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LETTER

Public attitudes toward biodiversity-friendly greenspace management in Europe

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Abstract

Increasing urbanization worldwide calls for more sustainable urban development. Simultaneously, the global biodiversity crisis accentuates the need of fostering biodiversity within cities. Policies supporting urban nature conservation need to understand people's acceptance of biodiversity-friendly greenspace management. We surveyed more than 2,000 people in 19 European cities about their attitudes toward near-natural urban grassland management in public greenspaces, and related their responses to nine sociocultural parameters. Results reveal that people across Europe can support urban biodiversity, yet within the frames of a generally tidy appearance of public greenery. Younger people and those using greenspaces for a greater variety of activities were more likely to favor biodiversity-friendly greenspace management. Additionally, people who were aware of the meaning of biodiversity and those stating responsibility for biodiversity conservation particularly supported biodiversity-friendly greenspace management. Our results point at explicit measures like environmental education to increase public acceptance of policies that facilitate nature conservation within cities.

KEYWORDS

biodiversity conservation, biodiversity-friendly greenspace management, environmental education, environmental policy, environmental responsibility, lawn alternative, maintenance intensity, sustainable city planning, urban grassland vegetation, urban meadow

1 | INTRODUCTION

Public greenspaces are of vital importance for the health and well-being of urban citizens (Hartig, Mitchell, Vries, & Frumkin, 2014; van den Bosch & Sang, 2017), who form the growing majority of global populations. As urban growth exacerbates the current biodiversity crisis, a key challenge for sustainable urban development is to increasingly integrate biodiversity conservation in greenspace design and management (Shaffer, 2018). A better understanding of people's attitudes toward biodiversity-friendly public greenspaces is thus essential for improving urban conservation strategies (McDonnell & MacGregor-Fors, 2016).

While many people appreciate biodiverse urban ecosystems (Fischer et al., 2018a), biodiversity-friendly greenspace management still faces multiple challenges (Aronson et al., 2017). Changing park management from an ornamental, high-maintenance to low-intensive, near-natural manner supports native biodiversity (Cilliers, Müller, & Drewes, 2004; Rudolph, Velbert, Schwenzfeier, Kleinebecker, & Klaus, 2017) but also considerably changes a greenspace's visual appearance. This may compromise the surrounding aesthetic scenery and the perceived appropriateness for recreation (Bjerke, Østdahl, Thrane, & Strumse, 2006; Gobster, Nassauer, Daniel, & Fry, 2007). Furthermore, a wilder appearance of public greenspaces may raise concerns about health risks, such as pollen allergy (Jianan, Zhiyun, Hua, Xiaoke, & Hong, 2007) or ticks (Lerman & D'Amico, 2019).

As biodiversity conservation is a global challenge, the need for international strategies and policies is steadily increasing (Bonebrake et al., 2019). Yet ignoring people's lack of support for specific measures of greenspace management strategies can considerably undermine the effectiveness of policies aiming to promote urban biodiversity (Stoll-Kleemann, 2001). Thus, identifying the extent to which citizens support less manicured, near-natural greenspaces is crucial for designing policies supporting urban biodiversity. To increase the acceptance of urban biodiversity conservation strategies, we need to understand the main factors influencing people's attitude toward biodiversity-friendly greenspace management. These attitudes may trace back to the interplay of different social and cultural background variables (Fischer et al., 2018a,b), including geographic characteristics (Lafortezza, Carrus, Sanesi, & Davies, 2009), people's age and gender (Bjerke et al., 2006; Sang, Knez, Gunnarsson, & Hedblom, 2016), urban

versus rural residence (Berenguer, Corraliza, & Martin, 2005), and nature relatedness (Lin, Fuller, Bush, Gaston, & Shanahan, 2014; Nisbet, Zelenski, & Murphy, 2009). Including people's opinions and differences due to sociocultural background in the design and management of biodiversity-friendly greenspaces is thus critical for successful biodiversity conservation in cities.

Urban grasslands are a global element of cities (Hedblom, Lindberg, Vogel, Wissman, & Ahrné, 2017; Ignatieva & Hedblom, 2018), and a useful model system for studies on greenspace management and its public acceptance in the international realm (Yang, Ignatieva, Larsson, Zhang, & Ni, 2019). Urban grasslands encompass a wide range of different types, from short-cut and sometimes irrigated lawns with ornamental and recreational functions to less-intensively managed tall-grass meadows (Figure 1; Tables S1 and S2; Rudolph et al., 2017; Sehrt, Bossdorf, Freitag, & Bucharova, 2020). Tall-grass meadows are typically mown once or twice per year in late summer and can provide habitat for native plants and animals (Cilliers et al., 2004; Norton et al., 2019; Watson, Carignan-Guillemette, Turcotte, Maire, & Proulx, 2020). Converting lawns to meadows significantly increases their value for biodiversity (Chollet, Brabant, Tessier, & Jung, 2018; Wastian, Unterweger, & Betz, 2016) and benefits ecosystem functions such as pollination or heat regulation (Ignatieva & Hedblom, 2018). However, especially the visual appearance of senescing tall-grass meadows and their usability for outdoor activities strongly differs from short-cut lawns. Thus, it is likely that people prefer one of the two urban grassland types, possibly depending on their individual background (Figure 1).

