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Visiting the Forest with Kindergarten Children: Forest Suitability

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Abstract: By providing ecosystem services, urban forests contribute significantly to the well-being of urban populations. Urban forests, along with other urban green spaces, are often the closest natural environment in the city where a child can play. The majority of pre-school children spend a large part of the day in kindergarten, which means that forest visits should have a prominent place in the kindergarten curriculum. Therefore, this study focuses on making the forest more suitable and thus more accessible for visits with children. The first goal of the research is to identify teachers' preferences for the forest environment they visit with a group of pre-school children. The second goal is to present a forest suitability model for a visit with kindergarten children based on the teachers' preferences. Based on the research survey conducted among the teachers in Slovenian public kindergartens, we formed and evaluated the criteria for the construction of a model of forest suitability for a visit with children. As the most important requirement for visiting a forest, the teachers note its proximity. They prefer a mature, mixed forest, with a bit of undergrowth, dead wood, and a presence of water and a meadow. Based on the identified criteria, we used the multi-criteria evaluation method in the GIS-environment in order to build a model of urban forest suitability for a visit with kindergarten groups of children in the study area of the City of Ljubljana, Slovenia. The results are useful in urban forest planning and management to ensure better forest suitability and accessibility for visits by children. Suitability maps can be used as one of the spatial foundations necessary for an integrated urban forest planning with emphasis on social functions. The model can be adapted beyond Slovenia to different spatial and social requirements and contexts.

Keywords: multi-criteria evaluation; urban forest; forest preferences; pre-school children; suitability analysis

1. Introduction

Urban forests increasingly benefit from careful management and planning. While they offer urban population numerous ecosystem services, they are also subject to various pressures. Among the ecosystem services provided by urban forests, climate ones with urban heat islands mitigations and cooling effect and social/cultural are the most prevalent [1]. The latter encompassing the aesthetic, spiritual, educational, recreational, and tourist forest value [2]. Studies on the benefits of urban green spaces, including urban forests, report positive effects on healthy living in urban areas [3,4]. Moreover, not only larger enclosed green spaces, but also smaller, even individual roadside trees have an impact on our health [5]. For decades, we have associated spending time in a natural environment with the physical, mental, and social well-being [6–8] of people of all ages. There has been focus on the most vulnerable groups in society: the elderly, the sick, women, the poor and the socially disadvantaged, but recently the focus has shifted towards children [9]. Access to green spaces and spending time there promotes physical, cognitive, emotional, behavioural and social development [10–12].

Sufficient time spend by a child in nature not only has a direct effect on development, but also has an impact on adulthood. It can have an impact through a better ability to maintain a healthy lifestyle and the ability to estimate and manage risks [3,9]. The experience they gain in their youth shapes their attitude towards nature and environment in the adult years [13,14]. Seeland et al. [15] note that spending time in public green spaces plays an important role in the social life of children: it affects their social network by creating contacts and friendships across cultures, which is considered a prerequisite for social inclusion. Children playing together in a natural environment (without artificial toys) acquire the ability to work cooperatively, communication skills and increase their awareness of others [10].

Contemporary educational trends, which attach less importance to direct contact with nature, as well as the structure of cities and time pressure of parents and teachers, greatly limit the time a child spends in nature. The studies have shown that due to the modern 'digital' lifestyle, children are losing contact with natural and semi-natural environment [12,14]. The time spent in nature helps recover mental capacity, decreases psychological distress, and has restorative effects [3,6,14]. Based on these findings, countries around the world, starting with the Nordics, have started the establishment of the so-called forest kindergartens or nature-based preschools [10,16].

Apart from city parks, an urban or peri-urban forest is usually the closest or even the only natural environment with which a child living in a large city first or most often comes into contact. The majority of pre-school children spend large portions of the day in kindergartens or similar pre-school institutions, while the afternoon activities are structured around or confined to the closest playground within a residential district [17,18]. Consequently, the amount of time a child spends in nature is highly dependent on the visits of the natural environment in the frame of kindergartens' curriculum. To the pre-school children, a forest offers an environment for free play or a means to learn about nature.

However, the needs and preferences of children regarding natural environment are often strongly neglected in the process of spatial planning [19]. Before the needs of children can be considered in spatial planning, it is necessary to recognize the qualities of the natural environment making it more inviting for a visit with children.

The preferences for various forest structures and social functions of forests have already been discussed [20–24], especially in Northern Europe [1,25–29]. From the point of view of forest structure, the most well researched is the recreational function, whereas the studies focusing on the elderly, young adolescents and pre-school children remain under-represented [26]. In light of that, the present article focuses primarily on the spatial preferences for visiting an urban forest with pre-school children. Their experiences and habits they gain in a forest shape their attitude towards the natural environment and visiting habits in the adult years and, by extension, improve the well-being of urban population.

According to the previous studies concerning adult population, the main factors influencing forest preferences and, simultaneously, visiting habits, are forest proximity [24,27,30], its structure and composition [20,24,26,28], the accompanying infrastructure such as pathways, parking spaces and picnic spots [21], and methods of forest management [24,26,28].

