from WTP	1,808,465,182
ha green total budget	155
how many football fields?	63

Appendix 9: Extended Literature Review Tables

Main findings per paper – Welfare of dogs, wildlife, and humans (n= 19)

Reference	Topic Subgroup	Aim	Main findings
Aspling, Juhlin and Chiodo (2015)	Dog-owner interactions	Find suitable ways to include animals and human-animal interconnections from the animal's perspective.	- Different interests for dogs and dog owners in urban areas.
Carrier *et al.* (2013)	Dog welfare	Study hormone levels (cortisol), personality, and behavior of dogs in dog parks.	- For many dogs, dog parks are places with high stimuli. - Almost every observed dog performed some stress-indicating behavior, including play behavior.
Carter (2016b)	Dog welfare	Examining why urban planners have not included dogs' needs in city plans.	- The main reason for interviewed urban planners to not include dogs in city plans was to balance other elements (mainly for human purposes).
Clarke (2007)	Human welfare	Discuss relevance of dog owner education for reducing injuries to humans by dogs.	- Teaching dog owners is crucial to reduce injuries to humans by dogs.
Colonius and Earley (2013)	Welfare	Propose the concept of One welfare, building on the concept of One Health.	- One welfare aims to facilitate linking human welfare, social welfare, and animal welfare in a framework, to evoke human and animal welfare in ecosystems and communities.
Cutt *et al.* (2007)	Dog welfare	Investigate literature on how being a dog owner affects the owner's physical activity levels and policy-related aspects regarding this matter.	- An increasing amount of papers support that dog owners have a higher level of physical activity than people who do not have a dog.
Gibbs (2014)	Welfare	Explain the history of the One Health concept, explain present challenges, as well as future opportunities.	- One Health aims to provide an approach to increase interdisciplinary alliances regarding health care for humans, animals, as well as the environment. - One Health was established because of fear of a zoonotic disease, and to provide a strategy to address this. Nowadays, One Health encompasses activities beyond zoonotic diseases, including activities that can improve human, animal, and environmental health. - Future opportunities include focussing on interdisciplinary partnerships, cost and benefits studies, and communication.
Gómez, Baur and Malega (2018)	UGS-human welfare	Test if dog parks can generate social cohesion between people.	- Dog parks can contribute to social interaction between people from different ethnic origins.
Letchford (2021)	Dog welfare	Enhance understanding of ways parks are used by dogs and their owners.	- Off-leash dog parks facilitate various interactions. - Among interactions there are dog-dog contacts, but also interactions among humans (both dog and non-dog owners).
Keeling *et al.* (2019)	Animal welfare	Assess the degree of potential of UN sustainable development goals (SDGs) to enhance animal welfare.	- A general co-advantage between reaching sustainable and enhancing animal welfare. - Reaching an SDG was slightly more constructive for increasing animal welfare than the potential for improving animal welfare to reach an SDG.

Keeling *et al.* (2022)	Animal welfare	Use the map created by Keeling et al. 2019, to direct organizations on how animal welfare can be enhanced, working on sustainable development goals, and the other way around.	- The largest association was found between enhancing animal welfare and reaching SDG3, SDG14, and SDG12. - Supports findings of Keeling et al. 2019.
Lerner and Berg (2015)	Welfare	Assess some of the features of the One Health umbrella: individual, population, and ecosystem health.	- Deciding on a description of health is crucial for deciding which aspects of health are important in the One Health context.
Pinillos *et al.* (2016)	Welfare	Present the theory of One Welfare.	- The potential outcomes facilitated by the One Welfare concept can improve animal welfare and human well-being.
Rock and Degeling (2015)	Animal welfare	Build on the human-centered approach of solidarity, reflecting on the effect of implementing more-than-human solidarity on public health.	- Human perceptions of and experiences with non-human animals are related to public health.
Rock *et al.* (2014)	Pet welfare	Present a conceptual framework regarding pets in urban areas, and the intertwines and linkages with humans in these areas.	- The framework recognizes five aspects linked to local government policies on pets: preventing risks from pets, facilitating pets' emotional and physical requirements, treating pets properly, facilitating appropriate veterinary care, and licensing and detecting pets.
Rock *et al.* (2016)	Pet welfare	Study participation of citizens in decision-making regarding a policy on off-leash dog areas.	- Empowered societies are most suited to engage efficiently in decision-making, for example in public practices defined as 'engagement'.
Rock and Degeling (2013)	Pet welfare	Examine bylaws regarding pets in Calgary, Canada.	- Health endorsement beyond humans, can be defined as a theoretical approach, which can help establish policy and implementation plans.
Toohey *et al.* (2017)	Pet welfare	Study points of view and opinions of community organizations on how relations between humans and pets influence experiences of aging-in-place.	- Pets might contribute to people's feeling of being socially situated, but might also contribute to feeling less independent. - There is a lack of affordable housing facilities that also support animals.