We conducted an extensive field survey across 19 European cities in nine countries to explore people's attitudes to biodiversity-friendly urban greenspace and grassland management. We related their responses to nine sociocultural variables that described their personal background to assess how these attributes relate to individual preferences and opinions about public greenspace management. Further, we presented a hypothetical scenario of changing urban grassland management from short-cut lawns to near-natural tall-grass meadows to assess whether potentially perceived disadvantages (i.e., changes in visual appearance, usability, health risks) prevent people from supporting biodiversity-friendly greenspace management. Such novel insights help understanding the level of support for urban biodiversity conservation, and highlight options how to stimulate people's willingness to accept alternative, potentially unpopular greenspace management. We regard this study as an important step in providing support for

FIGURE 1 Urban grassland is a global element of public greenspaces. Its appearance reaches from short-cut lawns for ornamental and utility purposes (a, g) to near-natural meadows with tall-growing vegetation (b, d). The latter can act as a habitat for native species and might have colorful flowering aspects (e, i) but also a brownish appearance in late summer (f) compared to (irrigated and frequently mown) short lawns (a). Formal framing, for example, through mowing strips may enable people to accept better a biodiversity-friendly management (d–f, h). Pictures by L. Fischer (a, e, g, h), V. Trotsiuk (b), G. Filibeck (c), and V. Klaus (d, f, i). See Tables S1 and S2 for further details on European urban grasslands

strategies and policies to intensify biodiversity conservation in future sustainable cities, both at a local and international scale.

2 | METHODS

2.1 | Field survey

We surveyed 2,027 urban residents in 19 cities of nine European countries that span wide gradients from Northern to Southern Europe and from West to East. Cities thus cover temperate and summer-dry climates and range from small to large populations (see Tables S3 and S4 for details). We used questionnaires with embedded photographic stimuli to assess people's preferences for biodiversity-friendly, near-natural management of specifically public greenspace (Table S4). The exemplary study object, urban grasslands, is a common feature of all study cities (Table S1), with lawns being generally more common than meadows (Table S2).

The questionnaire was tested in Münster, Germany the year preceding the main study ($N_p = 100$), and was carefully translated into local languages. Interviews were conducted from 02/08/2016 to 23/12/2017 using a common protocol by trained staff assessing randomly selected respondents in three standardized types of typical urban locations (*in park/greenspace*, *close to park/greenspace*, *no park/greenspace in sight distance*). We received 2,027 valid entries with an overall rejection rate of 44%. Interviews included in this analysis came from respondents aged 18–90 years with a median age slightly younger than in the European Union (39.0 compared to 42.6 years). The overall male to female ratio of all respondents is close to the representative value from the European Union (0.95 compared to 0.96 in the EU; Eurostat 2019).

2.2 | Questionnaire design

In the first part of the questionnaire (Table S4), we assessed people's preferences for different types of urban grasslands. We asked respondents how much they preferred short-cut lawns and tall-grass meadows in public greenspaces shown on five different pictures. Two of these pictures (hereafter called *lawn with tall-grass area*, Table S5) were a photo collage that depicted the same scene twice, once with tall-grass meadow elements bordering a large short-cut lawn, and once showing solely short-cut lawn in the whole area. We asked the respondents which of the two scenes they preferred. A third picture depicted a path toward a lake with tall-grass meadow on the left and short-cut lawn at the right side (hereafter called *meadow* vs. *lawn*, Table S6). One further pair of pictures differed in the photographic stimuli between temperate and summer-dry locations to assess geographic differences in more detail (Table S4). For the temperate cities, the picture pair showed greenspace with varying amounts of tall-grass meadows among apartment houses. For summer-dry cities, the respective scenes depicted a lawn with versus a meadow without the effect of irrigation (Table S7). Generally, we consciously chose situations of late summer vegetation in our photographic stimuli to measure preferences for partially brown wild tall-growing vegetation.

