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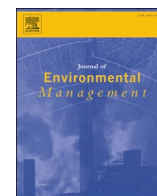
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Research article

Understanding public preferences for urban wildflower meadows

Peter King^{a,*}, Tristan J. Pett^b, Mark A. Goddard^c, Thomas H. Lundhede^d, Gail E. Austen^b,
Zoe G. Davies^b, Martin Dallimer^e

^a Institute for Transport Studies, University of Leeds, Leeds, LS2 9JT, UK

^b Durrell Institute of Conservation and Ecology (DICE), School of Natural Sciences, University of Kent, London and South East University Group, Canterbury, Kent, CT2 7NR, UK

^c School of Geography and Natural Sciences, Northumbria University, Newcastle upon Tyne, UK

^d Department of Food and Resource Economics, University of Copenhagen, Rolighedsvej 23, Frederiksberg, DK-1958, Denmark

^e Centre for Environmental Policy, Imperial College London, London, SW7 1NE, UK

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ABSTRACT

Accelerating urbanisation challenges biodiversity and human wellbeing, demanding effective urban nature-based solutions. Urban wildflower meadows are increasingly popular interventions that may offer biodiversity and wellbeing benefits. However, realising their potential depends on public support, which requires robust evidence on which meadow design attributes the public prefers and values most. We conducted a choice experiment with urban greenspace users across three UK cities to quantify willingness-to-pay (WTP) for some of the key characteristics of wildflower meadows in public parks, namely flower colour diversity, native species composition, plant species richness, and pollinator habitat quality. Respondents generally preferred wildflower meadow options over the status quo of mown amenity grass and were willing to pay for improvements to meadow attributes through increased local taxation. Respondents had positive WTP for more colourful, pollinator-friendly meadows with more native species, but not for additional plant species. Preferences were largely consistent across respondents interviewed at different meadow types (annual, perennial, or control sites), suggesting that enhanced attribute salience from direct exposure to existing meadows had minimal influence on stated preferences. Methodologically, this suggests that *in situ* surveys of preferences for urban greenspace are broadly robust to salience effects and can inform management beyond the surveyed sites. Attributes that offer positive outcomes for biodiversity, such as supporting pollinators and including native species, were aligned with, rather than conflicting with, public preferences. Urban greenspace managers can enhance public support while achieving ecological objectives by designing meadows with moderate colour diversity, high native species content, and demonstrable pollinator benefits.

1. Introduction

The proportion of the world's population living in cities is projected to rise to 68% by 2050 (UN Habitat, 2022). In developed regions, this percentage is much higher; over 80% of the UK population is urban (DEFRA, 2021). Urbanisation increases pressures on biodiversity (Hahs et al., 2023), ecosystem service provision (Karimi et al., 2021) and people-nature interactions (Soga and Gaston, 2022). Amidst these challenges, opportunities remain to enhance both biodiversity and human wellbeing through integrating natural features into new and regenerated urban landscapes (Artemann et al., 2017; Seto et al., 2012).

Stakeholders and policy makers interested in urban planning are increasingly using nature-based solutions that can deliver multiple benefits for both nature and people (Pineda-Pinto et al., 2021). Biodiversity in urban greenspaces can provide a plethora of benefits e.g., climate change resilience and pollution mitigation (Nilon et al., 2017); and supporting a greater diversity and abundance of insect pollinator species (Llodra-Llabrés and Cariñanos, 2022; Theodorou et al., 2020; Wenzel et al., 2020). Urban greenspaces also contribute to human health and wellbeing by reducing psychological stress (e.g., Cox et al., 2017), having restorative effects (Hoyle et al., 2017a), enabling positive interactions with biodiversity (e.g., Fisher et al., 2022, 2023) and creating

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* Corresponding author.

E-mail address: P.King1@leeds.ac.uk (P. King).

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opportunities for “green exercise” (“being physically active within a natural environment or greenspace” e.g., Rogerson et al., 2020). Lahart et al. (2019) found that the benefits of ‘green exercise’ were attributable to experiencing nature *in situ* over virtual experiences. Thus, urban greenspaces may enhance biodiversity while providing opportunities for beneficial interactions with nature.

The design and management of urban greenspaces can prove challenging when balancing stakeholder goals (Jia et al., 2023). For instance, rather than ecological function (Macháč et al., 2022), some users value the recreational benefits of an urban greenspace, (e.g., Kefale et al., 2023; Palliwoda and Priess, 2021), whereas other users may prefer spaces with vegetation that is colourful, florally and structurally diverse (e.g., Austen et al., 2021; Lindemann-Matthies and Bose, 2007; Southon et al., 2017). Practical management interventions in urban areas need to balance human needs and perceptions, alongside the goal of maintaining ecological processes (Aronson et al., 2017; Reyes-Riveros et al., 2021). However, urban greenspace managers often overlook the needs and preferences of users, particularly the role of nature in their wellbeing (Ugolini et al., 2022). Moreover, the concepts used by scientists to describe ecological quality may not correspond with the cultural concepts of aesthetic quality valued by the public (Austen et al., 2023; Pett et al., 2016). To create successful, effective, and long-lasting nature-based solutions, we must understand where these concepts align or diverge.

The introduction of urban wildflower meadows for insect pollinators is an increasingly popular form of ecological intervention in urban greenspaces (Roguz et al., 2023). Southon et al. (2017) found site users preferred urban wildflower meadows to herbaceous borders, bedding plants and mown amenity grass. Species-rich meadows can therefore potentially provide a win-win strategy for biodiversity and urban greenspace users (Aronson et al., 2017; Southon et al., 2017). Critically, urban greenspace management affects publicly owned, shared spaces serving many stakeholders, and are designed and implemented using public funds. It is, therefore, imperative for decision-makers to understand and represent public preferences and attitudes towards environmental interventions (Graves et al., 2017; King et al., 2025).

Management of urban greenspace requires a multi-faceted approach to balance social, environmental, and economic needs, particularly as budget constraints impose trade-offs in urban greenspace management (Rambhia et al., 2024). A key challenge for policy makers is to understand public preferences for trade-offs between different meadow attributes. Stated preference methods, such as Choice Experiments (CEs), can address this challenge by quantifying respondents' preferences for the different attributes of urban meadows in willingness-to-pay (WTP) terms (Christie et al., 2006; Hanley and Barbier, 2009). In contrast, most prior work on individuals' preferences has used qualitative measures (Fischer et al., 2020; Hoyle et al., 2017a) with less evidence quantifying preferences for urban meadows in WTP terms (Tomitaka et al., 2022). This points to a need to understand respondents' preferences for changes in the attributes of urban meadows.

An important methodological consideration is whether preferences elicited *in situ*, i.e., adjacent to existing meadows, differ from those elicited in hypothetical contexts because of enhanced attribute salience (Haghani et al., 2021a, 2021b). Salience describes how noticeable or apparent an attribute is to an observer. For example, the range of flower colours in a meadow is likely to be more salient to a respondent by a flowering meadow than to a respondent by mown amenity grass. The management of urban wildflower meadows may, therefore, create a natural contrast in salience. At annual or perennial meadows, aesthetic attributes such as flower colours are directly observable (Hoyle et al., 2018; Junge et al., 2009; King et al., 2025; Lindemann-Matthies and Bose, 2007), whereas at sites of mown amenity grass the same attributes are hypothetical to respondents. Prior work has shown that stated preferences are often sensitive to the information provided about the policy context or attributes (Needham et al., 2018; Welling et al., 2022). Here, we examine whether preferences also differ with the physical

environment in which the survey is conducted, by comparing respondents interviewed at annual meadows, perennial meadows, and control sites of mown amenity grass. Understanding such salience effects is important for judging whether *in situ* surveys at existing meadows can inform planning at other sites.

Therefore, we posed two interlinked research questions. Firstly, we investigated which attributes of urban meadows people relatively preferred as understanding relative preferences is important for managers balancing multiple objectives within budget constraints. Secondly, we assessed whether preferences varied by the meadow type adjacent to the interview location, testing for potential salience effects in *in situ* stated preference surveys. As urban meadow management practices can vary both within and between urban areas, we tested the differences in preferences across different parks in different cities. Our contributions are both methodological, relating to the assessment of context effects during *in situ* stated preference fieldwork, and practical, informing the management of urban nature-based solutions.