Main findings per paper – Interactions between dogs, wildlife, and humans (n= 21)

Reference	**Topic Subgroup**	**Aim**	**Main findings**
Beasley *et al.* (2023)	Dog, wildlife, human conflict	Investigate the relation between human and dog presence and activity of bird and mammal species in urban forests in Hampstead Heath, London.	- Spatial and temporal activity of most of the studied species did not differ between places with lesser and more occurrences of humans and dogs. - Only European hedgehogs showed a changed activity pattern.
Borrelli *et al.* (2022)	Dog-owner interactions	Literature review to investigate literature on the advantages of caring for a dog.	- Caring for a dog caused advantages such as increased physical and psychological well-being, as well as enhanced social interactions between people. - However, some papers did not find any advantages.
Degeling and Rock (2012)	Dog-owner interactions	Investigate similarities and varieties in different aspects of dog walking: where dogs are walked, when, and by whom, and how this can contribute to health.	- Taking care of a dog impacted the daily routines of the participants studied. - Being a dog owner influences the way people use space, as well as can function as a motivation for being physically active, depending on the dog and dog owner's health.
Doherty *et al.* (2017)	Dog-wildlife conflict	Refine the estimates of the amount of threatened species that are impacted by domesticated dogs, documenting the type of impact, and in which regions most impact was prevalent.	- Globally, domesticated dogs have caused 11 vertebrate species to go extinct, and have posed a threat to 188 species. - The kind of impacts included predation, followed by disturbance, spread of diseases, competition, and hybridization. - Most impacted species were found in Southeast Asia, followed by Central America, the Caribbean, South America, Asia, Micro/Mela/Polynesia, and Australia.
Gaynor *et al.* (2018)	Human-wildlife conflict	Assess shifts in daily activity patterns of mammal species as a response to human presence.	- Mammals studied in this meta-analysis showed an increase in nocturnal activity, reacting to human disturbance.
Handlin *et al.* (2015)	Dog-owner interactions	Study heart rate and oxytocin, cortisol, and insulin levels in dog	- Short-period interaction between dogs and dog owners alters levels of hormones and heart rate.