In the second part of the questionnaire, we assessed individual greenspace uses and people's opinions on how urban greenspace should be like. We first asked which activities respondents usually perform in urban greenspaces, such as "Going for a walk," "Sports" etc. (open choice, resulting data ranging from 0 to 12 activities; Table S4), and calculated the number of different activities done by each person. Then, we assessed peoples' opinions (i.e., normative beliefs; see Stern & Dietz, 1994) on general greenspace management (hereafter *greenspace appearance* and *habitat function*) on a five-point Likert scale (ranging from 1, *strongly agree*, to 5, *strongly disagree*; Likert, 1932; Table S4).

In the third part of the questionnaire, we asked whether respondents were familiar with the term biodiversity/biological diversity (*yes/no*). After reading a standardized explanation on what biodiversity means, we asked whether people feel biodiversity conservation is a primary societal responsibility (five-point Likert scale). Then, a standardized text informed the respondents about ecological benefits of tall-grass meadows compared to short-cut lawns for native plants, insects and birds (Table S4). The text also pointed at possible trade-offs with visual appearance and usability for outdoor activities in order to assess not only respondents' initial attitude toward greenspaces (as in part 1 and 2 of the questionnaire) but to also to determine how they would prioritize potentially conflicting greenspace functions. To assess this prioritization, we presented a hypothetical scenario where 50% of the city's lawns would be converted into biodiversity-friendly tall-grass meadows (hereafter *lawn conversion)* and asked, how respondents agree to this procedure (five-point Likert scale). We also asked whether people think tall-grass meadows would increase health risks (e.g. ticks bites, pollen allergies; five-point Likert scale).

Finally, we collected information on people's age, gender (*female*, *male*, *other*) and place of residence (e.g., *in the city center*, *in the suburbs*; Table S4).

2.3 | Statistical analyses

We used Pearson's χ^2 tests for detecting differences between grassland preferences as revealed by the different photographic stimuli across European cities, countries and climate regions. We used multiple linear mixed-effects models with city as random factor to assess the effect of explanatory variables on dependent variables using *lmer()* in R package

lme4. As dependent variables, we chose three variables that described how people agreed to statements on (A) greenspace appearance, (B) habitat function and (C) the lawn conversion scenario. As explanatory variables, we used people's individual responses on age, gender, knowledge of the term biodiversity, stated feelings of societal responsibility for biodiversity conservation, presumed health risks from tall-grass meadows, number of activities performed in urban greenspaces, place of residence, location of the city in summer-dry vs. temperate climate and the standardized type of location of each interview within the city (Table S4 for further details). Multicollinearity of numeric explanatory variables was low (Pearson`s $R^2 < 0.2$) and distribution of values of numeric explanatory variables among the factor levels of categorical explanatory variables was even (Figures S1–S4, Table S8). Model results were extracted according to ANOVA type II errors so that the order of explanatory variables in the models did not affect their estimates. Normality and variance homogeneity of model residuals were checked visually. In order to assess relationships between people´s opinions on greenspace appearance and management, we calculated a Principal Component Analysis (PCA) from all answers about photographic stimuli, greenspace appearance, habitat function and lawn conversion using *prcomp()* in R package *stats*. Patterns in responses were related to selected explanatory variables by an overlay of the latter in the resulting biplot. Analysis including the preference for one pair of photographic stimuli (Table S6) could not include data from Reading (UK) due to missing information. All statistical analyses were carried out using R (v.3.1.0) in the RStudio environment (v.0.98.932).

3 | RESULTS

3.1 | Preferences for short-cut lawns versus tall-grass meadows

Over all 19 cities, people did not show a significant preference for one of the two pictures where a tall-grass area is surrounded by short-cut lawn versus the short-cut lawn only ($p > 0.05$; Figure 2). However, respondents from six cities showed a significant preference for the lawn-only picture, while respondents from Germany rather preferred the tall-grass meadow in combination with lawn to the lawn-only situation (Table S5). When showing the footpath picture with lawn at one side and meadow at the other side, the majority of respondents clearly preferred the short-cut lawn over the tall-grass meadow (Figure 3), mostly independently from country and city, and with only three cities not showing a preference for either of the two grassland types (Table S6). In the third set of photographic stimuli people preferred the picture dominated by tall-grass meadows in temperate cities, while in summer-dry cities the respective scene showing a clear visual effect of stopping irrigation in the near-natural meadows was strongly rejected but the scene showing the irrigated lawn was preferred (Figure S5, Table S7).