Forest visits in the frame of kindergartens' curriculum are specific based on the population, location and activities. The pre-school children visiting a forest differ in their capabilities and needs from the adult population discussed in the majority of forest preference studies.

The first goal of the research presented is to determine teachers' preferences for the forest environment they visit with a group of pre-school children. With this knowledge, I obtain data to introduce a GIS-based model of forest suitability for a visit with kindergarten children, which is the second goal. The forest suitability model is tested on urban forests in Ljubljana, the capital of Slovenia.

In this way, I will acquire information on spatial preferences contributing to the inclusion of forest visits in the kindergartens' curriculum in order to achieve sufficient contact of urban children with the natural or semi-natural environment in urban areas. As a result of the implemented model, the suitability map for the Ljubljana case study is presented. Suitability models or maps can be used as one of the spatial foundations necessary for integral urban forest planning with emphasized social functions.

2. Materials and Methods

Using the Municipality of Ljubljana as an example, I constructed a simple GIS-based model of urban forest suitability for a visit with kindergarten groups of children. Ljubljana is the capital and the largest city of Slovenia (Figure 1), with 290,000 inhabitants. With its forest surfaces reaching 40% and other green infrastructure, it is one of the greenest European capitals [31]. The criteria for the evaluation of forest suitability for a visit with kindergarten children were acquired based on the survey conducted among the teachers in the Slovenian public kindergartens.

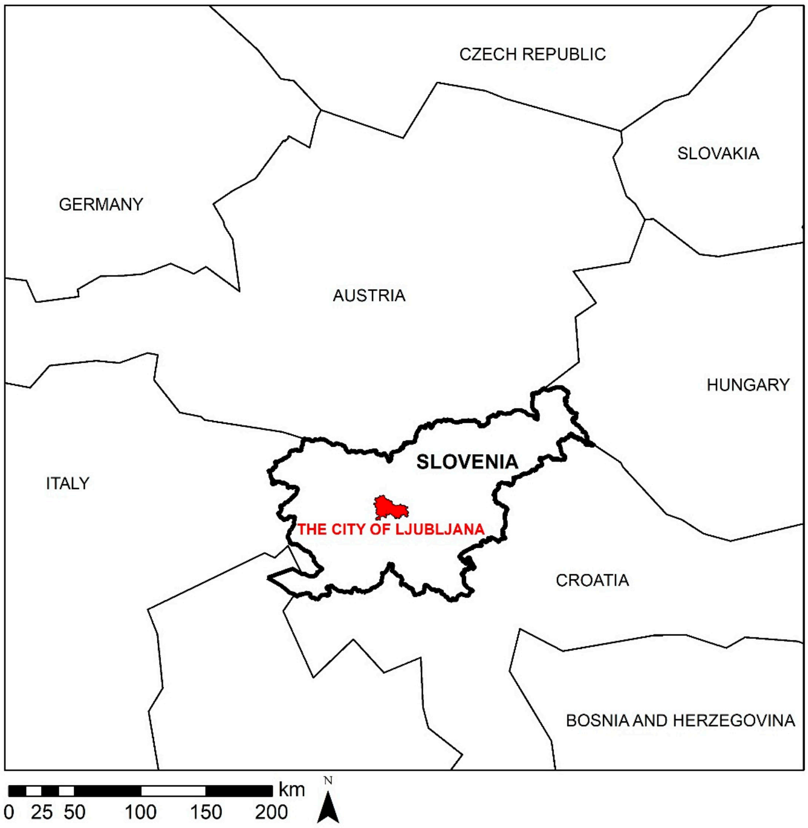

Figure 1. The location of Slovenia with the capital, The city of Ljubljana, in a broader context.

2.1. Survey

In June 2017, we conducted a survey among the teachers in the Slovenian public kindergartens. The survey was accessible on the internet for a month. The invitation to participate in the survey and request for distribution by their units was sent to the contacts (headquarters of public kindergartens, N = 310) listed on the website of the Ministry of Education, Science and Sport of the Republic of Slovenia [32]. Because participants were from different kindergarten units, not even a partial response rate can be given. In addition, we promoted the survey on social media and asked our acquaintances (kindergarten teachers) to participate and distribute it as well. As a result, the sampling was unsystematic, as it partially followed the "snowball method". We received 167 completed surveys altogether. 34 (20.4%) of them were excluded from further analysis because they were incomplete and therefore unsuitable for multivariate analysis. 133 fully completed surveys were statistically analysed.

The survey consisted of four parts. The first part referred to demographic and other data from participants, location of the kindergarten and the age of children. In the second part, the teachers were asked about their habits when visited the forest with their kindergarten groups. The third part asked about the teachers' observations during forest visits and the fourth after their forest visiting preferences. The present article discusses primarily the last part of the survey referring to the spatial preferences for a forest visit (Supplementary Materials). I have focused on five survey questions in the model of forest suitability, inquiring after the proximity of a forest to a kindergarten, the preferences for the chosen forest elements, and the preferred forest type and structure.