2. Methods

2.1. Study system

Although short, mown grassland, managed primarily for recreation, is the dominant form of urban greenspace in many temperate regions, it results in low plant diversity that does not support a diverse invertebrate community (Norton et al., 2019). Urban wildflower meadows (hereafter urban meadows) may deliver biodiversity, provisioning, and cultural ecosystem service provision benefits (Klaus, 2013). Urban meadows with diverse flowering and non-flowering plant species can increase the quality of urban habitats for invertebrates and pollinating species conservation (Hall et al., 2017). Replacing short-mown amenity grassland with sown urban meadows has thus become increasingly popular, both in the UK (e.g., Buglife, 2017; Hoyle et al., 2018; Southon et al., 2017) and internationally, including across continental Europe (Süle et al.; Zajdel et al., 2025), North America (Pham et al., 2025), and Australia (Horsfall et al., 2024). However, the biodiversity and amenity benefits of urban meadows depend in part on whether greenspace users accept or oppose new meadows (Nassauer et al., 2009). Evidence on which meadow attributes the public values most is, therefore, informative for meadow design and management, and may support the wider adoption of urban meadows.

2.2. Experimental design

To understand respondents' relative preferences for attributes of urban meadows, we conducted *in situ* interviews at three meadow types: urban meadows (annual or perennial) and control sites of equally sized amenity grass areas. *In situ* surveys ensured that respondents had direct experience of these greenspaces. In-person face-to-face interviews may be an appropriate survey modality for eliciting values for environmental goods, given their advantages in motivating respondents and ability to use visual aids (Arrow et al., 1993). Although contemporary guidance suggests that *ex situ* approaches, such as online surveys, are also able to visually describe the survey context (Dillman et al., 2014; Johnston et al., 2017; Mariel et al., 2021), we chose an *in situ* approach to ensure that respondents were aware of the meadow types under study. Although preferences recovered through *in situ* surveys may be susceptible to interviewer effects through social desirability bias (e.g., Leggett et al., 2003), this risk is mitigated when multiple well-trained interviewers are used (Lindhjem and Navrud, 2011; Loosveldt, 2012). As such, our surveys were conducted by six trained interviewers using a consistent method of guiding respondents through the survey. Interviews were conducted during the peak flowering season (July–August 2014), with site visits scheduled across four timeslots, weekdays, and weekends, as well as daytime and early evenings, to capture a broad range of greenspace users. Although the COVID-19 pandemic likely

affected greenspace use (e.g., [Armstrong et al., 2021](#)), the effect on preferences may be limited (c.f., [Hynes et al., 2021b](#)), and thus our 2014 dataset remains valuable for assessing whether *in situ* methods can reliably recover policy-relevant preferences or whether attribute salience influences preferences.

By conducting interviews at three meadow types, we created variation in how directly respondents could observe the attributes being valued. At control sites of amenity mown grass, managed through intensive mowing to maintain short, uniform vegetation, respondents experienced only the baseline management condition: no flower colours beyond green grass, minimal pollinator activity, and low structural complexity. When presented with choice scenarios describing alternative management that would enhance flower diversity, native species content, or pollinator habitat, the effects of these management changes were hypothetical. Instead, respondents relied on our visual aids and written descriptions rather than direct observation of these enhanced attributes. Conversely, at annual and perennial meadows, the outcomes of alternative management were directly observable and potentially more salient. Prior research on hypothetical bias suggests that such direct exposure can enhance attribute salience, which can ultimately influence stated preferences ([Aoki et al., 2010](#); [Haghani et al., 2021b](#)). This point is relevant to the management of urban wildflower meadows, because if preferences are sensitive to attribute salience, then evidence from *in situ* surveys at existing meadows may have limited generalisability to planning decisions about other sites. We explored this by comparing preferences across meadow types while controlling for respondent characteristics.

As alterations in management practices can occur both within and between urban areas, we sampled respondents across 17 sites within 11 public parks across three cities, based on sites being publicly accessible and, therefore, likely to receive sufficient visitors. Sampling across multiple parks allowed us to fully represent the diversity of preferences for urban meadows. Sampling across multiple cities allowed us to understand whether the effect of meadow type on preferences was robust to spatial variation across parks and cities ([Glenk et al., 2020](#)).

Our sampling covered three of the UK's largest cities ([ONS, 2016](#)); Leeds, Bristol, and Edinburgh ([Fig. 1](#)), each with parks in parts of the city with different levels of affluence (supplementary material: [Table B.1](#)). All selected sites within parks were surrounded by residential areas and were visited by local people. The annual meadows contained a mix of native and non-native wildflowers, perennial meadows contained predominantly native wildflowers, while the control areas had not been turned into meadows and were managed as frequently cut amenity grassland. We provide example pictures of all three meadow types (supplementary material, [Figure B.1](#)) with further details of the meadows described in [Hicks et al. \(2016\)](#). Meadows were 300 m² in size and rectangular in shape. Respondents were asked to provide verbal informed consent and made aware that their participation was voluntary, and that no compensation would be provided. All respondents were over 18 and we received ethical approval from the University of Kent before proceeding with the study.

2.3. Survey design

Stemming from [Lancaster's \(1966\)](#) characteristic theory of value, CEs assume that individuals derive utility from the attributes of a good. Under Random Utility Theory ([McFadden, 1974](#)), respondents are assumed to choose the alternative that maximizes their utility. By observing trade-offs between attributes, CEs can recover the marginal utility for changes in attributes and can express these in WTP terms when a monetary attribute is included ([Adamowicz et al., 1998](#)). We aimed to elicit WTP for attributes of urban meadows known to be relevant to the public, including aesthetic quality ([Junge et al., 2009](#)), biodiversity ([Fischer et al., 2011](#)), and pollination resources ([Breeze et al., 2015](#)).

Our CE ([Fig. 2](#)) presented respondents with a hypothetical scenario

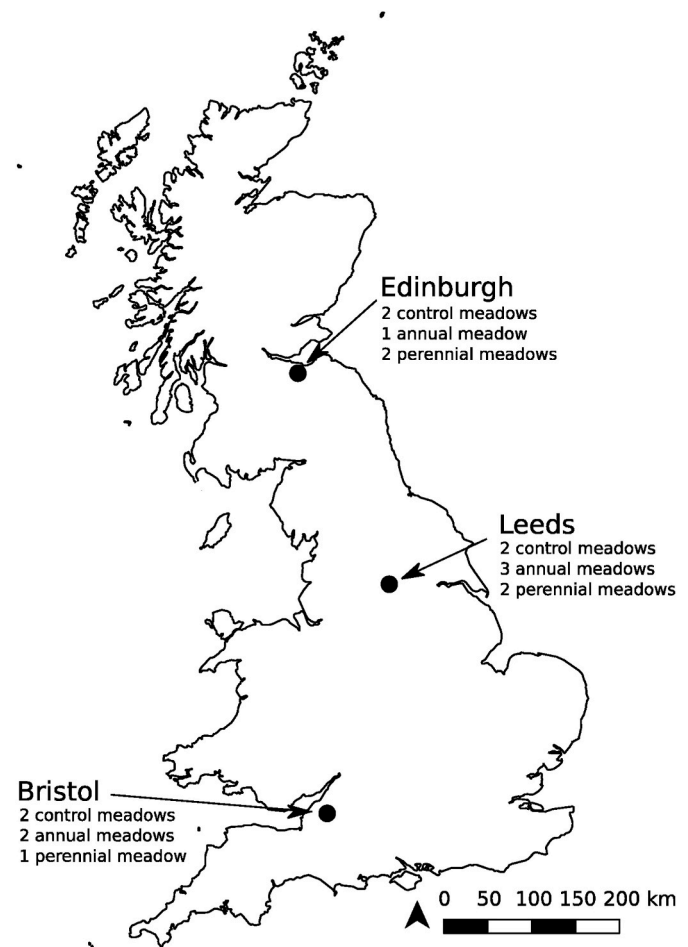


Fig. 1. The location of the number and type of meadows in each city sampled. Further details of each park are provided ([Supplementary Table B.1](#)).

in which the city council (i.e., a local level of government) proposed changes to the management of grassy areas to enhance aesthetic appeal, safeguard native plant species, and support pollinating insects. Each choice task had four options (A, B, C, and D), with D representing the status quo option through an image of amenity grass with low levels of all attributes. Each option was described by five attributes: one monetary attribute (a form of local tax) and four non-monetary attributes.