3.2 | Opinions about greenspace appearance and management

The large majority of respondents stated that greenspaces should be well kept and tidy (*greenspace appearance*, Figure 4A). However, the majority of respondents also supported the function of greenspaces as valuable habitats for plants and animals (*habitat function*, Figure 4B). After respondents were informed about the ecological value of tall-grass meadows for biodiversity and possible trade-offs of near-natural management with visual appearance and usability, two-thirds agreed to a scenario that suggested the conversion of 50% of lawns to biodiversity-friendly tall-grass meadows within their city (*lawn conversion*, Figure 4C). The PCA ordination of the previous five questions on greenspace appearance and management (Figures 2–4) shows that the preferences for tidy greenspaces and short-cut lawns were strongly positively correlated, while being positive about habitat function and lawn conversion was almost orthogonal to (i.e. independent of) these preferences (Figure 5). Despite some variation in the position of the city centroids (core area), individual interviews from different countries showed an extensive overlap in ordination space, regardless of climatic regions.

3.3 | Effects of sociocultural and geographic context

People's attitudes toward urban grassland management were affected by several aspects of their sociocultural and geographic context (Table 1). Multiple regression models with city as a random factor explained 43%–50% of variation in the respective data (Table S9). A higher number of activities performed in greenspaces, familiarity with the term biodiversity and more responsibility toward biodiversity conservation resulted in higher preference for tall-grass meadows and higher agreement with regard to their habitat function. Vice versa, people that were concerned about health risks from tall-grass meadows disliked the respective scenario and were more positive about tidy greenspaces. Older people were less positive about the habitat function of greenspaces and the lawn conversion. For the latter, the models also revealed a difference among male and female respondents with females being more likely to support lawn conversion. People from summer-dry cities in southern Europe showed a stronger preference for short-cut lawns but also more support for lawn conversion than people from temperate cities. The place of residence and the interview location in the city (relative to closest next greenspace) did not affect people's responses (Tables 1 and S9).

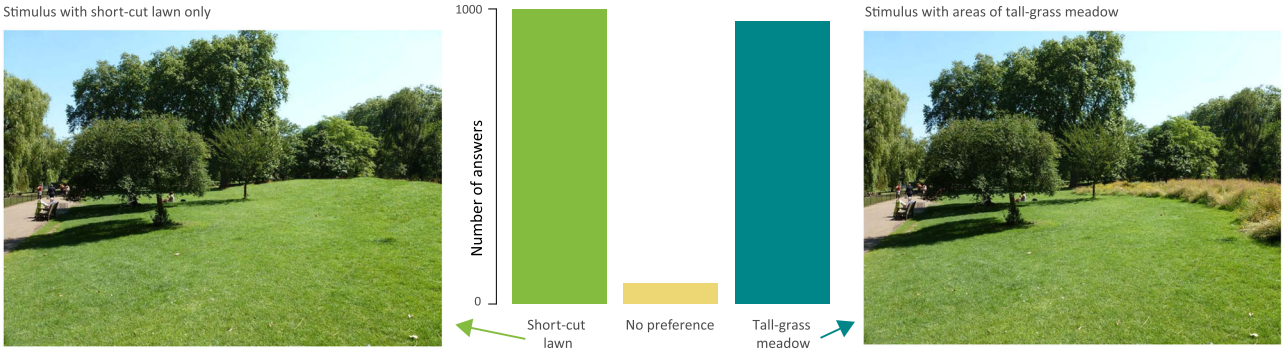

FIGURE 2 Preferences of urban citizens for high-intensity grassland (short-cut lawns) versus a combination of a lawn with embedded near-natural biodiversity-friendly grassland (tall-grass meadows) in urban greenspaces based on photographic stimuli of urban grasslands. The tall-grass patch has been removed from the picture on the left ($N = 1{,}925$; Table S5)

TABLE 1 Effects of sociocultural and geographic context (including 19 cities in nine countries) to average agreement on three statements on greenspace and urban grassland management (Figure 4). Red, circled minus signs indicate negative associations and green, circled plus signs demonstrate positive associations. Full question are given in Table S4 and complete model results in Table S9. Icon credit: https://thenounproject.com/

Factor	Greenspace appearance Focus on keeping sites tidy with a well-kept appearance (N = 2023)	Habitat function Focus on the creation of valuable habitat for animals and plants (N = 2017)	Lawn conversion Replacement of 50% of frequently mown lawns with grasslands (N = 2009)
Average agreement	⊕	⊕	⊕
Gender *Male vs. Female*	♂ = ♀	♂ = ♀	♂ < ♀
Place of residence *City center vs. Suburb*	city center = suburb	city center = suburb	city center = suburb
Interview location *Summer-dry vs. Temperate*	S = N	S = N	S > N
Number of activities performed in greenspaces	⊖	no trend	⊕
Knowledge of the term biodiversity	⊖	⊕	⊕
Societal responsibility for biodiversity	⊖	⊕	⊕
Concern about health risks	⊕	⊖	⊖

4 | DISCUSSION

Across 19 cities in 9 European countries, the preferences and opinions of more than 2,000 European citizens toward urban greenspace management turned out to be multifaceted but showed broad support for converting lawns into meadows to support urban biodiversity conservation. With some variation across European cities and people's sociocultural backgrounds, our results also revealed to some extent contradictory expectations with a preference for tidy greenspaces but also the clear wish for recognizing a habitat function for native species in greenspace management.

