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Urban Nature: Perception and Acceptance of Alternative Green Space Management and the Change of Awareness after Provision of Environmental Information. A Chance for Biodiversity Protection

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Abstract: Measurable ecological data, e.g., species diversity, provide inadequate information for achieving the comprehensive protection of biodiversity, because human acceptance attitudes can be important factors in undermining nature protection schemes. We have analysed an ecologically driven urban management system presented to urban habitants. A photograph-based survey answered by 424 participants was used to evaluate their impressions of natural meadows. The positive effect of provided information tables was demonstrated by pre- and post-test designs. Attitudes towards urban nature protection showed a statistical preference for green-area management systems optimising insect protection compared with more regularly mowed meadows and lawns. Thus, the perceptions of people should be considered in processes of biodiversity protection. Our results correlate with personal attitude and education, support the aims of extensive green-space management and should encourage urban planners to integrate biodiversity protection zones into urban planning.

Keywords: attractiveness; conservation; lawn; meadow; natural; mowing; spruceness; questionnaire; survey

1. Introduction

1.1. The Biodiversity Crisis and the Role of Urban Areas to Lessen the Loss

Urbanisation is one of the major environmentally relevant phenomena of our time. The expansion of urban areas is rapidly increasing. In western Germany, the area settled by humans has increased by about 140% in the past fifty years [1,2]. 13.6% of the area of Germany is covered by settlements and infrastructure [3]. Fragmentation and destruction of natural areas occurs as a result of these developments [4]. The biodiversity of urban areas has long been neglected [5], although cities possess many open spaces and public grassland (usually cultivated in the form of lawns) that could help to enhance biodiversity [6–8]. The protection of biodiversity in urban areas might thus contribute to the fulfilment of ecosystem functions such as pollination, oxygen production, human well-being and pest regulation [9]. This idea explains the current focus of conservationists on these easily introduced replacement biotopes [10]. In the last few years, mounting evidence has supported the expected improvement of biodiversity achieved by simple changes in vegetation management [11,12] and retention of native vegetation [13,14].

1.2. A University Student and Staff Initiative to Reduce Biodiversity Loss

In 2010, both students and employees of the University of Tübingen (Tübingen, Baden-Württemberg, Germany) founded a pressure group to support national and international aims to protect biodiversity [15]. This group chose the name "Initiative Bunte Wiese" ("The colourful meadow initiative") and aimed at persuading decision makers to improve the maintenance of inner urban green areas with respect to conservation issues. This improvement involved (1) the reduction of mowing events towards a twice-a-year only regime; (2) the use of bar mowers instead of mulchers and (3) the removal of grass cuttings from the surface [16]. The effects of such a management reduction were evaluated in several research projects on grasshoppers [17], true bugs [18], wild bees [19], beetles [20] and butterflies [21]. All these investigations have revealed a statistically significant positive impact of reduced grassland maintenance towards species diversity and the occurrence of rare or endangered species. This shows that simple measures such as the reduction of grassed area maintenance [11] can make an important contribution to international efforts to reduce the loss of biodiversity (e.g., [22–25]).

1.3. Aesthetics and Perception of Urban Green Spaces

With its focus on ecological arguments, this project has shown the positive potential of urban nature protection. Even if urban natural green spaces seem to have a high aesthetic value in residents' opinions (e.g., [26–28]), there might be potential negative aspects when trying to protect biodiversity in urban areas. As little is known about the specific case of public acceptance of unspoilt natural meadows in urban areas (e.g., [29,30]), sociological arguments should also be carefully considered in biodiversity protection [31]. A focus on strictly scientific ecological arguments is not a satisfactory way of solving this human–nature conflict. Natural planning in urban green spaces has been disliked for a long period of time [32,33]. A change has nevertheless occurred in this discussion [30,34], as a study of natural awareness [35] has found that two out of three habitants prefer places with spontaneous nature in urban areas. The value of urban green spaces has been considered at several levels [36]. Smardon [37] discusses various functional aspects of vegetation in the urban environment and distinguishes (1) economic benefits; (2) instrumental and physiological functions (e.g., benefits for health and alternative use); (3) visual and sensory benefits (e.g., optical and acoustical recovery by nature and natural noises and smells) and (4) symbolic functions. Cameron et al. [38] specify these aspects by presenting ecosystem functions. Several studies underline the value of urban nature for public health [39–44].

As urban nature can fulfil several functions for the urban population, parameters are needed to measure the extent to which maintained green spaces in the city are assessed by its inhabitants. For instance, both aesthetic and ecological [45] values of nature in urban areas can be considered in two different ways when evaluating nature. To optimise the functions of urban nature, both for biodiversity and other benefits for humans, human perceptions and aesthetic preferences have to be investigated with respect to urban green spaces [46–48]. Even if specialised knowledge of species and species richness is poor, nature and biodiversity are known to form important topics for people [35,49–52].

The potential tension between quantifiable nature in natural meadows, functional aspects, knowledge and attitudes towards nature and the aesthetic perceptions and preferences of citizens must be considered in urban conservation issues [45]. Therefore, in this contribution, we set our scope on the first impression of citizens when being confronted with urban natural meadows. Moreover, we analyse the value and the effect of additional given information on the attitudes of citizens towards the aims of natural protection in urban green spaces.

In our study, we address the way that the inhabitants of a middle-sized town in Germany perceive and evaluate landscape sceneries resulting from various maintenance strategies.

1.4. Research Questions and Hypotheses

In order to understand this interaction better, we addressed the following questions: (1) what are the first impressions of citizens looking at urban green spaces under different management systems (Figure 1); (2) how do they perceive these systems; (3) do nature and environmental education (e.g., conveyed by information tables, brochures, etc.) increase positive awareness of natural urban green spaces?

Figure 1. Structure of our questionnaire. (**A**) Pre-testing with meadows (green) and lawns (red); (**B**) Questions on personal behaviour; (**C**) Expert knowledge input; (**D**) Post-test with meadows (green), lawn (red) and unnatural/artificial green space (blue); (**E**) demographic questions. For further explanations see text.