Given the importance of visual stimuli in the experience of green-spaces, we expected that the aesthetics of urban meadows were an important attribute to respondents ([Akers et al., 2012](#); [Austen et al., 2021](#); [Hoyle et al., 2018](#)). While visual appearance varies with flower shape, size, planting structure, coverage, and seasonality ([Austen et al., 2023](#); [Southon et al., 2017](#)), we focused specifically on colour diversity ([King et al., 2025](#)), as visitors often prefer brightly coloured flowers ([Junge et al., 2009](#); [Lindemann-Matthies and Bose, 2007](#)).

Our CE attribute called 'appearance' allowed us to investigate preferences for the range of flower colours. This attribute was depicted pictorially by digitally manipulating an image of a perennial meadow containing white flowers (*Leucanthemum vulgare*). The status quo level was amenity grass, representing low visual variety with no white flowers. Three additional levels were included: a meadow with only white flowers, a meadow with three colours (white, yellow, blue), and a meadow with five colours (white, yellow, blue, pink, red). These categories broadly reflected the colour diversity of established meadows, such as *Malva moschata* (pink) and *Centaurea cyanus* (blue). Using four levels facilitates an investigation into how sensitive preferences were to the scope of changes in the diversity and variety of flower colours ([King et al., 2025](#); [Veisten et al., 2004](#)). As control sites had no additional

	A	B	C	D
Number of plant species	An additional 10 plant species 	No change in number of plant species 	An additional 5 plant species 	No change in number of plant species 
Native species	A decrease to a quarter native plant species 	An increase to three-quarters native plant species 	A decrease to a quarter native plant species 	No change: half of plant species are native 
Pollinators	High quality for pollinating insects 	Medium quality for pollinating insects 	No change: low quality for pollinating insects 	No change: low quality for pollinating insects 
Appearance				
Additional council tax cost per year to your household	£20	£10	£20	£0
Tick one box	☐	☐	☐	☐

Fig. 2. An example choice task respondents were asked to complete. Each card described four attributes of the meadow (appearance in terms of the range of flower colours, proportion of native species, number of plant species, quality for pollinating insects) and a monetary attribute (annual council tax) to fund proposed changes in the levels. Participants chose one of four options; a status quo listed as “D” and three where the levels of the attributes varied; “A,” “B,” “C.” We asked participants to complete six of these choice tasks. Visual aids were provided with textual descriptions of the attributes to improve survey understanding (supplementary material, Table B.2).

flower colours whereas sown meadows may have had a greater diversity of colours; preferences for this attribute are likely to be sensitive to meadow type.

We included a “*number of plant species*” attribute to represent changes in plant species richness. Previous work found that preferences for meadows were higher with greater plant species richness (Southon et al., 2017), possibly through the influence of richness on the perceived restorative effect of urban meadows (Hoyle et al., 2017a, 2017b). The baseline level here proposed no change, while the two nonzero levels proposed an additional five or ten plant species, levels based upon the increase in the number of plant species observed in the study cities. Respondents were told that these changes could be achieved through “additional management”, without the method being specified, although plant species richness can also increase through reduced mowing alone (Sehrt et al., 2020). The attribute was presented both textually (“An additional 10 plant species”) and pictorially to illustrate

how an additional number of plant species would appear.

Alongside plant species richness we included a “*native species*” attribute to measure public preferences towards native or non-native planting. Prior studies have found that preferences towards species based on their nativeness were heterogeneous and contextual (e.g., Fischer et al., 2020; Hoyle et al., 2017b; Lewis et al., 2018)). Although there is a prevailing opinion among conservationists that meadows should consist of native species, non-native planting schemes can benefit native fauna (Garland and Wells, 2020). For instance, there is growing evidence that non-native plants may provide valuable resources for pollinating insects (Seitz et al., 2020; Tew et al., 2021), sometimes extending beyond the flowering season of native plants (Zettlemoyer et al., 2019). Further, some species may be better suited to future climates than native alternatives (Pötzelsberger et al., 2020). Despite these potential benefits of non-native planting schemes, there are ingrained negative attitudes towards such species that may limit their acceptance

and appreciation by members of the public (Lewis et al., 2018). To evaluate public preferences, we defined this attribute as the change in the proportion of native species, visually represented with a bar chart and text. The status quo level ('no change in % native plant species') contrasted our two other levels: 'a decrease to a quarter' and 'an increase to three quarters,' allowing us to assess preferences for both positive and negative shifts.

Our final non-monetary attribute "pollinators" was important given recent public concerns about insect pollinator declines (Breeze et al., 2015; Powney et al., 2019). Although urban areas may be able to support native insect pollinators (Baldock et al., 2019; Wenzel et al., 2020), the extent to which people value and are aware of insect pollinators and services has been identified as a knowledge gap (Hanley et al., 2015). Given the challenge of accurately predicting the abundance or diversity of pollinators in any given meadow, even with ecological training and expertise (Bartkowski et al., 2015; Christie et al., 2006), our attribute description used an ordinal scale of 'quality for pollinating insects' described with both text and illustrations of different varieties of pollinating insects. The attribute levels started from a status quo "No change" ("low quality for pollinating insects" and had two nonzero levels: "medium quality for pollinating insects" and "high quality for pollinating insects."

To achieve any changes to the attributes of urban meadows, respondents were informed that 'choices may be paid for through an increase in council tax.' Therefore, our monetary payment vehicle was specified as increases to the household annual council taxation bill for the next ten years, a local taxation system used in England and Scotland for council services. As urban parks in the UK seldom charge entrance costs, instead supporting management through council funds, this was an appropriate and credible payment vehicle. The levels used, £0 (only for Option D), £5, £10, £20, £40, and £60 per household per year for ten years, were adapted from a previously tested scenario involving changes in the number of species in public greenspaces in a UK city (Dallimer et al., 2014). Including this monetary attribute allowed us to describe preferences for trade-offs in WTP-terms (Mariel et al., 2021). We included a section prior to the choice tasks, which prompted respondents to think carefully about their choices: *'Results from similar studies have shown that respondents tend to overestimate how much they are willing to pay. We ask you to think carefully about the different alternatives in relation to your household's income. Please note that the additional council tax payment will reduce your spending on other things in your everyday life. There are no right or wrong answers so please provide your personal answers and choices. In some cases there may not be an option that you like - if so, choose the least-worst of the combinations available'*. Such "cheap talk" scripts are intended to reduce hypothetical bias (Cummings and Taylor, 1999), remind respondents of their budget constraint (Carlsson et al., 2005), and may reduce the sensitivity of willingness-to-pay estimates to the cost levels presented (Börger et al., 2025).

The survey was piloted (N = 16) to validate that the payment vehicle, bid vector, and attribute presentation and description and choices were acceptable to members of the public. Priors from the pilot sample informed the statistical design with the ex-ante D-error for the final multinomial model being an acceptable 0.1076 (Scarpa and Rose, 2008). A D-efficient design was created using software Ngene, 2014 (version 1.1.2; 2014) consisting of twelve choice tasks. To reduce the cognitive and time burden of completing multiple tasks, we created two blocks that were randomly and equally allocated to respondents (Mariel et al., 2021). Consequently, each respondent completed six choice tasks, with an example set in Fig. 2.

The scenario emphasized incentive compatibility by stating, *'the City Council will only implement the scheme if enough people support it'*, ensuring respondents understood their choices were policy consequential. After completing six choice tasks, respondents who serially chose option D were asked about their motivations for protest votes (von Haefen et al., 2005). The full survey with replication code and data is publicly available at <https://anonymous.4open.science/r/mchg-Me>

adows/. All the CE attributes and levels are available (supplementary material, Table B.2).

After selecting relevant attributes, the survey recovered explanatory variables. Prior to the CE we asked respondents about (a) their visits to urban meadows, and (b) their perceptions of the meadow site that they were interviewed by. Several prior studies have found that respondents' visit frequency, duration, travel method and motivations to greenspaces, here meadows, influence preferences as frequent visitors tend to live closer to sites (e.g., Dallimer et al., 2014; Lindemann-Matthies and Bose, 2007; Koppen et al., 2014; Taye et al., 2019). Post-CE, all respondents were asked about membership of relevant wildlife conservation or natural heritage organisations, gender, ethnicity, education, income, and age, all commonly recovered variables that may further explain variation in preferences (e.g., Johnston et al., 2017; King et al., 2025). We also used the connectedness to nature (CNS) seven-point scale to better understand respondents' emotional connection to nature and how that may influence their preferences for urban meadows (Mayer and Frantz, 2004; Perrin and Benassi, 2009).