Due to the opinion of many respondents that greenspaces should generally look pleasant and neat, a mosaic of

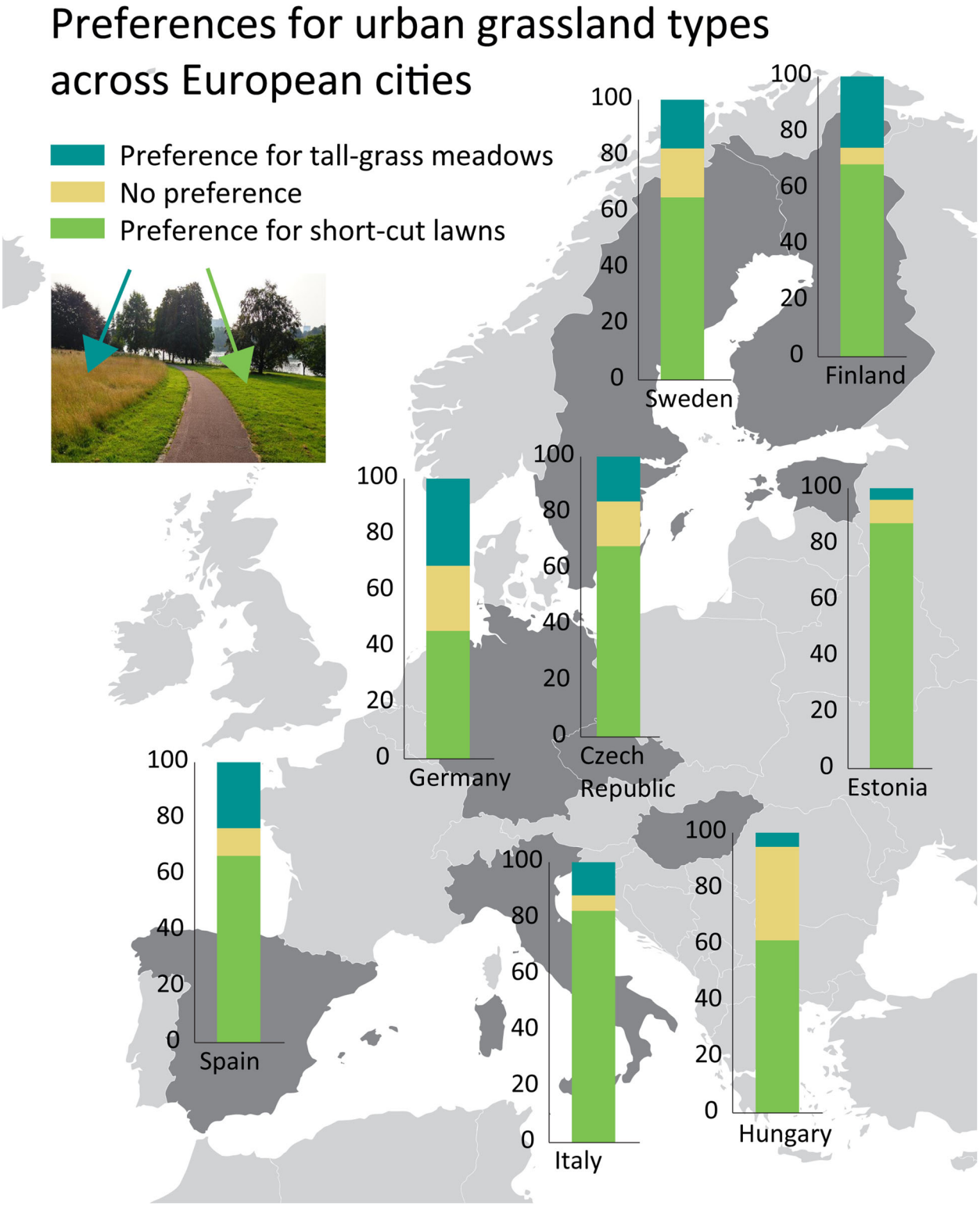

FIGURE 3 Preferences of urban citizens for high-intensity grassland (short-cut lawns) versus near-natural biodiversity-friendly grassland (tall-grass meadows) in urban greenspaces, based on a photographic stimulus that showed an autumn aspect of an urban greenspace ($N = 1{,}925$; Table S6)