		owners and dogs related to short-period contact.	
Holderness-Roddam and McQuillan (2014)	Dog-wildlife conflict	Compare the impacts of dogs on wildlife with that of cats.	- More attacks were found on wildlife by dogs than by cats.
Hughes and Macdonald (2013)	Dog-wildlife conflict	Create a body of knowledge that can be used for future joint work between conservation biologists and other specialists, studying information on contacts between dogs and wild animals.	- Results show the following interactions: wild animal predation by dogs, followed by disease spread, disruption, hybridization between dogs and wild animals, and dog predation by wild animals.
Kotrschal *et al.* (2009)	Dog-owner interactions	Study the relation between dog owner character, attitude, and gender on the behavior of their dog, dyadic interaction, and cortisol levels in the dog's saliva.	- The character of the owner and their gender affects the interaction between the dog and its owner, as well as the dog's behavior, and dyadic interactions.
Miller *et al.* (2015)	Dog-owner interactions	Investigate changes in the level of oxytocin of dog owners after spending time with their dog after being parted for a longer period.	- Female dog owners might have a different response in hormonal levels when interacting with their dog than male dog owners.
Miller, Knight and Miller (2001)	Dog-wildlife conflict	Study the chance of reaction of several wild animal species in different circumstances on and off trails, in response to human and dog prevalence.	- For grassland bird species, human presence seemed to be the factor to disturb them, rather than dogs. - For mule deer, responses were heightened under the presence of a dog.
Ng *et al.* (2019)	Dog-wildlife conflict	Study dog husbandry exercises and the occurrence of disease canine distemper virus (CDV).	- 70% of the studied dogs had CDV antibodies in their blood, meaning that they had been subjected to the virus before. - 13% of the studied dogs contained the P-gene, indicating circulation of the virus.
Odendaal *et al.* (2003)	Dog-owner interactions	Identify neurochemical changes during an interaction between people and dogs.	- Levels of b-endorphin, oxytocin, prolactin, b-phenylethylamine, and dopamine were higher in both people and dogs after a positive interaction between the person and dog. - For humans, cortisol levels decreased after a positive interaction, but not for dogs.
Rehn and Keeling (2016)	Dog-owner interactions	Examining strong and weak points of current methods to study dog-human bonds.	- Need for focusing future research on attachment styles in individual dogs, rather than taking averages of larger groups of dogs. - Need to study both the relation from the dog perspective and the human perspective – i.e. using a dyadic approach.
Rehn *et al.* (2014)	Dog-owner interactions	Analyze the affectional bond of dogs to their owner, to investigate the strength of the bond from the dog's perspective. Assess whether there is a relation between this and the owner's perspective of the bond.	- Dogs of dog owners who interact more with their dog, and regularly, looked for more contact with the owner when reunited, and showed less independent play i.e. more attachment.
Schell *et al.* (2021)	Human-wildlife conflict	Identify how interactions between humans and animals in cities form the adaptation of wildlife to urban areas.	- Management of wildlife plays a significant role in the genetic and behavioral adaptation of urban wildlife. - Wildlife individuals in urban environments seem to express bolder behavior than individuals in non-urban environments.
Toohey *et al.* (2013)	Dog-owner interactions	Study relations between dog ownership, features present in localities, neighborhood-based recreational walking, and experiencing community, for people older than 50.	- Dog-walking caused older adults to express more physical activity and more interactions with others. - Frequent dog walkers older than 50, stated more positive feelings toward their neighborhood, including a sense of community.
van Herwijnen (2021)	Dog-owner interactions	Study how human caregiving style influences dog-dog owner interactions and can benefit dog welfare.	- The parenting style of dog owners towards their dogs can benefit dog welfare, as well as improve benefit dog-dog owner interactions.
Vanak and Gompper (2009)	Dog-wildlife conflict	Review ways in which dogs and wild carnivores interact, and to what extent the presence of dogs in an area affects native carnivore communities.	- Dogs can impact wildlife prey populations on a local level but do not form competition with other carnivores as exploitative competitors. - In interference with wildlife, dogs can compete with carnivores.

			- In addition, dogs and other carnivores can spread diseases.
Wedl, Schöberl and Bauer (2010)	Dog-owner interactions	Study how owner gender, dog and dog owner personality, dog-dog owner interactions, and the attachment of the owner to their dog influence dog-dog owner contact.	- Personality, as well as the relationship between the dog and dog owner affect the degree to which dogs engage in social interactions with their owners.
Williams *et al.* (2009)	Dog-wildlife conflict	Study dog owners' feeling of responsibility to conform to leash use obligation on shores in Victoria, Australia.	- Dog owners who believed their dog would cause disturbance to other people or wildlife had a higher sense of obligation towards dog leashing. - Dog owners who found recreation of leash important, felt a lesser responsibility to conform to the leashing obligation.