The Kruskal-Wallis test and Chi-square tests were conducted to examine the dependence of the frequency and duration of visits on the proximity of a forest to a kindergarten. The last survey part consisted of the preferences kindergarten teachers have for the importance of the selected elements (water, stones and rocks; trees, tables and benches; meadows, dead wood, pathways, undergrowth, shrubbery etc.) being present when visiting a forest with children. The participants were asked to choose up to three most important elements. The questions on the forest type preferences (deciduous, coniferous and mixed forest) and its development stage and structure were supported graphically. The descriptive statistics ware used for analyses of these variables.

The participants were shown three photographs of different forest types and asked to choose the one they would decide to visit with their group of children. When acquiring after the preferences regarding the development stage of a forest, I referred to Edwards et al. [20] suggesting the use of photographs as a suitable substitute for the description of forest stands. The participants arranged the photographs of forests differing in development stage and structure according to their suitability for a visit with children from the most to the least suitable one. We selected the photographs representing different forest attributes most visibly. When selecting suitable photographs, we focused primarily on ensuring a comparable lighting, leaf coverage, terrain, and stand structure in the case of forest type. The acquired survey data was analysed using the IBM SPSS Statistics 25 software (IBM, Armonk, NY, USA).

2.2. GIS Analysis—Suitability Model

The suitability of urban forests for a visit with kindergarten groups of children in the study area of the city of Ljubljana was determined based on the geographic information system (GIS) and multi-criteria evaluation method. This method is among the most important tools of spatial data analysis in GIS-environments supporting spatial decision-making [33]. By evaluating various geographic data, it leads to a spatial decision. The evaluation process consists of a discrete and a continuous evaluation. The discrete evaluation transforms decision-making factors into Boolean values (true/false, yes/no) usually representing restrictions in the process of suitability determination under which an activity cannot be or is not allowed to be performed. A more commonly used method in determining the preferred areas for the chosen activity is the continuous evaluation, by means of which factor values are usually standardized to the chosen numerical scale [33,34].

In the presented case study of Ljubljana I used five factors in the suitability model that were identified in the surveys as important when visiting forest with kindergarten groups and for which spatial data are available: kindergarten-forest distance, water distance, meadow distance, forest type and forest development phase. Each of these factors is divided into categories estimated from 1 to 5. These estimates are based on the results of the survey, which are interpolated on a scale of 1 to 5 (forest type and forest development phase) or assigned according to the distance to the desired element (kindergarten-forest distance, water distance, meadow distance). Forest suitability maps for all factors are combined to a model of forest suitability for a visit with kindergarten children. The factors are weighted according to their importance. The kindergarten-forest distance as the most important factor based on literature and the survey is weighted with 0.4, other factors have a weight of 0.15. Additionally, a restriction factor (Boolean value) slope above 30° was included in the model. Such steep terrain is listed in the literature as unsuitable for children. More detailed explanations of the factors and estimates can be found in the Results section.

2.3. Data

The criteria for the construction of the forest suitability model were identified based on the results of the survey. For the forest suitability model, six spatial data I had access to were used. Due to modelling and standardization to a unified numerical scale from 1 to 5, the data were transformed into a raster image with a resolution of one meter (with the exception of the digital elevation model, the resolution of which was 12.5 m). For the preparation, modelling, and mapping of data, the ArcGIS Desktop 10.5 program was used (ESRI, Redlands, CA, USA).In order to determine the proximity of kindergartens to urban forests in the Municipality of Ljubljana, I used the address coordinates of all the public and private kindergartens in the municipal registry [35]. The vector data on the proximity of water and meadows were gained from the Register of Existing Agricultural and Forest Land Use of the Ministry of Agriculture, Forestry and Food [36], while the vector data layer on the level of forest sections for different types and development stages of forests was provided by the Slovenia Forest Service [37]. Forest type is divided into three categories: coniferous (containing more than 75% of coniferous trees), deciduous (containing more than 75% of deciduous trees) and mixed (the share of coniferous or deciduous trees does not exceed 75%). The data on the development stages of forests contain four categories: thicket, pole wood, timber, and regeneration stand. Since the photographs in the survey correspond only to the first three categories, they are the only ones evaluated in the suitability model. The data on the terrain steepness were obtained from the digital surface model of Slovenia with the spatial resolution of 12.5 m [38].

3. Results

The survey was completed by 130 women and only three men, which corresponds to the Slovenian gender ratio among kindergarten employees. 44% of the participants were younger than 40 years (21–40 years), while 56% were older (41–60 years). 52% of the participants had been employed in a kindergarten for over 15 years, 37% 10–15 years, and 11% less than five years. At the time the survey was taken, ten % of the teachers were responsible for the children from the age group between one and three years, and the rest for the children from the age group between three and six years. The information of the total population of kindergarten teachers in Slovenia were not available for comparison with the research sample.