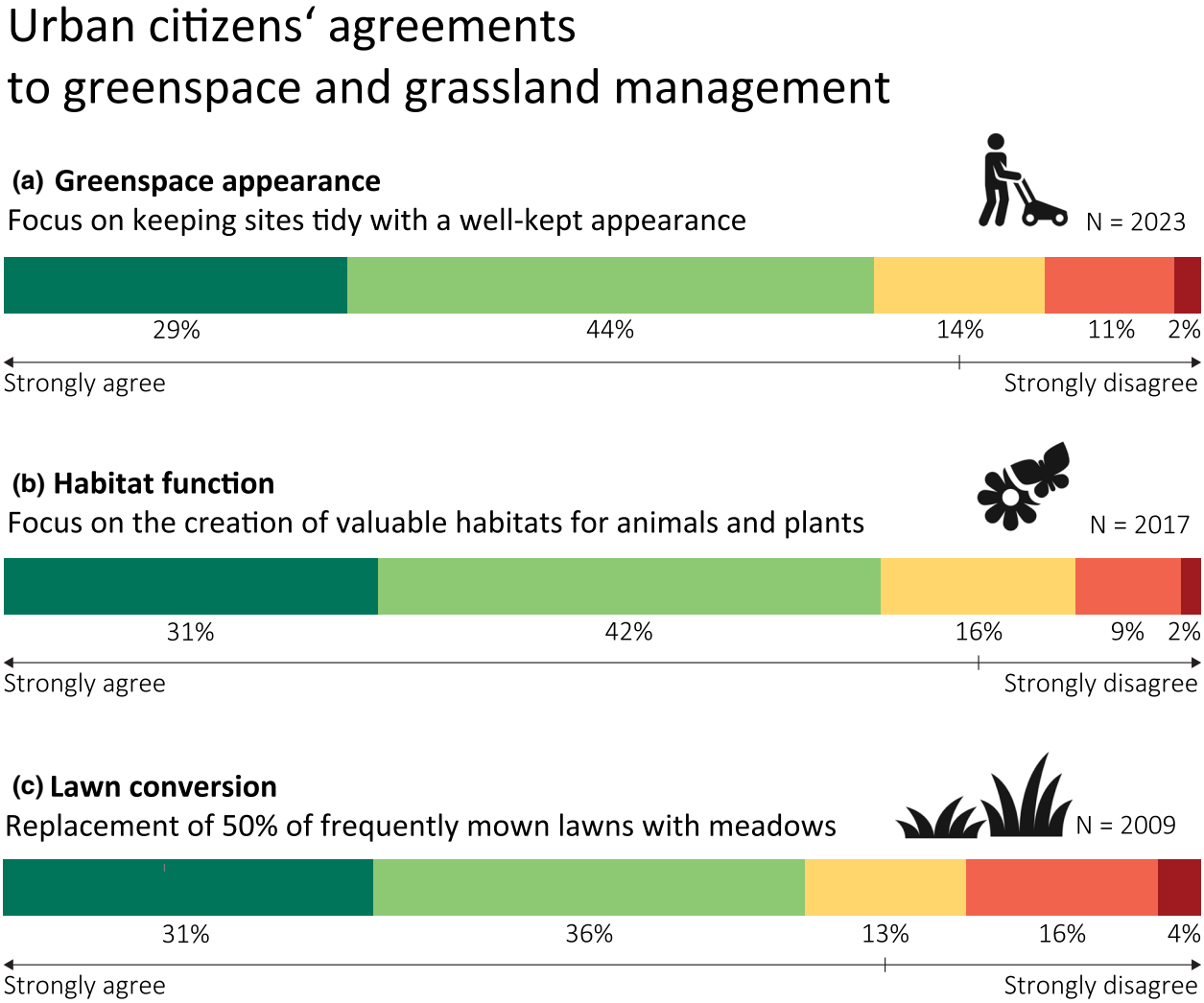

FIGURE 4 Agreement with three statements on greenspace and grassland management in cities, based on Likert-scale ratings ranging from *strongly agree* (dark green) to *strongly disagree* (dark red) as indicated by the arrows below the bar, with neutral statements displayed in yellow. Full question are given in Table S4. Icon credit: www.freepik.com

conventionally and biodiversity-friendly managed areas could help satisfying divergent expectations toward greenspaces. For urban grassland management, this suggests the limitation of wild, near-natural meadow-patches to well-defined areas, the mowing of trail edges to give paths a cared appearance and the establishment of mowing strips that enhance accessibility of grassland areas to avoid the unwanted impression of unkemptness of wild elements (Kowarik, 2018), and to account for the complexity of underlying human–biodiversity relations (Pett, Shwartz, Irvine, Dallimer, & Davies, 2016).