2.4. Entropy balancing

Our econometric approach proceeds in three stages. Firstly, as selection into meadow types may be confounded with preferences, we used continuous entropy balancing (Hainmueller, 2012), a preprocessing covariate balancing method, to identify the treatment effects of meadow type on preferences (Hynes et al., 2021b). The estimation of treatment effects using observational data is an area of emerging interest to the CE literature (Vass et al., 2022). Secondly, we estimated a mixed logit model weighted using entropy balancing to recover attribute WTP. Moreover, our choice model recovered the interaction effects of meadow type on preferences after controlling for socioeconomic and park-specific effects. Post-estimation we simulated 10,000 draws from the variance-covariance matrix of the weighted mixed logit to bootstrap the distributions of mean WTP and thus test the effect of meadow type on preferences (Hynes et al., 2021a; Matthews et al., 2017).

Our understanding of the variation in preferences between meadow types may be confounded by the potential for selection bias, whereby pre-existing differences between respondents' socioeconomic factors influenced their presence at a particular meadow type. A popular solution is to weight observations prior to estimation to ensure that subgroups of interest are balanced on observables. However, traditional matching and weighting methods involve a trade-off between maintaining sample size while ensuring that subgroups are highly balanced (Vass et al., 2022). Hainmueller (2012) proposed entropy balancing, a non-parametric weighting technique, which offers an algorithmic solution that consistently achieves high levels of balance across treatment groups. We preferred entropy balancing over alternative methods due to its ability to achieve balance on the first two covariate moments without extreme weights or reduced statistical power (Hainmueller, 2012; Zhao and Percival, 2016). Robust in a range of contexts (Zhao and Percival, 2016), entropy balancing can be used for both discrete and continuous treatments (Tübbicke, 2021). Hynes et al. (2021a, 2021b) introduced this method to the CE literature and demonstrated that it can be used to investigate binary treatment effects, such as whether respondents watched nature documentaries (Hynes et al., 2021a). For discrete treatments, such as the binary pre/post-pandemic variable in Hynes et al. (2021a), entropy balancing eliminated correlations between covariates and treatment assignment, enabling identification of causal effects. We, therefore, used entropy balancing to generate weights that mitigate the effect of potential observed confounders across the three meadow types.

Our study examined the treatment effect of direct exposure to sown meadows on WTP for attributes of urban meadows. While previous studies have focused on binomial treatments (e.g., pre-vs. post-intervention; Hynes et al., 2021a, b), we investigated a multinomial treatment variable (annual, perennial, control sites), as evaluated by Feyman

et al. (2025). We demonstrate that pooling sown meadows (i.e. annual and perennial) did not fundamentally alter our conclusions about attribute and meadow type interactions (supplementary material, Tables C.4, C.5). As our primary question was to investigate the effect of meadow type, we balanced samples between meadow types, rather than the park or city of sampling given that there were multiple meadow types in each park and city.

Identification of the effect of meadow type could be biased if selection into being sampled at any meadow type was influenced by observable covariates. We, therefore, balanced our samples on the first and second moments of selected socioeconomic covariates. Covariates were selected based on their known influence on preferences (e.g., Breeze et al., 2015; King et al., 2025; Tomitaka et al., 2022) and included a gender dummy (male/female), a binary age dummy (older/younger than the sample median), self-reported income bands (ordinal), and categorical variables for education and employment type. The use of binary and categorical covariates remains a valid strategy for achieving covariate balance, particularly as dummy variables that are balanced on the mean are also balanced on higher moments (Ladd and Lenz, 2009; Vass et al., 2022). We can plausibly assume that selected covariates were exogenous; the meadow type where a respondent was interviewed did not directly influence their age, gender, income, education, or employment status. We relaxed this assumption in an unweighted model for robustness. Although our opportunistic sampling method introduced the potential for selection bias arising from unobserved factors, such as underlying preferences for nature or socioeconomic attributes not captured in our survey design, respondents were intercepted at parks rather than at specific meadow sites, and several parks contained multiple meadow types, suggesting limited systematic bias. Balancing on observed characteristics further mitigates this risk (Hainmueller, 2012). We report the details of selected covariates pre- and post-balancing with the pre-balancing distribution of the sample across these variables (supplementary material, Table B.5; Figure B.2). Weights for the population average treatment effect were calculated using the WeightIt R package (Greifer, 2023) and incorporated into the log-likelihood function in Apollo (Hess and Palma, 2019) to ensure that the effect of meadow type was not confounded with socioeconomic variables.

2.5. Econometric approach

Following the random utility model, we assumed that respondents chose the CE option that provided the highest utility (Train, 2009). The utility (U_{ij}) that respondent i derives from choosing option j in a choice task is given by Equation (1), which is composed of the deterministic component of utility (V_{ij}), and a stochastic term (ε_{ij}), typically assumed to follow an extreme value distribution (Train, 2009). The deterministic component is a function of individual i 's income y subtracted by a tax payment t for option j , the option's attributes x_j , and the respondents' characteristics z_i . The vector of attribute-specific parameters β_k captures the effect of each attribute level on the probability of selecting an option, while β_{Cost} represents the marginal utility of money.

$$U_{ij} = V_{ij} + \varepsilon_{ij} = \beta_0 + \sum_k \beta_k x_{ijk} + \gamma z_i + \beta_{Cost} (y_i - t_j) + \varepsilon_{ij} \quad (1)$$

To recover attribute, level, and meadow-specific WTP we estimated a random parameters mixed logit model (MXL), which is a common and highly flexible method (Mariel et al., 2021). This model relaxes the assumptions needed for other choice models and assumes a probability distribution around the estimated preference parameters (β_k) (McFadden and Train, 2000). We allowed preferences for each non-monetary attribute to be random normally distributed. We estimated the model in WTP-space with a fixed cost parameter to improve ease of interpretation (Hoyos, 2010; Mariel et al., 2021; Sagebiel et al., 2017). Although fixing the cost coefficient assumes homogeneous cost sensitivity (Train, 2009), it ensured a WTP distribution with finite

moments (Daly et al., 2012) and stabilised the estimation. All utility functions included an alternative-specific coefficient (ASC) with a fixed value of zero for all options except the status quo Option D. Our model was specified thusly:

$$\begin{aligned} V_A = & ASC_A - \beta_{Cost} * ((\beta_{Appearance:white} * Appearance_{white,A}) \\ & + (\beta_{Appearance:white,yellow,blue} * Appearance_{white,yellow,blue,A}) \\ & + (\beta_{Appearance:white,yellow,blue,pink,red} * Appearance_{white,yellow,blue,pink,red,A}) \\ & + (\beta_{Native:decrease} * Native_{decrease,A}) + (\beta_{Native:increase} * Native_{increase,A}) \\ & + [(\beta)]_{Plants:five\ species} * Plants_{five\ species,A} + [(\beta)]_{Plants:ten\ species} \\ & * Plants_{ten\ species,A} + (\beta_{Pollinator\ quality:medium} * Pollinator_{Quality:medium,A}) \\ & + (\beta_{Pollinator\ quality:high} * Pollinator_{Quality:high,A}) + (Type_{Annual} * Annual) \\ & + (Type_{Perennial} * Perennial) + Interactions_{Annual} + Interactions_{Perennial} \\ & - Cost_A \end{aligned} \quad (2)$$

The (β) parameters in Equation (2) represent the mean preferences for each non-monetary attribute, while the associated standard deviations capture preference heterogeneity across respondents. The sign, significance, and magnitude of these parameters thus provide insight into respondents' preferences for attributes of urban meadows. Our choice model was estimated with 2000 quasi-random Sobol draws and correlations between random parameters (Mariel et al., 2021). The use of correlations between attributes may both improve model performance and precision (Mariel and Artabe, 2020; Mariel and Meyerhoff, 2018), and better represent correlations between our specific attributes e.g., plant species richness can be correlated with colour diversity (Graves et al., 2017). We also estimated main effects for being interviewed at annual meadows ($Type_{Annual}$) and perennial meadows ($Type_{Perennial}$), with control sites as the reference category. These parameters capture systematic differences in baseline utility for choosing an option when interviewed at sown meadows versus control sites, after accounting for attribute preferences.