Using a questionnaire, participants had to evaluate lawns and meadows in terms of "attractiveness", "spruceness", and their "potential to enrich urban settlements". Additionally collected demographic and behavioural data (e.g., perception and use of nature, knowledge and attitudes) were used to improve the interpretation of the survey results.

These research questions led us to the formulation of four hypotheses. (H1) The provision of additional environmental education raises the acceptance of natural urban meadows in terms of attractiveness, spruceness and the perceived value for urban areas. (H2) Differences in behavioural and demographic data play an important role in the overall acceptance of urban nature protection. (H3) Confronted with urban nature and asked about their willingness to change anything, citizens show a high acceptance for natural meadows with little support of any change, except (H4) an endorsement of expanding nature in urban areas.

2. Materials and Methods

2.1. Structure of Questionnaire

We designed a photo-based online questionnaire with Unipark (Questback GmbH. EFS Survey, Version 10.5. Cologne: 2005.) (Figure 1). The questionnaire was divided into a pre- and a post-test (see questionnaire as online attachment).

For this online survey, we presented images from typical green spaces, whose maintenance had been extended according to the recommendations of the initiative "Bunte Wiese Tübingen" (e.g., colourful meadow initiative). The images were taken in a standing position during cloudy weather and were not digitally edited.

We first (Figure 1A) presented seven pictures of meadows (5) and lawns (2) as a pre-test combined with four questions. The first question was an open one: (I) "What are your first impressions on looking at this photograph?". This first associative approach was chosen to generate a spontaneous assessment of the image, one more guided by (aesthetic) feelings and implicit knowledge rather than by rational thought. This approach can be seen in accordance with Fechner's aesthetic association principle [53], which says that not only the perceived objects stimulate the senses, but also the feelings and experiences associated with the individual perception. The second question, which could be answered with a five level Likert item, was: (II) "How do you asses this picture: attractive, spruce (e.g., horticultural, proper and tidy maintenance), enriching (e.g., educational, functional, social benefits) for urban areas", followed by question three: (III) "Would you change anything and, if so, what?" and the last question: (IV) "Would you like to have more meadows like this? Why - why not?". With these questions, we intended to specify the first association by encouraging further reflections on the photographs.

In the second part of the questionnaire (Figure 1B), aspects of the personal attitude of the participant were investigated: (1) Does nature play a role in your life? (Six level Likert scale); (2) Do you have access to a garden? (Five level Likert scale); (3) Do you use the natural environment as a place for relaxation? (Five level Likert); (4) Do you observe plants and animals? (Five level Likert scale); (5) Are you knowledgeable about insects? (No, limited, yes); (6) Do you actively participate in protecting nature? (Five level Likert). These questions were correlated with the answers given in part one of our questionnaire (Figure 1A, question II).

After this block, we introduced an intervention (place in questionnaire: Figure 1C), whereby we presented the participants information given on public information panels from the initiative "Bunte Wiese Tübingen". We wanted to learn whether the evaluation of lawns and meadows changed after such an intervention presenting additional explanations of the conducted management measures. This intervention contained information about (A) the possibility of transforming lawns into meadows and the ecological and social value of these meadows; (B) the results of zoological investigations previously conducted in these areas [17–21], and (C) the problem of unnatural meadows with plants that are not autochthonous for the region.

In the third part of the questionnaire (Figure 1D), eight pictures were presented, showing meadows (6), lawns (1) and unnatural artificial meadows (meadows seeded with colourful non-native flowers) (1). We repeated some pictures from the pre-test and presented some new photographs, since our focus was on lawns and meadows in general and we did not want to test specific green spaces. As for part two of the questionnaire, we applied the same five level Likert item, i.e., "How do you asses this

picture: attractive, spruce, enriching for urban areas?" Secondly, we inquired about the potential of the scenery for the items biodiversity, insects, grasses, bees, butterflies, beetles and birds. Therefore, another five level Likert item (low–high) was used.

In the last part (Figure 1E) of the questionnaire, we requested demographic data (sex, age, education and discipline) for their further correlation with other results (see below).

2.2. Participants

In August 2015, we distributed the link to the questionnaire across the collection of e-mail addresses of the university and the Facebook account of the initiative "Bunte Wiese Tübingen". The survey ran for eight weeks. 1376 participants finished only the first part of the survey, whereas we attained completely finished datasets from 424 participants. The total number of answers is indicated as "*n*" in our results. For each statistical analysis, we used the number of participants (*n*) who had finished the relevant questions.

2.3. Analyses and Statistics

We used Microsoft Excel 2011(Microsoft Office, Excel 2011) (Microsoft, Redmond, WA, USA) and IBM SPSS 22 (SPSS 22 IBM) (IBM, Armonk, NY, USA) for statistical analyses. For Hypothesis 1 (H1), we tested the values (means, normally distributed) of various picture pairs with Student's *t*-tests for dependent samples. Means were built from five level Likert values over the two management types (meadow/lawn) per participant.

The results of the first part of the questionnaire, which addressed the immediate intuitive impressions of various green spaces, are presented descriptively in percentages and means. Open answers (answers were unrestricted and individual text was required) were aggregated into our topics. These topics were submitted manually and were oriented to keywords in the answers. This helped us to sort the answers into various fields. This method is based on "grounded theory methodology" [54,55], a common method in qualitative social research, which does not define the themes in advance (the way that "classical" thematic coding does), but develops them out of empirical material. This approach also allows unexpected topics to be identified. After sorting, we were able to evaluate the number of given answers per field. The linkage between the demographic and behavioural data was evaluated via an analysis of variances (one-way ANOVA (analysis of variance), a posteriori Bonferroni tests) (H2).