Significant differences (Table 1) were observed among the three distance categories (<1 km, 1–2 km, >2 km) and visit duration (<1 h, 1–2 h, >2 h) as these categories were in the survey. A chi-square tests of independence were performed to examine the relations between forest proximity (from kindergarten) and visit frequency and proximity and visit duration. The relations between these variables have been significant, X^2 (6, N = 133) = 24.1, p = 0.001 for visit frequency and X^2 (4, N = 133) = 11.4, p = 0.023 for visit duration. To reveal where exactly differences between categories are, they were decomposed to dummy variables and Chi-square tests were run. As expected, extreme categories of visit frequency (never and more than four times) have been significantly different ($p < 0.05$). Similarly, also between proximity and visit duration, the significance exists with the longest visit duration (>2 h) and with extreme proximity categories (<1 km and >2 km). Forest proximity is one of the key factors of its suitability for a visit with kindergarten groups. Our study has shown that the closer a forest lies to a kindergarten, the longer and more frequent the visits with children are likely to be.

For the purpose of the forest suitability model, I attributed the highest value to the forest proximity of 400 m corresponding to the distance children can traverse in approximately five minutes [39]. The time a kindergarten group can take to reach a forest is limited. Forests in the walking distance of more than approximately 20 min were evaluated as less suitable.

When visiting a forest, the most important elements observed by the teachers (besides trees) are water, dead wood, proximity of meadows, and undergrowth (Figure 2). In the suitability model, I used the land use data on the proximity of water and meadows, while the discussion contains other attractive elements as well.

Table 1. The dependence of the frequency and duration of forest visits on the proximity of a forest to a kindergarten.

	Visit Duration	Visit Frequency
Kruskal-Wallis H	8.06	20.772
Degrees of freedom	3	3
Asymp. Sig.	0.32	0.000

Grouping Variable: the distance between a forest and a kindergarten.

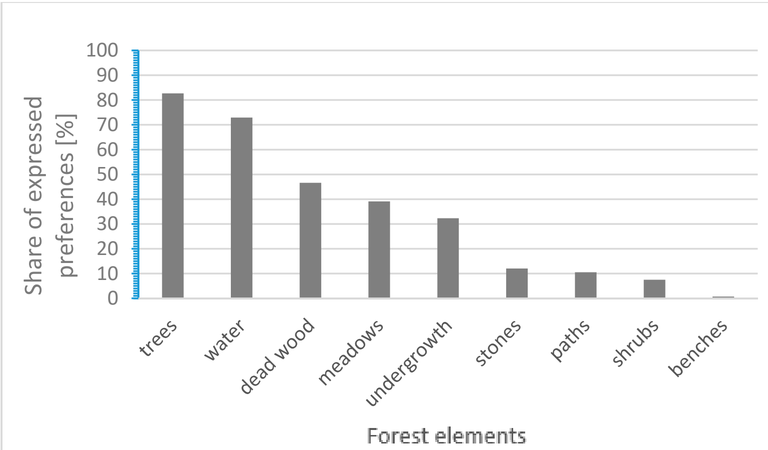

Figure 2. The availability preference for the chosen forest elements.

Concerning forest types (deciduous, mixed, coniferous), suitability values (1–5) were attributed based on the percent of the forest type selected by teachers as the most suitable to visit with children (Table 2).

A one-way ANOVA was conducted to compare the effect of forest development stage on teachers' preference of forest visit with children for thicket, coppice, pole wood and timber development stage. There is a significant effect of development stage on preference at the $p < 0.001$ level [$F(3, 528) = 161.49$, $p = 0.000$]. Post hoc comparisons using the Tukey HSD test indicate that teachers make a significant distinction between the suitability of forest development stages ($p < 0.001$) but not between coppice and timber ($p = 0.064$). For a visit with children, the teachers favour coppice and timber. In accordance with our expectations, their least favoured forest type is thicket (Table 3, Figure 3). For the evaluation of forest development stages in the suitability model, I used a rounded-up average teachers' assessment obtained from the survey, which were also at likert scale from one to five.

Table 2. Teachers' forest type preferences when visiting a forest with kindergarten groups.

Forest Type	Frequency	Percent	* Standardization on 1–5
deciduous	11	8.3	1
mixed	101	75.9	4
coniferous	21	15.8	1

* Standardization: 81–100%: 5; 61–80%: 4; 41–60%: 3; 21–40%: 2; 1–20%: 1.

Table 3. Teachers' forest development stage preferences when visiting a forest with kindergarten groups.

Dev. Stage	Mean	Std. Deviation	Variance	Standardization on 1–5
Coppice	3.98	1.190	1.416	* No spatial data
Timber	3.65	1.155	1.334	4
Pole wood	3.00	1.037	1.076	3
Thicket	1.35	0.835	0.698	1

* The survey contains category "coppice", but due to the lack of GIS-data on this particular forest development stage in Ljubljana, the results were not included in the suitability model.