Main findings per paper – UGS (n= 19)

Reference	**Topic Subgroup**	**Aim**	**Main findings**
Melo and Piratelli (2023)	UGS-wildlife	Study the relationship between functional diversity indices of bird species groups and community characteristics of urban green spaces (abiotic and biotic), in the megacity of São Paulo, Brazil.	- Bird diversity was high. - Small-sized urban green spaces showed restricted abilities to facilitate and preserve functional diversity of avian species, associated with smaller shrub layers or the absence of it; the presence of a high number of vehicles; the presence of glass panes; and the occurrence of dogs. - Management recommendations include large-sized urban green spaces, covered by shrubs.
Arnberger *et al.* (2022)	UGS-human welfare	Investigate how dog ownership influences the sense of place attachment.	- Dog walkers reported a higher place attachment than walkers who do not own a dog.
Beninde, Veith and Horchkirch (2015)	UGS-wildlife	Review biodiversity in urban areas for a diverse set of taxonomic groups, worldwide.	- Habitat patch areas and corridors were found to be the most important factors to benefit biodiversity, along with vegetation structure.
Beyer *et al.* (2014)	UGS-human welfare	Study the relationship between green space and mental well-being in city and rural environments.	- More green in the neighborhood was linked to significantly lower depression, anxiety, and stress levels in respondents.
Cai and Duan (2022)	UGS-pet welfare	Study the effect of the Covid-19 pandemic on public spaces for companion animals.	- As a result of Covid-19, a lower amount of public spaces where animals are allowed were available.
Cameron *et al.* (2020)	UGS-human welfare	Study people's emotions regarding bird species diversity in UGS.	- Participants showed a higher level of happiness when green spaces included a larger diversity of bird species. - When exposed to a larger variety of habitats, respondents reported being happier. - These correlations were enhanced with a higher perception of overall biodiversity.
Douglas, Lennon and Scott (2017)	UGS-human welfare	Literature review to assist in site-specific planning for green spaces that improve the health of citizens in all life stages.	- For planning: maximize green spaces, and engage all users in the UGS planning. - For design: a variety of walking paths with a variety of environments was recommended - For management: ensure sufficient maintenance, and accessibility and provide guardians after sunset.
Felappi *et al.* (2020)	UGS-human welfare	Review aspects of UGS that impact mental health and urban wildlife, investigate potential synergies and trade-offs, and propose a framework in the scope of "One Health".	- Following the One Health approach is effective in increasing knowledge of socio-ecological systems regarding UGS.
Ha, Jin and With (2022)	UGS-human welfare	Study the relations between the amount, design, and geographical distribution of UGS and the degree of psychological distress in inhabitants.	- Less psychological distress levels were found when there were small water areas in the landscape and when there were larger distances between forest areas. - The degree of psychological distress was lower in areas where the UGS were less concentrated together; having multiple smaller UGS than a few big UGS.
Jia *et al.* (2023)	UGS-human welfare	Propose a general framework with spatial parameters and criteria to evaluate the contribution of the importance of UGS on-site for	- Proposes two criteria of UGS: accessibility and usability, which are important for an effective contribution of the space to human health.