Hypothesis 3 (H3) and Hypothesis 4 (H4) involved the use of Student's *t*-tests, whereas the descriptive part ("Would you change anything and, if so, what?" (H3) and "Would you like to have more meadows like this? Why - why not?" (H4)) is presented in percentages and means (numbers of "yes" and "no" votes). For this analysis, we used the total number of answers (n = 424) for each of the six meadows in the questionnaire and compared the means (n = 6) of the "yes" and "no" option (cf. Figure 3).

3. Results

3.1. Demographics of Participants

A total of 424 participants completed the entire questionnaire; their demographic data are summarized in Table 1. Only these completed questionnaires were further considered in our analysis. 309 (72.2%) women and 116 (27.4%) men participated. 60.1% of the participants were between 21 and 40 years old. Most participants had a university entrance diploma or higher qualification (94.6%) and studied natural sciences (41.3%).

Most participants could be described as living in close touch with nature. Our data were further analysed in relation to demographic characteristics.

Table 1. Demographic composition of the 424 participants who answered the questionnaire including their attitudes towards nature. The results are given in both total numbers and percentages.

		Total (n = 424)	Contribution (%)
Sex			
	male	116	27.36
	female	306	72.17
	n.a.	2	0.47
Age			
	0–20	35	8.25
	21–40	255	60.14
	41–60	100	23.58
	older than 60	27	6.37
	n.a.	7	1.65
Education			
	abitur	153	36.08
	diploma (University)	89	20.99
	bachelor	57	13.44
	doctoral thesis	35	8.25
	master	33	7.78
	state examination	17	4.01
	secondary school level 1	10	2.36
	diploma (technical college)	9	2.12
	postdoctoral qualification	8	1.89
	vocational training	6	1.42
	general school	1	0.24
	n.a.	6	1.42

		Total (n = 424)	Contribution (%)
I. Perception of nature			
1	I strongly appreciate, enjoy and protect nature	239	56.37
2	Nature is importent to me	102	24.06
3	I appreciate nature	75	17.69
4	Nature does not interest me	6	1.42
5	Nature frightens me	0	0.00
6	"Nature is just the forest"	2	0.47
II. Access to a garden			
1	daily	115	27.12
2	often	135	31.84
3	sometimes	106	25.00
4	rarely	45	10.61
5	never	23	5.42
III. Nature as place for relaxation			
1	always	121	28.54
2	often	236	55.66
3	sometimes	57	13.44
4	rarely	9	2.12
5	never	1	0.24
IV: Observation of animals or plants			

Table 1. *Cont.*

		Total (n = 424)	Contribution (%)
Discipline			
	natural science	175	41.27
	social science	71	16.75
	linguistics	42	9.91
	service sector	36	8.49
	medicine	27	6.37
	teaching	20	4.72
	historian	17	4.01
	economics	10	2.36
	law	9	2.12
	theology	5	1.18
	education	4	0.94
	n.a.	8	1.89

		Total (n = 424)	Contribution (%)
1	daily	126	29.72
2	often	182	42.92
3	sometimes	86	20.28
4	rarely	24	5.66
5	never	6	1.42
V. Knowledge of entomology			
1	yes	50	11.79
2	limited	184	43.40
3	no	190	44.81
VI. Involvement in nature protection			
1	I provide money and time for nature protection	98	23.11
2	I sometimes provide money and time for nature protection	104	24.53
3	I support people that protect nature	106	25.00
4	I do not provide money or time for nature protection	115	27.12
5	Nature does not play a role for me	1	0.24

3.2. Description Meadow/Lawn

In our questionnaire, we showed pictures of typical regional lawns and meadows (see material and methods) and asked the participants to describe their first impressions. These results were clustered into various topics: "insects", "flowers", "nature", "beauty", "colour", "value for nature", "ecology", "value for humans" using grounded theory methodology (GTM). Positive and negative statements and multiple answers (mentions of various topics in one answer) were also noted (e.g., picture meadow: Answer 1: "beautiful"—rated: meadow "beauty" positive; Answer 2: "fear of wasps"—rated: "meadow insect negative"). For this question, we received 522 answers. The perception of the topics was more positive for meadows compared to lawns. A negative perception of these topics was higher for lawns (see Table 2).

Table 2. Results of the first intuitive impressions when the participants were confronted with pictures of natural meadows. We rated positive and negative responses for each topic that we found (using grounded theory methodology (GTM)). The value represents the mean numbers of mentions per topic and percentage (for further explanation see text) of the five shown meadows and the two lawns. Multiple answers were allowed. SD = Standard deviation. n = 522.

(*n* = 522)			Meadow		Lawn	
Insects						
	positive	mean (SD)	45.80	(±17.92)	0.50	(±0.50)
		%	8.77		0.10	
	negative	mean (SD)	3.40	(±2.73)	8.00	(±6.00)
		%	0.65		1.53	
Flowers						
	positive	mean (SD)	43.80	(±16.27)	0.00	(±0.00)
		%	8.39		0.00	
	negative	mean (SD)	9.00	(±8.27)	14.50	(±4.50)
		%	1.72		2.78	
Nature						
	positive	mean (SD)	40.20	(±14.88)	0.00	(±0.00)
		%	7.70		0.00	
	negative	mean (SD)	4.40	(±4.08)	14.50	(±6.50)
		%	0.84		2.78	
Beauty						
	positive	mean (SD)	236.40	(±34.12)	122.00	(±101.00)
		%	45.29		23.37	
	negative	mean (SD)	28.40	(±10.61)	153.50	(±26.50)
		%	5.44		29.41	
Colour						
	positive	mean (SD)	39.80	(±25.53)	10.00	(±4.00)
		%	7.62		1.92	
	negative	mean (SD)	22.00	(±19.76)	13.50	(±2.50)
		%	4.21		2.59	
Value for Nature						
	positive	mean (SD)	11.40	(±10.33)	0.50	(±0.50)
		%	2.18		0.10	
	negative	mean (SD)	1.60	(±1.85)	13.50	(±5.50)
		%	0.31		2.59	
Ecology						
	positive	mean (SD)	8.80	(±6.73)	0.00	(±0.00)
		%	1.69		0.00	
	negative	mean (SD)	0.80	(±1.73)	9.00	(±4.00)
		%	0.15		1.72	
Value for Humans						
	positive	mean (SD)	35.40	(±27.53)	28	(±16.00)
		%	6.78		5.36	
	negative	mean (SD)	16.80	(±8.61)	15.5	(±7.50)
		%	3.22		2.97	