We then used interaction terms, as in Hynes et al. (2021b), between each non-monetary attribute and the meadow type to investigate how the location of the *in situ* meadow type uniquely affected preferences for each attribute level (Equation (3)). The interaction terms were evaluated with the control meadows as a reference level.

$$\begin{aligned} Interactions_{Type} = & Interaction_{Type * Appearance:white} * (Type \\ & * Appearance_{white,A}) + Interaction_{Type * Appearance:white,yellow,blue} * (Type \\ & * Appearance_{white,yellow,blue,A}) + Interaction_{Type * Appearance:white,yellow,blue,pink,red} \\ & * (Type * Appearance_{white,yellow,blue,pink,red,A}) + Interaction_{Type * Native:decrease} \\ & * (Type * Native_{decrease,A}) + Interaction_{Type * Native:increase} * (Type \\ & * Native_{increase,A}) + Interaction_{Type * Plants:five} * (Type \\ & * Plants_{five\ species,A}) + Interaction_{Type * Plants:ten} * (Type \\ & * Plants_{ten\ species,A}) + Interaction_{Type * Pollinator\ quality:medium} * (Type \\ & * Pollinator_{quality:medium,A}) + Interaction_{Type * Pollinator\ quality:high} * (Type \\ & * Pollinator_{quality:high,A}) \end{aligned} \quad (3)$$

We then formally tested whether preferences varied by meadow type by repeating Poe et al. (2005) tests of whether the distributions of mean attribute WTP were significantly different between meadow types. This non-parametric approach was chosen for consistency with prior work testing simulated WTP (Hynes et al., 2021a). For each attribute level, we report the p-value against the null hypothesis that mean WTP was not statistically different between meadow types. The Poe et al. (2005) combinatorial test does not report a test statistic.

We accounted for potential confounding effects of socioeconomic factors on choice in our analysis of meadow type effects in two ways. Firstly, to address potential selection bias arising from pre-existing

differences in observable respondent characteristics across the three meadow types, we included entropy balancing weights into the log-likelihood function of the model (Hynes et al., 2021a). Weights were generated to recover the average treatment effect and balance the distributions of respondent income, age, education, employment status, and gender across the samples at each meadow type. These weights were incorporated into the log-likelihood function of the mixed logit model. We present both weighted and unweighted models for comparison.

Secondly, we included park-specific effects in the model to control for unobserved heterogeneity across the different parks arising from, for example, visitor profiles, management actions, or existing levels of biodiversity beyond the immediate survey site, that could plausibly influence preferences. We, therefore, included effects-coded dummy variables representing each park as interactions with the ASC for the status quo option (Equation (4)). As parks could contain multiple meadow types this approach was an important step to controlling for average differences in the baseline utility of the status quo across parks. Our approach estimated the average effect of being interviewed *in situ* at each meadow type after controlling for observable respondent differences and average park-level characteristics. While our sample was not powered for the resulting number of parameters, future work with (a) more respondents or (b) fewer parks, may be able to implement triple interaction terms with the city of sampling to yield further insight into park and/or city-specific meadow effects.

$$\begin{aligned}
 ASC_D = & ASC + (\beta_{Income} * IncomeDummy) + (\beta_{Age} * AgeDummy) + (\beta_{Gender} * Gender) + (\beta_{CNS} * CNSScaleMean) + (\beta_{visitfrequency} * visitfrequency) + (\beta_{visittime} * visittime) + (\beta_{ParkBurley} * ParkBurley) + (\beta_{ParkGoresMarsh} * GoresMarsh) + (\beta_{ParkHorfieldCommon} * HorfieldCommon) + (\beta_{ParkInchPark} * InchPark) + (\beta_{ParkKingLane} * KingLane) + (\beta_{ParkMiddleton} * Middleton) + (\beta_{ParkPilrig} * Pilrig) + (\beta_{ParkRodley} * Rodley) + (\beta_{ParkStAndrews} * StAndrews) + (\beta_{ParkStMarks} * StMarks)
 \end{aligned}
 \quad (4)$$

3. Results

We gathered 589 responses from 1489 people approached: a response rate of 40%. We then truncated the sample for incomplete responses ($N = 96$) and serial non-participation ($N = 19$) (von Haefen et al., 2005) evidenced by answers to a post-CE follow-up question (supplementary material). Therefore, our final sample was 474 respondents, providing responses to 2844 completed choice tasks. The number of respondents per meadow type per park per city demonstrated that the samples were not balanced across the three meadow types according to the city, age, and income of respondents (supplementary material, Table B.4). Differences in the pre-balancing mean and variance of the distributions of these variables across meadow types supported our use of balancing weights (supplementary material, Figure B.2). The pre- and post-balancing differences versus the control meadows show that entropy balancing was able to achieve a high level of covariate balance between all sites according to our five covariate controls (supplementary material, Table B.5) for further detail. Coding and summary statistics for all variables used are available (supplementary material, Table B.3).

3.1. Preferences for urban meadows

The statistically insignificant ASC suggests that respondents did not generally have lower utility for the levels of attributes found in the control amenity grass site proposed in Option D (Table 1; Supplementary Table C.1; Figure C.1). Respondents were also cost sensitive, an important check of theoretical validity. We found that a majority of the

Table 1

Estimated coefficients for selected parameters from the weighted and unweighted pooled mixed logit models. Models estimated in WTP-space with correlations between random attributes. Robust standard errors (SE) are reported in parentheses with stars for p values against the null hypothesis that the coefficient is not statistically different from zero. Full model output (supplementary material, Table C3). Estimates for the cost coefficient were different at four decimal places.

Variables	Weighted		Unweighted	
	Mean	Std. Dev.	Mean	Std. Dev.
Non-random parameters				
Alternative Specific Constant (ASC)	1.937 (1.257)		1.844 (1.265)	
Cost	−0.043*** (0.004)		−0.043*** (0.004)	
Annual	37.737** (18.509)		39.199** (18.429)	
Perennial	−23.351 (14.462)		−22.195 (14.220)	
Random attributes				
Flower colours: white	35.523*** (7.802)	7.430* (3.835)	35.896*** (7.275)	14.040*** (3.913)
Flower colours: white, yellow, blue	53.123*** (10.109)	11.406** (5.817)	50.842*** (8.958)	0.240 (8.062)
Flower colours: white, yellow, blue, pink, red	41.464*** (7.093)	9.594*** (3.170)	40.979*** (6.777)	16.040** (7.014)
Native: decrease	−24.628*** (6.701)	6.164 (4.686)	−26.359*** (6.662)	5.399 (6.531)
Native: increase	19.703*** (4.672)	3.261 (4.317)	17.519*** (4.490)	1.995 (5.441)
Plants: five additional species	4.889 (5.056)	0.531 (4.597)	6.267 (5.054)	4.960 (3.130)
Plants: ten additional species	2.201 (4.770)	1.280 (5.366)	4.694 (4.657)	1.012 (3.128)
Quality for pollinating insects: medium	14.620** (6.540)	19.924*** (6.719)	16.187*** (6.195)	25.312*** (5.144)
Quality for pollinating insects: high	29.222*** (6.318)	39.493*** (6.050)	32.078*** (6.286)	28.361*** (4.989)
Covariates interacted with ASC				
Age dummy (0/1)	−0.143 (0.410)		−0.104 (0.409)	
Connectedness to nature scale	−0.474** (0.203)		−0.482** (0.208)	
Gender	0.524 (0.398)		0.494 (0.399)	
High income dummy (0/1)	−0.385 (0.405)		−0.250 (0.401)	
Park visit duration	−0.003 (0.008)		−0.003 (0.008)	
Park visit frequency	−0.128 (0.125)		−0.090 (0.124)	
Park: Burley (Leeds)	−1.059 (0.670)		−0.950 (0.666)	
Park: Gores Marsh (Bristol)	2.167** (0.865)		2.082** (0.858)	
Park: Horfield Common (Bristol)	−0.216 (0.672)		−0.253 (0.650)	
Park: Inch Park (Edinburgh)	−0.718 (0.679)		−0.678 (0.655)	
Park: King Lane (Leeds)	0.066 (1.074)		−0.248 (1.070)	
Park: Middleton (Leeds)	1.393** (0.684)		1.350* (0.701)	
Park: Pilrig (Edinburgh)	−0.832 (0.560)		−0.731 (0.552)	
Park: Rodley (Leeds)	2.184*** (0.810)		2.263*** (0.878)	

(continued on next page)

Table 1 (continued)

Variables	Weighted		Unweighted	
	Mean	Std. Dev.	Mean	Std. Dev.
Park: St Andrews (Bristol)	−0.327 (0.579)		−0.546 (0.583)	
Park: St Marks (Edinburgh)	−1.223 (0.811)		−1.102 (0.830)	
Diagnostics				
N	474		474	
AIC	5741.735		5736.579	
BIC	6432.279		6427.123	
Adj.R ²	0.224		0.225	
Log-Likelihood	−2754.868		−2752.289	

***p < 0.01, **p < 0.05, *p < 0.1.

mean and standard deviations parameters were statistically significant at the 1% level. The standard deviations were often, but not always, smaller than the means, indicating some heterogeneity across our sample. The significance of these parameters indicated that respondents were sensitive to the levels of all our non-monetary attributes, except for the additional plant species. The effectively zero WTP for additional plant species indicated that respondents may have considered the increase in plant species to be a less important attribute. As our model was estimated in WTP-space we can also comment on respondents' scope-sensitivity; WTP for the proportion of native species and the quality for pollinating insects were both increasing with higher levels. However, preferences for range of flower colours were mixed, three colours were preferred to both one colour and five colours, suggesting that there was a penalty to increased visual complexity. There were larger standard deviations for the five colours, however, suggesting that greater changes to the status quo are not uniformly preferred. The positive WTP for one colour suggests that respondents preferred increased visual diversity over a single flower colour but had sharply diminishing marginal utility from further increases to colour diversity. Alternatively, respondents may have had negative preferences towards additional pink and red flowers.