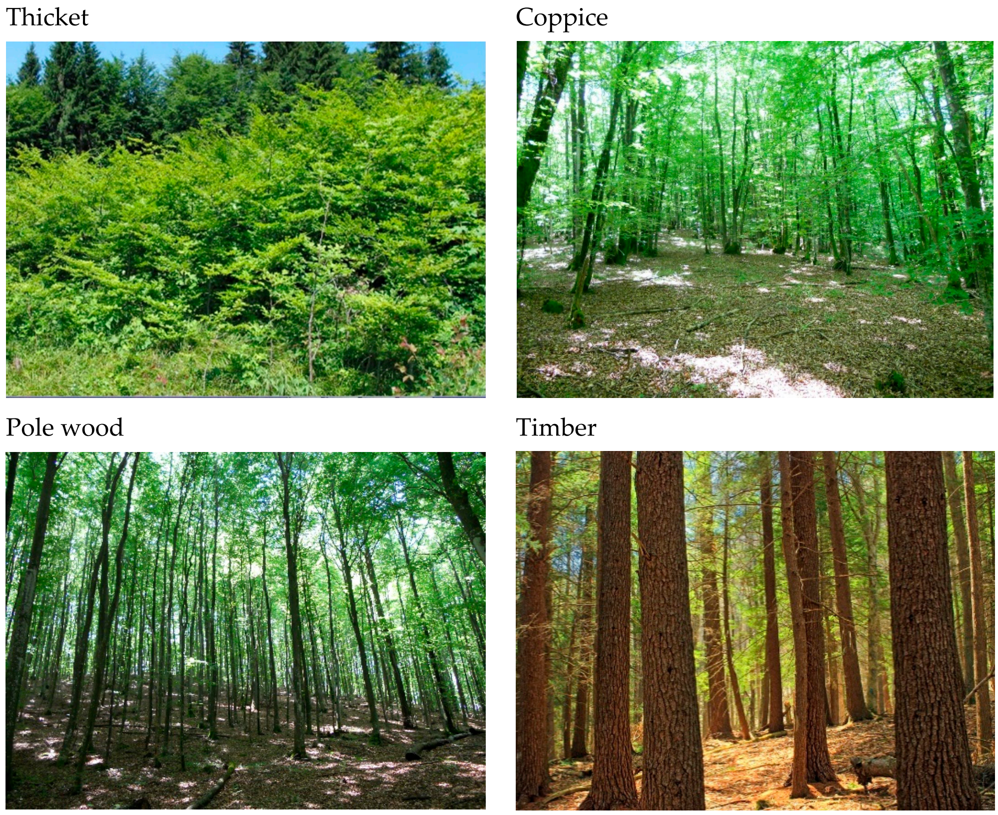

Figure 3. Forest development stages. References for photos: [40] (thicket), [41] (coppice), [42] (pole wood), [43] (timber).

Based on the presented results, their transformation into categories, and attribution of values (Table 4), I developed maps of forest suitability according to different factors (Figure 4) and combined them into a model of forest suitability for a visit with kindergarten children (Figure 5). Based on literature and surveys, I decided on weighting the factors used when constructing the model. Since the forest proximity proved to be the most important factor [27,30], I afforded it the weight of 0.4, while the rest of the influence was evenly distributed among the remaining factors (0.15) (Table 4).

Table 4. The factors used in the model of forest suitability for a visit with kindergarten groups of children with categories, values and weights.

Factors	Categories	Evaluation	Influence (Weight)
Kindergarten-forest distance	0–400 m	5	0.40
	400–800 m	4	
	800–1200 m	3	
	1200–1600 m	2	
	>1600 m	1	
Water distance	0–50 m	5	0.15
	50–100 m	4	
	100–200 m	3	
	200–300 m	2	
	>300 m	1	
Meadow distance	0–50 m	5	0.15
	50–100 m	4	
	100–200 m	3	
	200–300 m	2	
	>300 m	1	

Table 4. *Cont.*

Factors	Categories	Evaluation	Influence (Weight)
Forest type	deciduous coniferous mixed	1 1 4	0.15
forest development phase	pole wood timber Regeneration stand thicket	3 4 no data 1	0.15
slope	0–30° >30°	1 0	restriction factor