To improve the interpretability of the answers, we compressed these results into two major groups, comparable to Bogners "2meV model" (i.e., the two factor model of environmental values, that can be seen as a division of human-nature actions in the two factors of "use" and "protection") [56–58]. We categorised the aspects from Table 2 into "focus nature" and "anthropocentric focus" (human). This can also be seen as the differentiation of "nature protection" (hetero-referential) and "use of nature" (self-referential, egoistic (practical and aesthetic)). The aspects "insects", "flowers", "nature", "value of

nature" and "ecology" were combined into the "focus nature" aspect. "Beauty", "colour" and "value for humans" were factors of the "anthropocentric focus" aspect. These two aspects are presented in Table 3.

Table 3. Combination of results of Table 2 after re-arrangement of the answers, forming the new categories "focus nature" and "anthropocentric focus". Positive and negative entries are presented in mean numbers of mentions per category and percentages. n = 522.

		Meadow				Lawn			
		Positive		Negative		Positve		Negative	
Focus nature	mean total (SD)	30.00	(±21.44)	3.84	(±5.27)	0.20	(±0.40)	10.90	(±5.97)
	%	5.75		0.74		0.04		2.09	
Anthropocentric focus	mean total (SD)	103.86	(±98.20)	22.40	(±14.66)	53.33	(±76.33)	60.83	(±67.45)
	%	19.90		4.29		10.22		11.65	

5.8% of the participants had positive impressions of nature when being confronted with meadows, whereas only 0.04% mentioned such positive aspects when seeing a lawn. In both cases, anthropocentric factors gained higher values.

3.3. Results after Provision of Additional Information

After the first confrontation with the pictures, the intervention part of the questionnaire provided additional information on species-rich meadows. Following this section, another set of pictures was presented. In some cases, pictures of the previously shown set were repeated (see material and methods).

The effect of this intervention was tested by letting the participants rate the pictures according to (1) attractiveness; (2) spruceness; and (3) enrichment effect for urban areas. The statistical comparison of these three factors was made between various pairs, namely A: meadow pre-meadow post; B: lawn pre-lawn post; C: meadow pre-lawn pre; D: meadow post-lawn post; E: meadow post-unnatural; F: lawn post-unnatural.

Figure 2 allows the impact of the given expert information (see Hypothesis 1) to be evaluated. Before the intervention, meadows were considered more attractive and enriching, but less well cared for than lawns (C). The assessment of attractiveness, spruceness and the enriching factor of meadows rose after the intervention (A). Meadows were evaluated as more attractive and enriching than lawns before and after the intervention. However, lawns were seen as more spruce than meadows and unnatural meadows (C, D and F). Furthermore, lawns were seen as less attractive and enriching than unnatural meadows (F). Unnatural meadows were considered as being more spruce but less enriching than natural meadows (E). (B) Even on lawns, the effect of the intervention is measurable. It indicates that awareness campaigns lead to a higher awareness of topics and to an improvement in recognition.