Our study showed that lawns are not necessarily preferred in all greenspace settings—which is in line with previous findings (Southon, Jorgensen, Dunnett, Hoyle, & Evans, 2017)—but if tall-grass meadows appear dry and neglected, irrigated lawns are clearly favored. Many of the photographic stimuli used in this study showed a brownish late summer aspect. Thus, our results may underestimate the average level of agreement with near-natural greenspaces in temperate regions, as here, grasslands in early summer often include attractive flowering phases (Southon et al., 2017). In contrast, in summer-dry regions, already in early summer, meadows dry out and change their visual appearance (Filibeck, Petrella, & Cornelini, 2016). Still, people in summer-dry cities were on average slightly more positive about lawn conversion but also more positive about (irrigated) shot-cut lawns than people from temperate cities were. This suggests that to improve the aesthetical appearance of tall-grass meadows and including flagship species could be a measure to increase overall rates of acceptance (Andersson & McPhearson, 2018; Bretzel et al., 2016).

This study substantiates insights on public preferences that were revealed for biodiverse urban greenspaces across various ecosystem types, different European countries and diverse social groups (Fischer et al., 2018a), and highlights the need

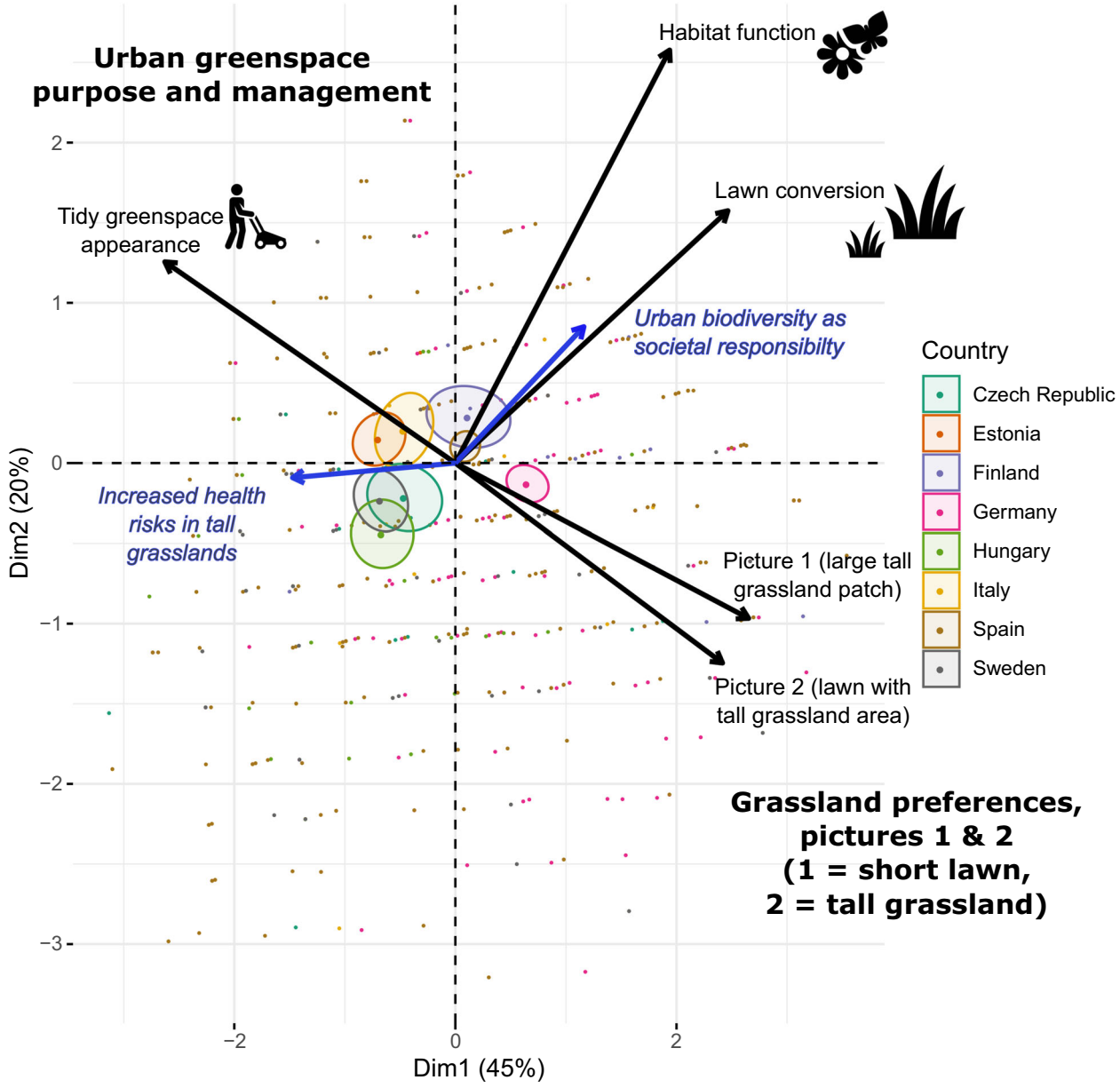

FIGURE 5 PCA biplot of 1,832 valid and complete responses to five questions on preferences for short-cut lawns versus tall-grass meadows (Figures 2 and 3), greenspace appearance, habitat function, and lawn conversion (Table 1). Dotted arrows indicate overlay with additional data. Each response (interview) is indicated by one small point, while larger points and ellipses indicate group centroids and the 95% CI around the group centroid estimation for all responses from one country (color coded)

for considering and integrating public preferences and opinions in greenspace policies and management when planning sustainable cities (Aronson et al., 2017). When surveying links between preferences and opinions of urban citizens and their sociocultural and geographic backgrounds, results indicate that citizens are very positive about biodiversity conservation in urban greenspaces when certain prerequisites are met. According to the responses, establishing near-natural greenspaces is strongly supported by people who knew about biodiversity, the benefits of "wild-looking" greenspaces and the presence or absence of health risks from such areas. To further increase the acceptance of biodiversity-friendly greenspace management, three drivers seem to be shaping people's attitudes and should receive greater attention from urban policy, city planning and conservation practice when designing future greenspaces.

First, the significance of knowledge about biodiversity and corresponding responsibility toward biodiversity conservation, both linked to positive opinions on biodiversity-friendly greenspace management, point at the importance of providing helpful information and environmental education on the role of biodiversity in cities and beyond. This could

include, for example, school education, information campaigns in newspapers and activities on social media platforms (Büscher, 2016). The low percentage of European citizens that have heard of biodiversity and are familiar with the term biodiversity (41%; European Commission, 2018), underlines the strong need for information on biodiversity and related topics. Information campaigns should take into account that especially the elderly were less positive about urban greenspaces serving as habitats for wildlife, which is in line with people aged 55 and older having significantly less often heard of biodiversity (European Commission, 2018). Such information measures could facilitate people becoming better accustomed to near-natural, wild-looking greenspaces in places where these have not been common before.