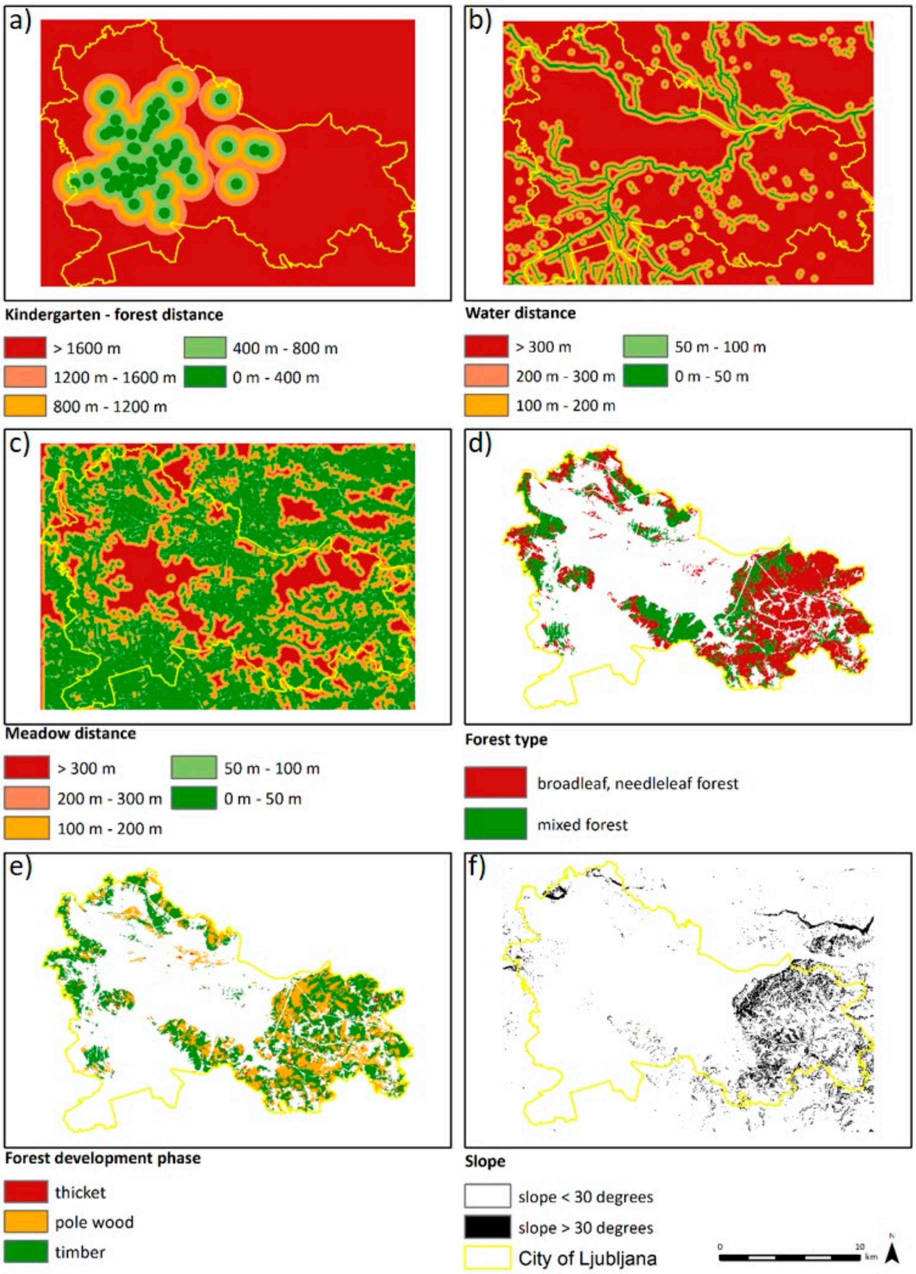

Figure 4. The factors used in the model of forest suitability for a visit with kindergarten groups of children with categories. (**a**) Kindergarten – forest distance, (**b**) Water distance, (**c**) Meadow distance, (**d**) Forest type, (**e**) Forest development phase, (**f**) Slope.

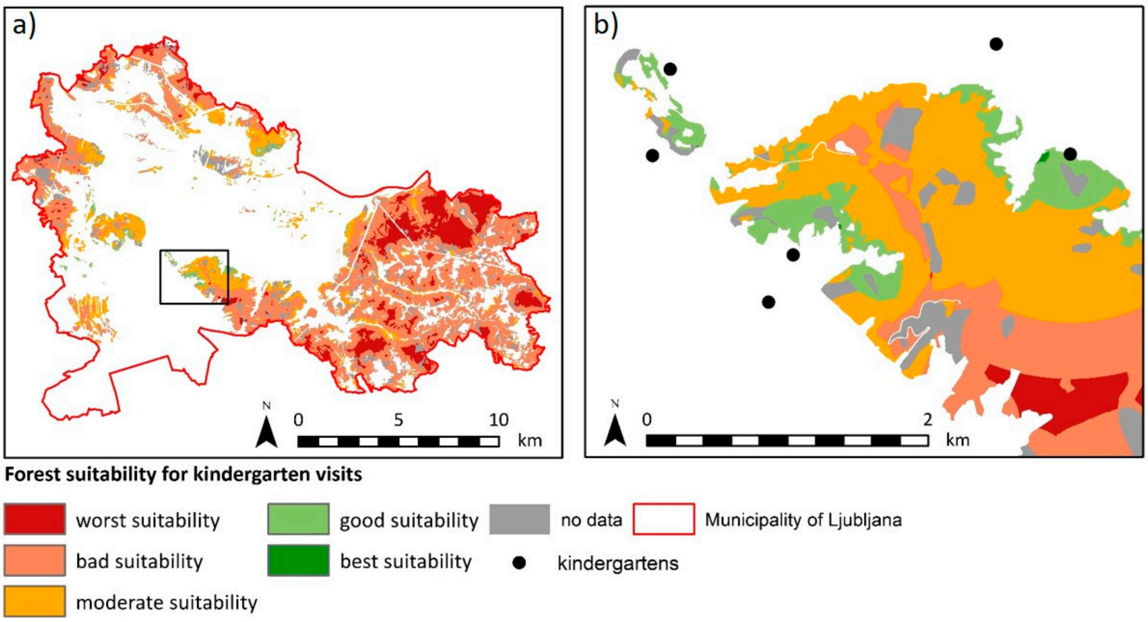

Figure 5. Forest suitability model for a visit with kindergarten groups of children (**a**) and enlarged city centre area (**b**).