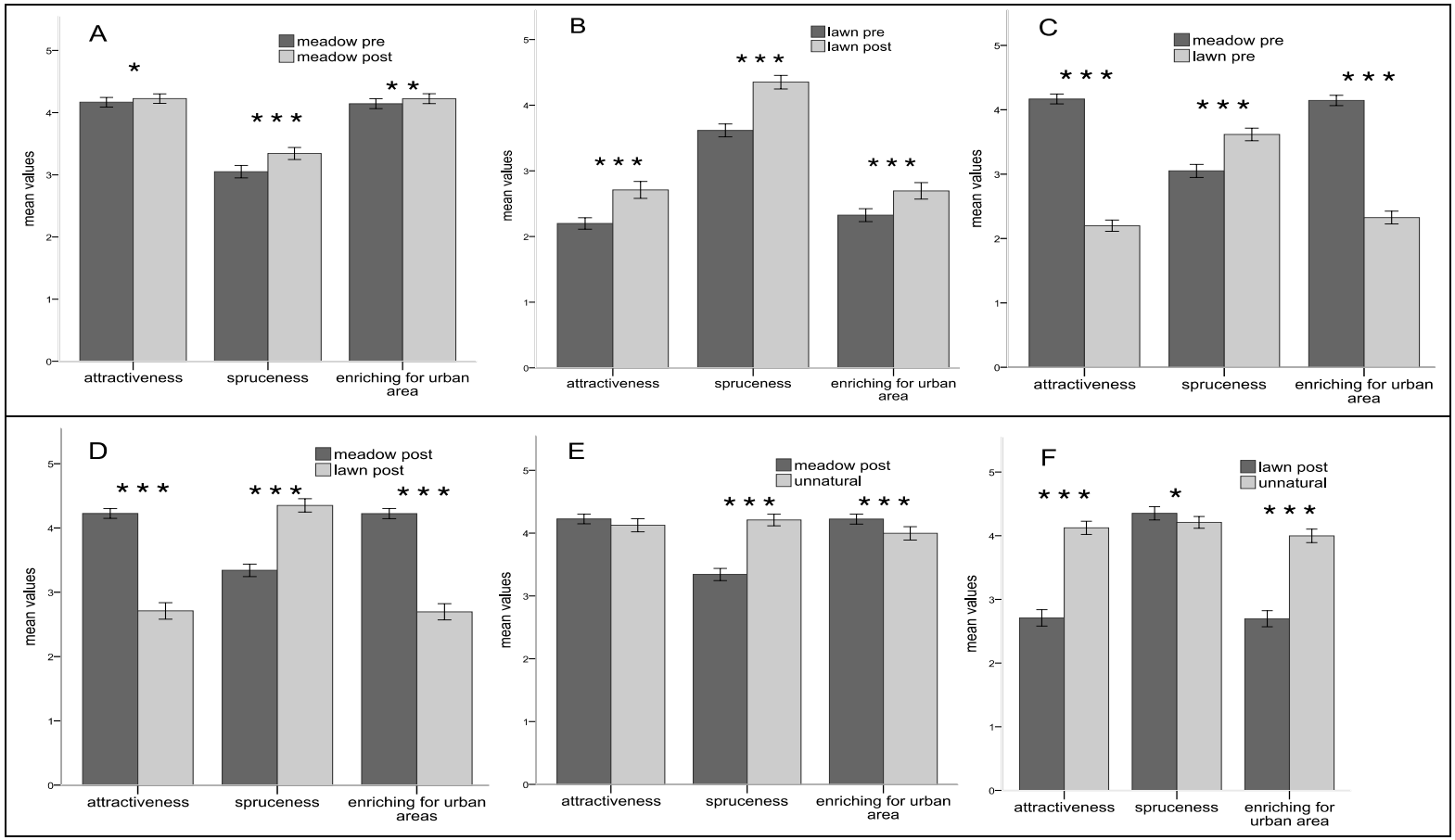

Figure 2. Arithmetic means ± standard deviations for the evaluation of the five level Likert item "attractiveness", "spruceness", "enrichment for urban area". The bars represent the means of the five-level Likert scale categories that could be selected in the answers. Paired *t*-tests for dependent samples were used to test for statistical significance. In this analysis, we tested pre (before additional information input) and post (after additional information input). **A**: meadow pre–meadow post; **B**: lawn pre-lawn post; **C**: meadow pre–lawn pre; **D**: meadow post–lawn post; **E**: meadow post–unnatural; **F**: lawn post–unnatural. Significant results ($p < 0.05$) are marked with * ($p < 0.01$ with **, $p < 0.001$ with ***; $n = 424$).

3.4. Demographic Data and Personal Attitude Towards Nature and Conservation Issues

The analyses of the possible influence of the demographic data and the participants' attitude towards natural conservation issues (Hypothesis 2) revealed the following results (Table 4).

I. Age:

Participants up to 40 years (Table 4) rated lawns more attractive, spruce and enriching than those > 40 years, whereas participants > 60 years rated meadows as being even less cultivated (category: spruceness) than did younger participants (for detailed results see Table 4).

II. Perception of nature:

People who strongly appreciate, enjoy and protect nature (category I.1. of Table 1) and those for whom nature is very important (category I.2. of Table 1) rated meadows as more attractive and enriching than others. Category I.1 also rated lawns as less attractive and less enriching for urban areas (for detailed results see Table 4).

III. Access to a garden:

People who had access to a garden daily (category II.1. (see Table 1)) considered lawns less attractive, less cultivated and less enriching than those accessing a garden only sometimes (category II.3. of Table 1) (for detailed results see Table 4).

IV. Nature as a place for relaxation:

Participants who regularly used nature as a place for relaxation (category III.1. of Table 1) considered meadows more attractive than those who used it sometimes for relaxation (category III.3. of Table 1). The participants who turned to nature always or often for relaxation (category III.1. and category III.2.) considered meadows more cultivated than those who rarely (category III.4. of Table 1) made use of meadows for relaxation. Lawns were less attractive for the group who always use nature for relaxation (category III.1. of Table 1) compared to those who used it sometimes (category III.3. of Table 1) or rarely (category III.4. of Table 1) (for detailed results see Table 4).

V. Observation of plants and animals:

People who never (category IV.5. of Table 1) observe animals and plants rated meadows more negatively than others. Those who observe animals and plants often (category IV.2. of Table 1) or daily (category IV.1. of Table 1) rated meadows as being more cultivated and enriching than those who observe animals and plants rarely (category IV.4. of Table 1) or never (category IV.5. of Table 1). People who observe animals and plants daily (category IV.1. of Table 1) evaluated lawns more negatively than all the others, in all factors (for detailed results see Table 4).

VI. Knowledge of insects:

People with at least a limited knowledge of insects (category V.2. of Table 1) preferred meadows on the three scales (attractiveness, spruceness, and enriching for urban areas) compared with those with no knowledge of insects (category V.1. of Table 1). The participants who were experts in entomology (category V.1. of Table 1) rated lawns as less attractive and less valuable for insects (for detailed results see Table 4).

VII. Involvement in nature protection:

Participants who did not use their money or time to protect nature (category VI.4. of Table 1) rated meadows as less attractive, less managed and less enriching compared with all the others. They also rated lawns as more attractive. On the other hand, those who frequently spent money and time to protect nature (category VI.1 of Table 1) rated lawns as being less attractive, less cultivated and less enriching than the others (for detailed results see Table 4).

Table 4. Influence of demographic and behavioural data on the perception of lawns and meadows. The significance level of the one-way ANOVA (analysis of variance) and the results of the Bonferroni tests are given. The given categories correspond to the categories of Table 1. n = 424.