The interaction of our control variables with the ASC resulted in several findings. Firstly, the statistically significant $\beta_{\text{TypeAnnual}}$ coefficient, suggests that, after controlling for park-specific effects, respondents interviewed at existing annual meadows had higher baseline utility for the non-status quo options, compared to those at control sites. This suggests that direct exposure to an existing annual meadow may have fostered a more positive preference towards such interventions. We did not find any effect for perennial meadows, however. Secondly, respondents who scored more highly on the connectedness to nature scale were less likely to have chosen the status quo Option D and thus more likely to be willing to pay for urban meadows with higher levels of biodiversity. Thirdly, spending longer at the park containing the meadow, or visiting more frequently, had no statistically significant effect on choices. Finally, we controlled for park-specific effects on the ASC, which revealed notable spatial heterogeneity in baseline preferences. Respondents interviewed at Gores Marsh (Bristol), Middleton (Leeds) and Rodley (Leeds) exhibited significantly higher baseline utility for the status quo (Option D) compared to the average across all parks.

We formally tested the effect of meadow type on preferences through interaction terms in the weighted and unweighted mixed logit models (Table 2). These interaction terms were evaluated against a reference level of the control sites. Generally, there was no statistically significant effect of meadow type on preferences, and no interaction terms were significant at the 1% level, although two interaction terms (Table 2) were significant at the 5% level as respondents interviewed at perennial meadows had higher mean WTP for both medium and high levels of improved quality of habitat for pollinating insects, compared to those at control sites (Table 3Table 3). However, our Poe tests (Table 3Table 3; supplementary material Table C.3) suggest that the distribution of WTP for most attribute levels was not statistically different between meadow

Table 2

Estimated interaction terms between each attribute and meadow type from the weighted model. Effects must be interpreted against responses in control meadows as the reference level. Robust standard errors (SE) are reported in parentheses with stars for p values against the null hypothesis that the coefficient is not statistically different from zero.

Attribute	Annual	Perennial
Flower colours: white	8.437 (10.164)	7.076 (10.014)
Flower colours: white, yellow, blue	3.775 (10.756)	−3.411 (10.565)
Flower colours: white, yellow, blue, pink, red	8.514 (8.881)	−5.326 (8.695)
Native: decrease	−1.008 (8.236)	−3.351 (7.931)
Native: increase	−10.445 (6.409)	−7.174 (6.231)
Plants: five additional species	11.106 (7.071)	8.974 (7.032)
Plants: ten additional species	12.101* (6.776)	12.966* (6.665)
Quality for pollinating insects: medium	6.049 (8.395)	20.423** (8.270)
Quality for pollinating insects: high	6.904 (8.420)	19.320** (8.441)

***p < 0.01, **p < 0.05, *p < 0.1.

types.

Mean WTP for flower colours and native species did not differ significantly by meadow type (Fig. 3; Table C.2 supplementary material). Preferences for additional plant species overlapped zero at control sites, indicating that respondents had low WTP or did not consider this attribute as important as the others. Although preferences for other attributes were mostly positive (negative for decreased native species), there was a small right-hand tail of low/no WTP for habitat quality for pollinating insects.

3.2. Variation between meadow types

We formally tested whether the mean WTP was statistically different between meadow types (Table 3). Across most attributes, WTP was not statistically different between meadow types. The moments of the distribution of WTP were highly similar between meadows (Table C.2). The confidence-interval overlaps for many of the attributes and crossed zero for the additional plant species attribute (Fig. 3). Our findings were robust to pooling annual and perennial meadows (Tables C.4, C.5; Figure C.2).

4. Discussion

Given the role that urban areas can play in mitigating the ongoing pollinator crisis (Hicks et al., 2016), and the imperative to create liveable and healthy cities, urban meadows have the potential to contribute to addressing environmental and social challenges (Aronson et al., 2017). Understanding public preferences for the design of urban meadows is essential if these interventions are to deliver both biodiversity and wellbeing benefits, as their long-term viability depends on alignment between management objectives and landscape perceptions (Ugolini et al., 2022). Although other studies have examined attitudes towards attributes of urban meadows (Hoyle et al., 2017b), we quantified preferences for these attributes in WTP-terms. We found that urban greenspace users had positive WTP for increased floral colour variation, native species, and quality for pollinating insects. Given the overlapping distributions of simulated WTP, we conclude that the relationships between attributes and levels were largely consistent between meadow type, suggesting that respondents' preferences for meadow attributes were not context-dependent reactions to immediate visual stimuli, but are instead more stable underlying preferences. Practically, this means that greenspace managers may be able to consider stated preference evidence from *in situ* surveys at existing meadows to planning decisions about new sites. Finally, we found that respondents who scored higher on the connectedness to nature scale were less likely to prefer the status

Table 3

Mean WTP per meadow type with [Poe et al. \(2005\)](#) test p-values. P-values represent the one-tailed test of the null hypothesis that the WTP distributions were equal. The WTP was simulated from the weighted mixed logit model.

Attribute	WTP			Poe Test P value		
	Control	Annual	Perennial	Control vs Annual	Control vs Perennial	Annual vs Perennial
Flower colours: white	£35.44	£43.81	£42.51	0.240	0.273	0.459
Flower colours: white, yellow, blue	£52.90	£57.07	£49.58	0.386	0.596	0.291
Flower colours: white, yellow, blue, pink, red	£41.52	£49.95	£35.99	0.204	0.713	0.078*
Native: decrease	-£24.55	-£25.69	-£28.01	0.547	0.644	0.405
Native: increase	£19.72	£9.20	£12.56	0.945	0.870	0.701
Plants: five additional species	£4.92	£15.97	£13.86	0.059*	0.103	0.383
Plants: ten additional species	£2.21	£14.27	£15.16	0.038**	0.029**	0.552
Quality for pollinating insects: medium	£14.78	£20.49	£35.01	0.264	0.014**	0.945
Quality for pollinating insects: high	£29.28	£36.44	£48.20	0.217	0.018**	0.895