Second, concerns about health risks seem to reduce the acceptance of near-natural greenspace management. Information campaigns to resolve (presumed) concerns such as ticks in highly urbanized environments could have a strong effect of the acceptance of biodiversity-friendly greenspace management (Lerman & D'Amico, 2019). In cases where concerns might be well reasoned, for example, when flowering plants increase pollen loads (Jianan et al., 2007), appropriate solutions are needed to avoid conflicts, for example, by reducing the abundance of species with a high allergenic pollen load.

Third, frequent visits and multiple uses of urban greenspace were positively related to a higher agreement on increasing habitat functions and converting lawns. At the same time, agreeing to a tidy greenspace appearance was considerably less strong when people used greenspaces for many different activities. This is in line with previous studies showing that people spending more time in greenspaces exhibited higher nature relatedness (Lin et al., 2014) and higher valuation of plant biodiversity (Fischer et al., 2018a)—and ultimately suggests that accessibility and usability of greenspaces can influence people's support for urban biodiversity conservation. Enabling people easy access to (wild) urban greenspaces might thus facilitate a win–win situation for people's well-being and health (van den Bosch & Sang, 2017) and the acceptance of biodiversity-friendly greenspace management (Kowarik, 2018).

5 | CONCLUSIONS

When asking about converting lawns into meadows for the sake of biodiversity, we found strong support by urban populations across Europe. This clearly stresses the need—and the opportunity—to consider biodiversity conservation as mandatory aspect of future policies for public greenspace and city planning. Due to the wide geographic gradient across 19 cities differing in size, climate and culture, this study conveys several important messages to stakeholders in and outside Europe. Most prominently, our study encourages everybody concerned with greenspace planning and management to engage in urban biodiversity conservation, as this is clearly supported for by large parts of urban populations. From our results, we conclude that measures to manage greenspaces more biodiversity-friendly should achieve an overall tidy and neat appearance. Thus, both near-natural but also more classical elements of urban greenery could be combined, such as lawn-like mowing strips along the edges of tall-grass meadows. In parallel, environmental education and information are crucial measures to address skeptical members of society, especially those that are older, those perceiving wild urban nature as potential health risk and those that use greenspaces for only few activities. Taking into account these prerequisites, the doors for biodiversity conservation in public greenspaces seem to be widely open, with potential benefits for biodiversity, but also for the well-being of the city residents.

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SUPPORTING INFORMATION

Additional supporting information may be found online in the Supporting Information section at the end of the article.

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