		Sig. ANOVA	Bonferroni Tests
Age	attractiveness of meadow	0.338	none
	spruceness of meadow	0.002	0–20 has higher values than 60+ (p = 0.058); 20–40 has higher values than 60+ (p = 0.015); 40–60 has higher values than 60+ (p = 0.001)
	enriching effect of meadow	0.153	none
	attractiveness of lawn	0.000	0–20 (p = 0.021) and 20–40 (p = 0.000) have higher values than 40–60
	spruceness of lawn	0.000	0–20 (p = 0.012) and 20–40 (p = 0.000) have higher values than 40–60; 20–40 has higher values than 60+ (p = 0.009)
	enriching effect of lawn	0.000	0–20 has higher values than 40–60 (p = *0.010*) and 60+ (p = 0.026); 20–40 has higher values than 40–60 (p = 0.000) and 60+ (p = 0.008)
Perception of nature	attractiveness of meadow	0.000	Highest category has higher values than category 2 (p = 0.024), category 3 (p = 0.000) and category 4 (p = 0.036)
	spruceness of meadow	0.001	Highest category has higher values than category 3 (p = 0.003)
	enriching effect of meadow	0.000	Category 1 has higher values than category 3 (p = 0.000) and category 4 (p = 0.014); category 2 has higher values than category 3 (p = 0.000)
	attractiveness of lawn	0.000	Category 2 (p = 0.000) and category 3 (p = 0.000) higher values than category 1
	spruceness of lawn	0.270	none
	enriching effect of lawn	0.002	Category 1 has lower values than category 2 (p = 0.030) and category 3 (p = 0.006)
Access to a a garden	attractiveness of meadow	0.697	none
	spruceness of meadow	0.115	none
	enriching effect of meadow	0.137	none
	attractiveness of lawn	0.006	Category 1 has lower than category 3 (p = 0.006)
	spruceness of lawn	0.001	Category 3 has higher than category 1 (p = 0.002) and lower values than category 4 (p = 0.014)
	enriching effect of lawn	0.001	Category 1 has lower values than category 3 (p = 0.001)
Nature as place for relaxation	attractiveness of meadow	0.037	Category 1 has higher values than category 3 (p = 0.034)
	spruceness of meadow	0.056	none
	enriching effect of meadow	0.000	Category 1 has higher values than category 3 (p = 0.000) and category 4 (p = 0.001); category 2 has higher values than category 4 (p = 0.010)
	attractiveness of lawn	0.001	Category 1 has lower values than category 3 (p = 0.020) and category 4 (p = 0.009)
	spruceness of lawn	0.029	none
	enriching effect of lawn	0.030	none
Observation of plants and animals	attractiveness of meadow	0.000	Category 1 (p = 0.000), category 2 (p = 0.000), category 3 (p = 0.002) and category 4 (p = 0.020) have higher values than category 5
	spruceness of meadow	0.000	Category 1 has higher values than category 3 (p = 0.003) and category 5 (p = 0.024); category 2 has higher values than category 3 (p = 0.017) and category 5 (p = 0.044)
	enriching effect of meadow	0.000	Category 1 has higher values than category 3 (p = 0.005), category 4 (p = 0.002) and category 5 (p = 0.000); category 2 has higher values than category 3 (p = 0.004), category 4 (p = 0.002) and category 5 (p = 0.000)
	attractiveness of lawn	0.000	Category 1 has lower values than category 2 (p = 0.003), category 3 (p = 0.000), category 4 (p = 0.000). category 2 has lower values than category 4 (p = 0.007)
	spruceness of lawn	0.000	Category 1 has lower values than category 2 (p = 0.000), category 3 (p = 0.000) and category 4 (p = 0.004)
	enriching effect of lawn	0.000	Category 1 has lower values than category 2 (p = 0.000), category 3 (p = 0.000), category 4 (p = 0.001) and category 5 (p = 0.046)
Knowledge of insects	attractiveness of meadow	0.005	Category 1 has higher values than category 2 (p = 0.004) and category 3 (p = 0.004)
	spruceness of meadow	0.000	Category 2 has higher values than category 3 (p = 0.000)
	enriching effect of meadow	0.000	Category 2 has higher values than category 3 (p = 0.000)
	attractiveness of lawn	0.005	Category 3 has higher values than category 1 (p = 0.021) and category 2 (p = 0.030)
	spruceness of lawn	0.141	none
	enriching effect of lawn	0.010	Category 1 has lower values than category 3 (p = 0.010)
Involvement in nature protection	attractiveness of meadow	0.000	Category 4 has lower values than category 1 (p = 0.003), category 2 (p = 0.003) and category 3 (p = 0.001)
	spruceness of meadow	0.000	Category 4 has lower values than category 1 (p = 0.000), category 2 (p = 0.001) and category 3 (p = 0.016)
	enriching effect of meadow	0.000	Category 4 has lower values than category 1 (p = 0.000), category 2 (p = 0.000) and category 3 (p = 0.000)
	attractiveness of lawn	0.000	Category 1 has lower values than category 3 (p = 0.007) and category 4 (p = 0.000). category 2 has lower values than category 4 (p = 0.015)
	spruceness of lawn	0.001	Category 1 has lower values than category 3 (p = 0.000) and category 4 (p = 0.020)
	enriching effect of lawn	0.000	Category 1 has lower values than category 3 (p = 0.004) and category 4 (p = 0.000)

3.5. Benefits for Biodiversity

We were interested in the way that the various participants estimated the diverse aspects of biodiversity on the natural urban meadows (Figure 1, green marked pictures). We asked for the estimation of the value of "biodiversity in general", "diversity of insects", "grasses", "bees", "butterflies", "beetles" and "birds". The demographic data provided a closer view of the participants with the highest appreciation of biodiversity on urban meadows.

Sex

Women rated "Biodiversity in general" (p = 0.008) and the "diversity of insects" (p = 0.048), "grasses" (p = 0.027), "bees" (p = 0.01), "butterflies" (p = 0.037), "beetles" (p = 0.005) and "birds" (p = 0.006) higher than did males.

Age

Participants < 40 years of age rated the "Biodiversity in general" (p = 0.006), "diversity of insects" (p = 0.001), "grasses" (p = 0.018) and "beetles" (p = 0.012) higher than did those between 40 and 60 years.

Perception of nature

People who strongly appreciated and protected nature and those for whom nature was important estimated the value for "diversity of insects" (p = *0.001*), "grasses" (p = *0.01*) and "beetles" (p = *0.017*) higher than did those who had no connections to nature in urban areas.