After a visual examination of the initial suitability model, I determined that due to the steepness of the terrain, the most suitable surfaces could be practically inaccessible to pre-school children. According to the recommendations for the planning of children's playgrounds [44], the steepest incline allowed when including natural slopes is 1:12 (30°). Consequently, I used the Boolean standardization to edit the model by disregarding all the slopes with an incline of above 30° (Figure 4).

4. Discussion

4.1. Suitability Model

Using the model of forest suitability for a visit with kindergarten groups of children, only 0.5 ha of forest grounds in Ljubljana were determined as having the 'best suitability', while a further 183 ha still provide a 'good suitability'. These grounds represent 2% of the forest areas in the city, whereas the share of forests with either a 'bad' or the 'worst suitability' amounts to 83%. This result is a consequence of the weight distribution as well as the values of the observed criteria. Given the low percentage of suitable forest, there is an obvious need for urban forestry measures to ensure a suitable natural environment that is accessible to urban children within the kindergarten curriculum as well as within the families. The most suitable forest areas from the suitability model should be prioritized when considering management measures and decisions. At the lowest level of implementation, measures such as thinning the undergrowth and leaving an appropriate amount of dead wood can be taken. Planting and maintenance of diverse, mixed stands and the preferred forest development phase (timber, coppice) in suitable forest areas, are the subjects of forest management plans at medium level. However, some measures would be required at a higher political-administrative level of urban green space planning in the city. For example, the allocation of highlighted social functions to the most suitable forests, which influences forest management planning at both planning and implementation levels. It is important that the results are considered in spatial planning of the city: in the selection of new locations for educational institutions, in land use planning, land acquisition, etc.

4.2. Forest Proximity

According to the survey, the most common reason for either not visiting or less frequently visiting a forest is its distance from the kindergarten. The teachers from the kindergartens located less than one kilometre away from the nearest forest visited it with their group more frequently. As determined by Hörnsten and Fredman [27], the Swedes' most common means of transport to the recreational forest within the distance of one kilometre is by foot or on skis. If the distance is longer than two kilometres, the prevailing means of transport becomes a car. Since kindergarten groups are limited regarding time and transport to the forest, its proximity is one of the key factors of the forest visits and I also regarded it as such and weighted more.

4.3. Forest Elements

When visiting a forest with a group of children, kindergarten teachers estimate that in addition to trees, the most welcome elements are the presence of water, dead wood, meadow, and undergrowth. All these are potential materials children can play with or natural playgrounds. Water always makes a location more inviting and interesting. Water surfaces have a positive impact on visual quality and attraction of recreational areas [21,29,45] and enrich them ecologically as well. Sticks or dead trees on the forest ground provide the children with excellent playing material and a polygon to move. An open area within a forest increases diversity and the number of games children can play. Undergrowth provides hiding places and, similarly to dead wood, offers playing material. The diversity of the available elements encourages moving within and learning about a forest [19].

Even though dead wood is an ecologically important forest element, studies of recreational forest preferences place it among the least appealing and welcome elements [26,29]. By contrast, kindergarten teachers participating in our survey deem its presence important when choosing a forest area to visit with a kindergarten group. For children, sticks and branches are means of playing and creating, often in combination with dry fruits they find on the forest ground. In a study conducted in the Swedish city of Gothenburg [28], the preferences regarding the photographs depicting the presence of dead wood were distributed rather evenly (in favour of 'dislike'). The participants evaluated the presence of dead wood positively due to the awareness of its ecological benefits or due to the impression of a more natural forest. Similarly, Pastorella et al. [23] have observed the presence of dead wood in the mountain forests of Bosnia and Herzegovina and Italy to be positively perceived by the tourists. I conclude that the preference for dead wood depends on the background of the participants (e.g., age, profession, education, nature preferences, ethnicity), research method (e.g., visual, on/off-site, interview), and purpose (e.g., recreation, aesthetics, education), which leads to the results being only approximately comparable.

The importance of the elements present when visiting a forest with children differs from the studies into the forest preferences and suitability for the adult population. Most commonly, the latter are based on the aesthetic value and recreational possibilities. People generally prefer a half-open forest with a small amount of undergrowth and dead wood [28]. According to the studies concerning forest recreation, visual penetration has a positive impact on forest suitability for recreational activities [20,26].

The absence of dead wood can also be related to the clearing of undergrowth. According to Tyrväinen et al. [1], Gundersen and Frivold [26] and Edwards et al. [20], people are more likely to visit clearer, more accessible forests with less undergrowth. Clarity, unobstructed movement, open areas, and good visibility of the surroundings are associated with safety [6,46]. These finding were confirmed by our results, as only one third of the teachers estimated undergrowth as being an important element in choosing a forest to visit. Since the presence of undergrowth reduces the visibility of children, they prefer the areas where it is not as dense. Another negative aspect of undergrowth is the presence of ticks, which our survey has shown to represent the greatest concern when visiting a forest with children [47]. Visibility relates to the importance of an open area (meadow or clearing) to be present within a forest or in its proximity.