***p < 0.01, **p < 0.05, *p < 0.1.

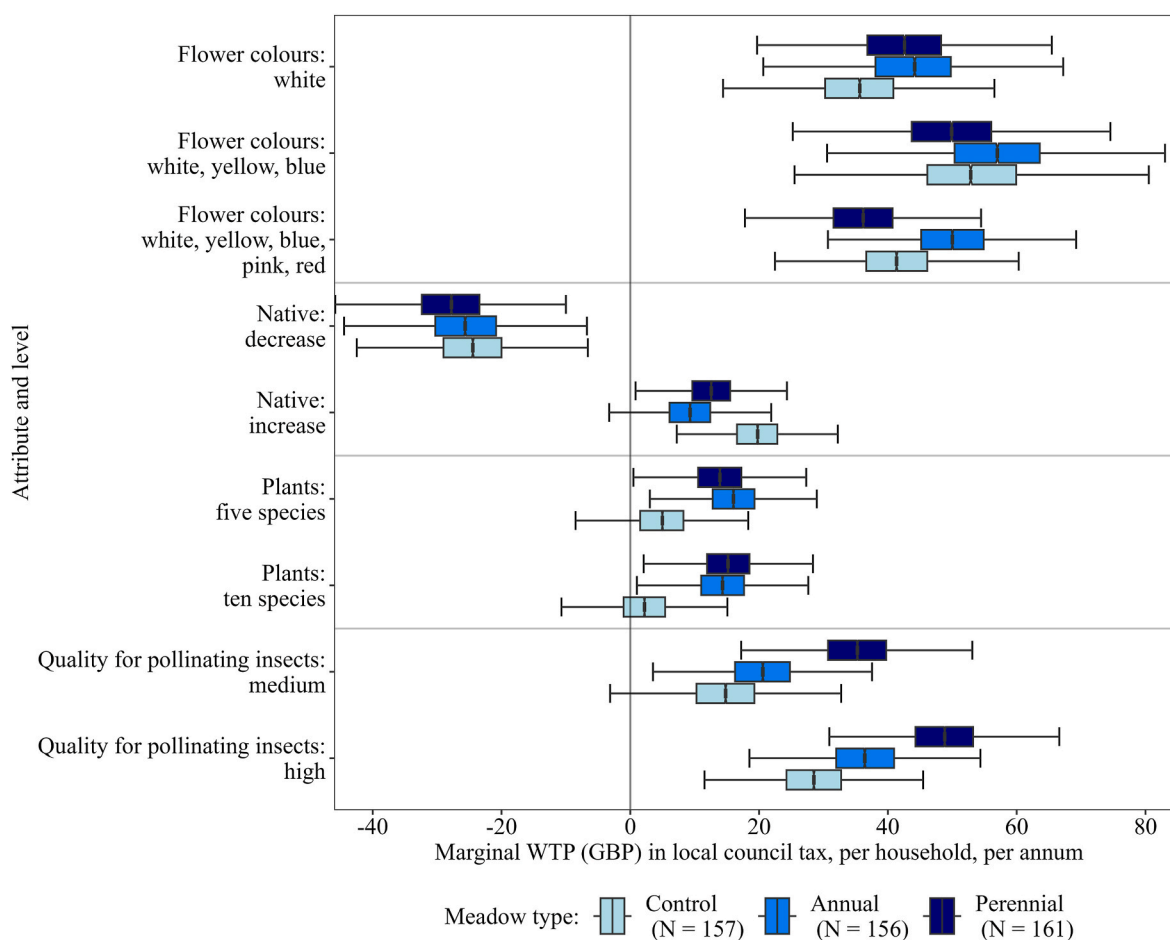


Fig. 3. Box and whisker plots of the mean attribute WTP for each level and attribute simulated with 10,000 draws from the variance-covariance matrix of the weighted mixed logit model. Mean WTP at annual and perennial meadows includes the meadow-type interaction terms (Table 2). Boxes show the interquartile range, the vertical black line shows the median, and whiskers extend to the most extreme values within 1.5 times the interquartile range. A vertical line at zero separates negative and positive WTP.

quo, consistent with evidence that stronger nature connectedness is associated with higher WTP for environmental improvements ([Sato et al., 2021](#)). This suggests that fostering nature connectedness through accessible urban meadows may itself strengthen public support for further interventions to support urban biodiversity.

4.1. Preferences for flower colours

Respondents were willing to pay for increases in the range of colours of flowers in urban meadows; suggesting that the visual aesthetic

experience of biodiversity was an important facet of recreational use ([Hoyle et al., 2018](#); [King et al., 2025](#)). Colour diversity is an important aspect of urban meadows both for its influence on the aesthetic experience ([Southon et al., 2017](#)) and link to perceived plant species biodiversity ([Southon et al., 2018](#)), and actual biodiversity in terms of abundance of pollinators ([Hoyle et al., 2018](#)). Although the mean WTP was not statistically different across meadow type, we found an interesting scope sensitivity whereby respondents typically valued three colours marginally more than five colours ([King et al., 2025](#); [Veisten et al., 2004](#)). This finding echoes [Hoyle et al. \(2017a\)](#) who found that

while colourful planting had the highest ratings in terms of aesthetic preferences, and was appreciated for its 'wow factor', subtler planting (e.g., greener, less flower cover) afforded a more restorative effect. It may, therefore, be that the WTP could correspond to a desire for neater and tidier urban greenspaces (Hoyle et al., 2017a). Although there are many other visual factors that may influence aesthetic appreciation, such as the proportion of floral coverage, the overall shape and size of a meadow and less objectively measurable qualities such as the 'neatness/messiness' of planting (Nassauer et al., 2009), our results indicated that planting a range of colours is preferred to a monoculture. As we only evaluated an increase in the number of visible colours in the same manipulated image but did not include shades of green, a colour noted for its perceived stress restoration (Akers et al., 2012), further study of the aesthetic appeal of urban meadows may be wise to disentangle these aspects of aesthetic value.

4.2. Preferences for native species

Our results indicated that regardless of meadow type, respondents were willing to pay (a) to avoid a reduction in native species, and (b) for an increase in native species. Together, these results suggest a strong preference for native species. The WTP to avoid a decrease in native species was marginally larger than that for an increase, and more homogeneous, possibly indicating that loss aversion may have influenced preferences here. Our findings diverge from those of Hoyle et al. (2017b), who found many people are positive about non-native planting. However, their results were sensitive to respondents being informed that non-native planting may be better adapted to a changing climate (c.f., Hoyle, 2021). By contrast, our survey only mentioned 'Non-native species can sometimes have negative impacts on native species, as well as impacting on people,' thus increasing the salience of a trade-off between native and non-native species instead of highlighting any positively framed aspects. Preferences for native species are common across different countries (Davis et al., 2011; Lewis et al., 2018; Teixeira et al., 2022). These preferences appear robust to the context as Wheeler et al. (2022) found positive attitudes for native plant species regardless of observed abundance. Furthermore, Lundhede et al. (2016) found that Danish respondents were willing to pay more for the conservation of birds that are currently native to Denmark, than for bird species emigrating into the country due to climate change. Further, Yao et al. (2019) found respondents in New Zealand were willing to pay for conservation of native fish and plant species and discussed how opposition to reported declines in native species may underpin these preferences. These preferences towards native species, and against non-native species, may be driven by a combination of a form of patriotic value towards culturally important native species (Lundhede et al., 2016; Yao et al., 2019) and concerns about the potential of non-native species to become invasive and therefore cause damage or harm (e.g., Lewis et al., 2018; Teixeira et al., 2022). The implications of these results for managers of urban meadows are that public support for planting native species is strong and should be prioritised. Correspondingly, climate change adaptation that uses non-native planting would need to successfully communicate the benefits of these species to overcome public perceptions about any potential negative aspects.

4.3. Preferences for species richness

On average, respondents were not willing to pay to increase species richness by an additional five or ten plant species. This contrasts with previous findings in the UK where respondents perceived meadows with higher plant species richness as having greater aesthetic value and site quality (Southon et al., 2017). The divergence may be attributed to methodological differences; Southon et al. (2017) explored perceptual responses, rather than preferences for trade-offs expressed in WTP-terms. Indeed, our use of a CE required respondents to weigh increased species richness against other relevant attributes of urban

wildflower meadows, including colour diversity. Together, these results imply that while respondents may perceive species-rich meadows positively, they did not value marginal increases as worth trading-off for in the context of other monetary and non-monetary attributes.

Although Graves et al. (2017) found species richness and colour diversity to be correlated, our respondents were only willing to pay for colour diversity, with statistically zero WTP for additional plant species. One explanation is that respondents evaluated increases in species richness through the lens of the adjacent nativeness attribute, which mentioned that the status quo level would be 50% native/non-native species. Indeed, the correlation terms between our random attributes also suggest that additional plant species and changes in the proportion of native species were significant influences on choices. Therefore, the statistically zero WTP we found for increased species richness could also reflect preferences to avoid increasing richness of non-native species (Teixeira et al., 2022), or uncertainty about how the additional species would be established. The phenomenon of 'plant blindness' could also explain why respondents may not have attended to our plant species richness attribute. Plant blindness refers to the tendency for people to overlook plants and undervalue their ecological importance relative to animals (Allen, 2003). The disparity in awareness may be driven by low familiarity with plant species, or cultural biases favouring charismatic fauna (Jose et al., 2019; Parsley, 2020). More generally, plant blindness is indicative of respondents' struggle to conceptualise plant species richness as an important facet of biodiversity (Bartkowski et al., 2015; Christie et al., 2006). Together, our findings suggest that respondents valued the effects of plant diversity, such as increased colour diversity or quality for pollinating insect species, more than species richness itself. As a result, efforts to increase plant species richness in urban meadows may not be widely recognised as valuable by the public unless framed in terms of their functional or aesthetic benefits.