Observation of animals or plants

The estimation of (a) "Biodiversity in general" (p = 0.003), (b) "diversity of insects" (p = 0.007), (c) "grasses" (p = 0.008), (d) "butterflies" (p = 0.01), (e) "beetles" (p = 0.009) and (f) "birds" (p = 0.011) by people who never observed plants and animals was significantly lower compared with those who observed plants and animals daily (significance for categories a, b, c, e, f), often (significance for categories a, b, c, d, e, f), sometimes (significance categories a, b, c, e, f), or rarely (significance categories b, c, e, f).

3.6. Willingness to Change Public Urban Green Spaces

As nature conservation in urban areas should always be closely linked to public opinion, we gave the participants the option to decide whether they would like to change anything on the visually presented natural meadows (Hypothesis 3). Most participants voted for no change (t-test, p = 0.000, n = 424) (Figure 3).

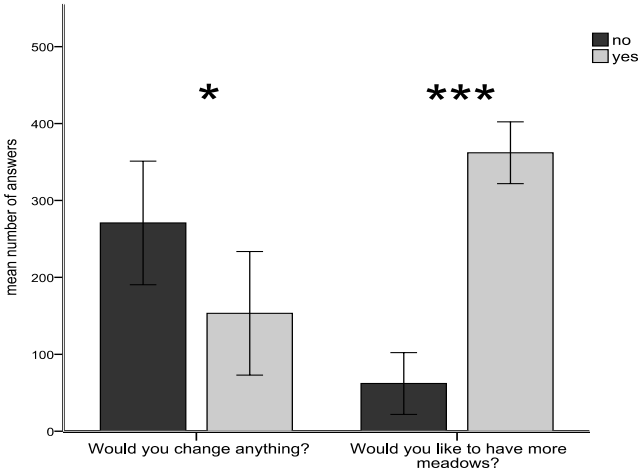

Figure 3. The graphic display of the questions: "Would you change anything?" (*t*-test, $n = 6$, 424 participants), $p = 0.021$ (*) and "Would you like to have more meadows?" (*t*-test, $n = 6$, 424 participants) $p = 0.000$ (***). Values are arithmetic means ± standard deviations.

When we asked the participants to decide whether they would like to see more natural meadows (Hypothesis 4) in their surroundings, most participants voted for more of such areas (*t*-tests, $p = 0.000$, $n = 424$) (Figure 3).

We finally asked the participants to comment on their decision concerning questions on Figure 3. The wish for more biodiversity was articulated for both lawns and meadows. Shrubs, trees and benches were also requested for both lawns and meadows. Paths crossing meadows and the enlargement (number and size) of meadows were also mentioned.

As an argument against more meadows, "fear of nature" and "ugliness" were mentioned. On the other hand, both lawns and meadows were considered useful for the various requests of citizens as seen in Table 3.

4. Discussion

The aim of this study was to determine the relationship of people to urban natural meadows on several strata. In this context, we addressed four hypotheses regarding (1) the change of perception of green spaces after the provision of additional information; (2) the role of demographic and behavioural prerequisites; (3) the willingness to change the current appearance of urban natural green spaces and (4) the wish to enhance natural maintenance concepts. Following the positive results of biodiversity perception in rural landscapes [59–61] and in gardens [62] and the positive relationship of citizens to urban nature in general [26,27,35], we wished to deepen these results by investigating the impact of additional information and socio-behavioural aspects. Botzat, et al., [30] have reviewed more than 200 publications in terms of urban biodiversity perception and found a widely neglected role of informal green spaces, a gap in the knowledge that is picked up in our contribution. Furthermore, these authors [30] found out that biodiversity is mostly evaluated from an ecosystem scale, whereas our present study was performed in the context of personal attitude and knowledge about nature and species richness. The multifunctional role of urban green [36], i.e., its value for both intrinsic nature and human use, must be an issue in urban nature planning and makes it necessary to consider both natural scientific environmental and socio-cultural studies. Some studies have already combined both these ways of evaluating nature [28]. Perpetuating this approach, we set a green space management that was already optimized according to the recommendation of our insect biodiversity studies [17–21] in direct connection with peoples' attitudes towards urban nature. We also investigated the possible change of opinion after having provided additional expert information.

4.1. Participants

Academically educated persons dominated the field of participants in our questionnaire (Table 1), which is an effect of our use of the e-mail distribution list of the University of Tübingen. The results should therefore be seen as strongly dominated by participants with a university background and with the habit of living in a town with an established and increasing natural green space management since 2010. An expansion of the test group by including other parts of the population (e.g., less educated) would be of interest. Furthermore, we did not ask our participants whether they had any pre-knowledge concerning the ecological value of lawns and meadows but the finding that their awareness strongly changed when they were additionally given ecological expert information shows that even potentially pre-educated (in this field) participants are probably influenced by receiving this specific information. A next step could be to use two different versions of the survey (with and without expert knowledge input) answered by two different groups of respondents.

4.2. Evaluation of the First Intuitive Impressions of the Presented Images

The results of our analysis of the first impressions performed with the "grounded theory methodology (GTM)" [54,55] leads to more detailed results on meadows. Visual landscape perception is crucial for connecting humans with nature [45]. The finding that, in this part of the questionnaire, animals and plants were more often named in the context of meadows shows that living aspects are key factors in the positive perception of landscape issues. Insects were more often mentioned than plants, a result that agrees with other studies (e.g., [59]), which have found that animals are preferred aspects in natural landscape evaluation. According to Kovacs et al. [63], beauty is a very important factor affecting both our emotions and our ecological practices. Beauty is a highly ambivalent and complex concept, as we can see from both lawns and meadows often being linked with beauty. This shows that we must be wary of using the term "beauty" as an argument for conservation issues [64], because the beauty bias can conflict with scientific ecological considerations [65,66]. Following the idea of Bogner's 2MEV model (i.e., the two factor model of environmental values) [56,57], the results of the "first impression analysis" could be clustered into the aspects of "preservation" and "utilisation" or, as we named them, "focus nature" and "anthropocentric focus". The results of this re-classification showed that, on both meadows and lawns, the human-based factor "utilisation" (the egoistic practical and aesthetic use) was evaluated higher than the factor "preservation". These results must be seen as an argument for including the perceptions of people in the process of biodiversity protection, since selfish ideas (such as "well-being" [41]) seem to play a role in nature evaluation. Communication between diverse interests must be part of this process of protection [63,67] to obviate aesthetic goals coming into conflict with ecological aims [45].