		human wellbeing, to aid multi-oriented UGS design.	
Lafrenz (2022)	UGS-human welfare	Uses a case study to show the use of a multidisciplinary, community-inclusive urban green space design framework, which integrates a public health approach.	- Mental and physical health was positively associated with the presence of UGS, where people could recreate and move their bodies.
Liu *et al.* (2019)	UGS-human welfare	Study biopsychological pathways between the exposure to green in the neighborhood and the mental well-being of the residents in the neighborhood.	- Results show that exposure to greenness in the outdoor living environment has a positive association with the mental health of the residents.
Pueffel, Haase and Priess (2018)	UGS-human welfare	Analyzing people's use of vegetated urban brownfields as a UGS, and analyzing how these brownfields contribute to ecosystem services (ES), especially cultural ES.	- Spatial use patterns depend on local features of the area and personal preferences. - Users state that they use the spaces predominantly for recreational services. - Dog-walking was the most frequently occurring ES. - Three main demands for ES were: dog-walkers prefer large, fenced spaces in which they can let their dog roam freely, without interrupting other users.
Ta and Levrel (2022)	UGS-human welfare	Investigate trade-offs between UGS features and the amount of time inhabitants are willing to spend traveling toward an urban green space, compared to staying at home.	- Strategies should be different, corresponding with the level of urbanization (density) of the city. - Citizens that live in the city centre prefer multiple small UGS, that are easy to reach. - Citizens in suburbs and less densely populated areas prefer larger UGS, also if they have to spend more time to reach these areas.
Ugolini *et al.* (2020)	UGS-human welfare	Investigate how people's behavior, perceptions, and attitudes on UGS changed due to COVID-19 restrictions. Analyze how content people are with UGS in their near surroundings, and give advice for improvement of these spaces.	- City inhabitants require access to UGS, to conduct physical exercise, to relax, and to watch and experience nature. - Dog walking was one of the secondary options to use UGS in a survey on UGS use in several European countries pre- and during the pandemic. - Respondents reported a need for having different types of greenery in the city, i.e. different sizes of UGS.
Ugolini *et al.* (2021)	UGS-human welfare	Explore citizens' use and the extent to which they reported they missed UGS during the lockdown restrictive measures for COVID-19.	- Citizens in areas with the strictest lockdown reported using UGS primarily to walk their dog (28%) and for relaxation (24%). - In areas where the lockdown was less strict, people would use the space most to do physical exercise (32%). - Going for a dog walk was the only parameter in this study that showed a strong increase during the lockdown.
Yang *et al.* (2020)	UGS-human welfare	Study barriers to soft mobility, regarding a) urban planning, and b) tourism in the north, comparing Nordic and non-nordic inhabitants.	- Nordic residents use soft mobility even in winter weather.
Zhao and Gong (2022)	UGS-human welfare	This pilot study explores how animals in urban green spaces affect mental restoration for people.	- Three out of four of the studied animal species affect people's mental restoration capacity positively, while dogs cause a decrease in mental restoration in UGS users.
Zhu *et al.* (2023)	UGS-human welfare	Provides framework which can be used to evaluate cultural ecosystem services (CES) of UGS related to the design of the area (Union Square Park, New York), based on social media data.	- Interactive activities are leading CES indicators in this case study in USP in NYC. Followed by aesthetic and health benefits. The educational function of CES is significantly absent.

Main findings per paper – Participatory governance (n= 4)

Reference	**Topic Subgroup**	**Aim**	**Main findings**
Arnstein (1969)	Participatory governance	Present a ladder of citizen participation, and explain them using examples from existing governmental social programs.	- The ladder of participation ranges from the lowest form of participation (manipulation - seen as non-participation) to the highest form of citizen participation in decision-making (citizen control - where citizens have the majority of control in decision-making).

Li *et al.* (2020)	Participatory governance	Create a community participation model and a workshop toolbox to work together for urban regeneration.	- Three pillars of the toolbox: mobilize participation, institutional establishment, and environment construction.
(Lockwood *et al.*, 2010)	Participatory governance	Introduce principles for good governance of natural resource management, to assist creation and assessment of natural resource management governance institutions.	- Eight principles for good governance are presented, including legitimacy, transparency, accountability, inclusiveness, fairness, integration, capability, and adaptability.
Santander, Lorenzini and Martinez-Cruz (2024)	Participatory governance	Bridge work from Lockwood et al. (2010) and Arnstein (1969), highlights complementory factors and potential trade-offs between the two approaches.	- Shows that synergies between Arnstein's ladder of participation (1969), and Lockwood et al.'s principles for good governance (2010) mainly start at middle levels of participation. - Trade-offs are mostly found in the highest levels of participation.

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