4.4. Preferences for quality for pollinating insects

Respondents expressed a significant and scope-sensitive WTP for increasing the quality of habitat for pollinating insects, consistent with public preferences to avoid declines in pollinating insects and associated services (Breeze et al., 2015; Garbuzov et al., 2015). The implication of this finding is that the public values functional ecological attributes, not just aesthetic features, and is willing to contribute financially to meadow designs that can benefit pollinator species. Furthermore, the scope sensitivity of WTP suggests that respondents meaningfully distinguished between levels of habitat quality, which is consistent with respondents understanding the attribute rather than simply expressing general pro-environmental attitudes. Although greenspace users were supportive of improving the quality of meadows for pollinating insects, this support did not extend to all the ecological characteristics of urban meadows that may contribute to that goal, as respondents were not willing to pay for additional plant species and preferred native to non-native planting, even though non-native plants may also provide resources for pollinators.

Respondents who were aware of the biodiversity benefits of meadows were more tolerant of the less attractive appearance of the meadows outside the flowering season (e.g., Southon et al., 2017). Hence, people appear to value the function that meadows can play in providing benefits to insects, especially where their function is pollination (Austen et al., 2021, 2023). The value of improved habitat for pollinating insects may be anthropocentric, arising from benefits to people, or ecocentric, arising from the notion that pollinators have a right to exist regardless of any benefit to people (Hargrove, 1989). Anthropocentric values include use values, such as enjoying nearby floral displays, and non-use values, such as the satisfaction of knowing that pollinators exist. We could not disentangle these values, and pollinators may be a poor test of ecocentric values given their economic importance to humans. Values for insects are also likely to differ between people, as King et al. (2026) found highly heterogeneous WTP for

the existence of bees, beetles, and wasps, including a distinct insect-averse group of respondents. Such aversion may reflect biophobia, i.e., fear or dislike of nature, which is expected to become more common, especially within urban areas (Jensen et al., 2026). Whether urban meadows increase, reduce, or are unrelated to biophobia is unclear. In this study, although mean WTP for pollinator habitat was positive, the estimated distribution implied that approximately a quarter of respondents had negative WTP (Table 1). We cannot determine whether aversion to nature underlies these preferences, as the connectedness to nature scale measures affinity for nature rather than aversion (Jensen et al., 2026). Future valuation studies of urban greenspace could, therefore, include direct measures of aversive attitudes towards nature alongside connectedness scales. Moreover, a key research gap remains regarding the extent to which members of the public know and understand the links between pollinating species, not limited to insects, and pollination services (Hanley et al., 2015; Wilson et al., 2017). We did not measure respondents' ecological knowledge, although all respondents received the same description of each attribute before the choice tasks. Future studies could include species identification tasks or compare perceived and actual site characteristics (cf. Dallimer et al., 2012; Southon et al., 2018; Hoyle et al., 2019) to understand how respondents' knowledge influences preferences for urban meadows, especially for less visible attributes such as plant species richness or native species composition.

4.5. Variation across meadow type

Our study investigated whether attribute salience from meadow exposure influenced WTP for attributes of urban meadows. Across most attributes, the distributions of simulated WTP were not statistically different between meadow types (Table 3; Fig. 3), indicating that preferences were not substantially influenced by the immediate landscape context. Although respondents at perennial meadows valued pollinator habitat more highly (Tables 2 and 3), the WTP for this attribute was positive at every meadow type and never exceeded WTP for the most preferred flower colours. Respondents in control meadows, where the preferences were more hypothetical, did not report different mean WTP for the flower colour and native plants attributes; mirroring Southon et al. (2018) who found no difference in perceived biodiversity or psychological wellbeing between experimental meadows and control sites. Although not statistically significant, the flower colour attribute showed the greatest variation across meadow types (Table 3). The small variation in mean WTP for this attribute is consistent with the primacy of visual perception in landscape experience (Akers et al., 2012; Austen et al., 2021; King et al., 2025) and with previous experimental stated preference work showing that preferences can be sensitive to information provided (Welling et al., 2022, 2023; Needham et al., 2018). Further study in contexts with sharper contrasts in attribute salience, such as comparing park visitors with non-visitors, may reveal threshold effects that our design could not detect. The broader consistency of preferences across meadows suggests that respondents held stable underlying preferences for meadow attributes. Our finding of similar distributions of WTP across three meadow types was an encouraging result for both the CE's validity in terms of hypothetical bias (Haghani et al., 2021b; Hoyos, 2010), and its reliability (Rakotonarivo et al., 2016). Our results thus support *in situ* sampling, that is valuation adjacent to the environmental context, as able to reliably recover stated preferences (Arrow et al., 1993; Lindhjem and Navrud, 2011; Loosveldt, 2012) and suggest that managers can draw on evidence from surveys at existing meadow sites without concern that enhanced attribute salience substantially biases results.

We found mixed evidence of spatial variation in preferences for the status quo (c.f., Glenk et al., 2020; Sagebiel et al., 2017). Specifically, while most park effects were not significant, respondents at Gores Marsh (Bristol), Middleton (Leeds), and Rodley (Leeds) exhibited significantly higher utility for the status quo compared to the sample average, even

after controlling for individual characteristics and meadow type. This park-specific preference for the status quo of amenity mown grass may reflect established recreational uses, such as sports, dog walking or picnicking, where more complex vegetation is perceived as a barrier (Norton et al., 2019; Palliwoda and Priess, 2021). However, our entropy balancing approach alongside the use of park fixed effects ensures that these localised effects did not confound our estimated effect of meadow type on WTP. As Breeze et al. (2015) found that rural respondents reported lower WTP for pollination services compared to urban respondents, further work with a more spatially variant sample may help elucidate spatial variation in preferences for attributes of meadows.

5. Conclusions

The Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services (IPBES) states an ambition to 'transform society's relationship with nature,' suggesting that one way to do this is through the management of urban greenspaces for pollinators (IPBES et al., 2016). Whether urban meadows can deliver win-wins in terms of biodiversity and wellbeing benefits depends on the alignment of management actions with public preferences. Our study illustrated public preferences for more colourful meadows that contain a higher proportion of native species and provide better quality habitat for pollinating insects. There are three implications for urban greenspace managers. Firstly, meadows need not maximise colour diversity to secure public support given that the highest WTP was for three additional flower colours (white, yellow, blue). Secondly, urban greenspace management could frame meadows as delivering both native biodiversity conservation and pollinator habitats, both of which respondents held positive WTP across all three meadow types. Thirdly, management can be informed by stated preference evidence from *in situ* surveys conducted at existing meadow sites without concern that enhanced attribute salience substantially biases results. For researchers, our results demonstrate that landscape perception assessments conducted *in situ*, i.e., adjacent to the landscapes being valued, can reliably recover preferences despite differences in attribute salience across survey contexts. The consistency of preferences for most attributes across meadow types suggests that people's valuations of landscape attributes were consistent with stable underlying preferences rather than context-dependent reactions to immediate visual stimuli.

As cities globally confront pressures from urbanisation, biodiversity loss, and climate change, the demand for nature-based solutions that can deliver multiple benefits will intensify. Our evidence that urban wildflower meadows can simultaneously advance pollinator conservation, native biodiversity, and visual amenity, while enjoying consistent public support, positions them as viable interventions for sustainable urban development. By quantifying trade-offs between design attributes in willingness-to-pay terms, we provide decision-makers with evidence to justify design choices amidst competing preferences.

CRedit authorship contribution statement

Peter King: Writing – review & editing, Writing – original draft, Software, Formal analysis. **Tristan J. Pett:** Writing – review & editing, Writing – original draft, Funding acquisition, Conceptualization. **Mark A. Goddard:** Writing – review & editing, Project administration, Investigation, Conceptualization. **Thomas H. Lundhede:** Writing – review & editing, Software, Formal analysis, Conceptualization. **Gail E. Austen:** Writing – review & editing, Writing – original draft. **Zoe G. Davies:** Writing – review & editing, Supervision, Project administration, Funding acquisition, Conceptualization. **Martin Dallimer:** Writing – review & editing, Writing – original draft, Supervision, Resources, Project administration, Funding acquisition, Conceptualization.

Declaration of competing interests

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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Appendix A. Supplementary data

Supplementary data to this article can be found online at <https://doi.org/10.1016/j.jenvman.2026.131156>.

Data availability

The full survey with replication code and data is publicly available at <https://doi.org/10.5281/zenodo.23374960>.

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