4.3. Impact of Additional Expert Information on Evaluation of Urban Green Spaces

The analysis of the first-image impressions underlines the importance of educational expert information (Hypothesis 1) in supporting the aims of biodiversity protection. In pre-tests, we found that meadows are considered more attractive and enriching for urban areas than lawns (Figure 2C) (see also [59]). Lindemann-Matthies et al. [48] have shown that people are able to differentiate between species-rich and species-poor plant communities, suggesting that meadows are preferred because of their higher diversity. This is supported by the differentiation between attractiveness, spruceness and the enriching effect. Lawns are considered more cultivated, and meadows more attractive and enriching for urban life.

The effect of the provided expert information can be verified in our pre- and post-comparison. After additional expert information was provided, meadows were considered even more attractive, spruce and enriching than before (Figure 2A). Lawns were still considered more cultivated after this information compared to meadows (Figure 2D), but unnatural artificial meadows did not outmatch natural meadows (Figure 2E). On the other hand, unnatural artificial meadows were seen as more

attractive and more enriching than lawns (Figure 2F). This might be a result of the general appraisal of horticultural work. Interestingly, the educational expert input has led to increased values not only for meadows, but also for lawns (Figure 2B). This might be a result of a generally heightened perception of urban green infrastructure, which was not especially paid attention to before. We do not know yet whether the observed changes after additional information input constitute long-term effects or just represent temporary effects of the given information. Whereas additional explanations of the conducted management measures improved the perception of natural meadows compared with lawns and unnatural meadows, they did not lessen the perception that lawns and unnatural meadows are considered spruce. This is of importance, if spruceness (which is more easily influenced than the more abstract values of "attractiveness" and "enriching effect" by extra measures such as mowed 1–2 m wide edge strips) becomes a key factor in political decisions on urban planning issues. Thus, additional expert knowledge should be persistently presented (e.g., by information boards) and memorised.

4.4. Demographic and Behavioural Data and Estimation of Biodiversity (Hypothesis 2)

Age played an important role in our study, as younger participants (<40 years) rated lawns as more attractive and enriching than those > 40 years (Table 4). This is despite the assumption that younger participants should be better educated in terms of ecological relationships than older people [49]. Junge et al. [68] and Lindemann-Matthies and Bose [69] have found that older people prefer species-rich field margins compared with species-poor ones, a finding that might be explained by their greater familiarity with species-rich communities in former times. On the other hand, in our study, the participants < 40 years rated the value of meadows for "biodiversity", "insects", "grasses" and "beetles" higher than did the older participants. Being aware of the value of meadows and still preferring lawns must have other reasons. The number of people suffering from hay fever is higher in the group < 40 years than in the older population [70]. This might correspond to the fact that the participants < 40 years estimated the diversity of grasses as higher in meadows than in lawns but this was not the case in the older population. In addition, for younger participants, lawns fulfil more human-based functions (e.g., sports, relaxing, playing games, barbecue) than for older participants [35], so that human-based and selfish factors might play a more important role in the younger generation than in the older one.

The analysis of the behavioural data shows that meadows and biodiversity aspects are better rated by people who have a higher affinity with nature (Table 4). This is also reflected in the lower ratings of lawns by this group of people. Lindemann-Matthies et al. [48] showed that people overestimate species richness when biodiversity levels are low and underestimate it when biodiversity levels are high. In general, our questionnaire revealed that, in particular, (i) women; (ii) people with a good perception and an awareness of nature; and (iii) people who observe animals and plants are readily able and prepared to recognise biodiversity hot spots in urban areas.

4.5. Support of Urban Nature Protection and Ideas for Change

Our results concerning the acceptance and attitudes towards lawns and meadows revealed a high general acceptance for natural green spaces in urban areas. Most participants voted for an extension of naturally maintained meadows in urban areas and did not support any change of natural green spaces (Hypotheses 3 and 4). These results correspond to other studies on nature awareness [35,71]. The discrepancy between the given answers and the lack of implementation in urban areas may be explained by different interests and different patterns [67] and the missing connection of these levels [72]. Various aspects of biodiversity such as species richness and ecosystem functions must play a role for establishing biodiversity hot spots in urban areas. The human-based arguments that were strongly represented in our findings must also be considered in optimising urban biodiversity protection. Our results support the significance of education in traditional nature study (e.g., [51,52,73]) to improve the recognition and acceptance of unspoilt nature, although one must be aware that the messages from this will often be pushed aside by anthropocentric arguments.

5. Conclusions

Our results indicate that people perceive nature in a rather self-referential way (see Table 2). Their appreciation of nature is closely linked to egoistic (practical and aesthetic) use. We have shown that additional micro-learning in the form of additional expert knowledge presented on information panels increases the acceptance and self-referential perception (see Table 2) of nature protection. In our study, the group that approved natural urban meadows most were women aged between 20–40 and people who show a large perception of nature and often observe animals and plants. We therefore consider that the integration of this group into public relations and environmental education should enhance positive attitudes towards nature protection in other demographic groups in society.

Urban natural meadows are popular among respondents. The finding that most of the polled citizens support natural meadows and would like them to increase, supports the results of previous studies on urban biodiversity and nature protection (e.g., [28,30,36]). Moreover, additionally provided information increased the acceptance for urban natural meadows. Natural protection in urban areas is no longer an end in itself. It is supported by popular perception and must be seen as a chance to renew the image of urban areas. Both biodiversity protection and the increase of the aesthetic value of extended urban green areas have positive impacts on urban life on several strata. This should encourage stakeholders to intensify their natural green area management efforts in their master plans for the cities of tomorrow.

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