4.4. Forest Type and Structure

Three quarters of teachers selected mixed forest as the most suitable type for a visit with children. Surprisingly, coniferous forest rated higher than deciduous forest. Mixed forest is preferred in the majority of studies around the world, whereas the preference for coniferous forests over deciduous forests is more typical for the countries of Northern Europe. Most of the studies show preference for mixed forest but then deciduous forest usually takes precedence over coniferous. Hong et al. [48] and Abildtrup et al. [21] have determined a significant preference for broadleaved and mixed forests over coniferous forests among the urban population of Seoul (Korea) and France. In the study review by Ciesielski and Stereńczak [24], central Europeans expressed preference for mixed forests with a higher share of coniferous trees. On the contrary, Tyrväinen et al. [1] and Skłodowski et al. [22] have observed coniferous forests to be aesthetically valued above the deciduous and both to be preferred over mixed forests in Helsinki (Finland) and Poland. In general, Scandinavians prefer coniferous forests [26], probably due to a higher share and forestry tradition. According to the review of Scandinavian forest preference studies by Gundersen and Frivold [26], the results highly depend on factors such as visibility, lightning condition, forest stand and stratification as well, therefore they are not entirely consistent.

Another preference factor is the development stage, also referred to as the size and thickness of trees in some studies. The teachers estimated thicket to be the least suitable, as its thickness does not offer enough room for playing and limits visibility. They were most approving of coppice and timber while remaining neutral towards pole wood. The appeal of mature stands and trees of older age classes is consistent with studies on recreational and aesthetic forest preferences [20,22,24,29]. According to Tyrväinen et al. [1], the least appealing forests consist of closed and dense stands, where young coppices limit visibility. A high suitability rating of coppice for a visit with children is interesting as well. As observed by Rydberg [49], children and younger people generally prefer young and dense stands.

4.5. Research Restrictions and Suggestions for Further Research

One of the weaknesses of these kinds of studies is the use of snowball sampling and internet survey based on voluntary participation [28]. The participants can have a more positive attitude towards forests and visit them with children more frequently than average.

The criteria for the forest suitability model are based on the teachers' preferences from whole Slovenia. Since forests in Slovenia can vary greatly, it is not necessary that the criteria from the sample of Ljubljana's teachers would be exactly the same (eight respondents came from Ljubljana). As the purpose of the case study is to show the application of the model based on the available spatial data, this possible discrepancy is neglected.

Our sample is based on a specific age and professional group–adult teachers estimating forest and its elements from two points of view, the first being its suitability for teachers and the second for children. The teachers estimated forests from the perspective of the person responsible for visiting them with children. The way to the forest and the visited forest area need to be safe, have a good visibility and be close enough. However, they also estimated them from the perspective of children, who prefer to play in a diverse forest containing more elements. Certain aspects of our research cannot be entirely compared to the results of the related studies, as the teachers do not estimate the forests solely based on their aesthetic and recreational value, but also from the viewpoint of children and a combination of other elements such as visibility, undergrowth, tree size, dead wood etc. According to Tyrväinen et al. [1] and Edwards [20], the determined preferences for the forest area and its use can also be influenced by the age, environment and background of the participants.

In the case of graphically aided questions, participants can estimate their forest preference based on multiple interrelated elements [1], although I might inquire after only one of them (e.g., lighting, development stage, undergrowth dead wood). Despite the photographs in our survey being comparable regarding the 'non-estimated' elements as well, I cannot fully exclude their interrelated influence on the assessment by the participants.

Certain studies focus on the preference for different stages of e.g., dead wood, undergrowth or visibility more thoroughly [20]. These studies are usually conducted with photographic methods: either by means of choosing or comparing. In our survey, I did not determine preference stages, as I focused on including more criteria available for GIS-analysis. The data on extensive forest areas are often less accurate regarding separate criteria. It would certainly be interesting to implement theoretical results of stage estimations in forest management practice, especially in a smaller area (e.g., forest sections) where the data could be more accurate.

The survey contains only some of the possible questions related to spatial estimation of forest suitability. A more accurate suitability model could include other spatial, educational, and play-related elements relevant to children, as long as the spatial data on them could be obtained and presented. Some facilities such as benches, picnic tables, paths, restrooms, parking spaces and other similar infrastructure are of course welcome and an important element when visiting the forest with children. This infrastructure makes it easier for families or kindergartens to visit, but in our case I have focused on the natural elements of the forest. The suitability model could be tailored to different contexts by considering the human infrastructure, which increase accessibility for school fieldtrips and families. Spatial multi-criteria evaluation method is rather adaptable: the selection and estimation of criteria is related to the evaluation purpose and further analysis. In the presented evaluation process, I could have used other weights or additional/other criteria. Especial weighting can be to some extent subjective and therefore manipulative to the results, so it is important that decisions are transparent. However, this gives the model a certain adaptability to different cultural and natural conditions. Our suitability analysis qualifies as a possible example used as one of the foundations in further urban forest management, while at the same time, it can be adapted for the use in a different geographic environment or other evaluation needs.

5. Conclusions

Children spend a large portion of the day in kindergartens or similar pre-school institutions. Therefore, it is important these programs enable children to visit natural environments to obtain benefits by spending time there. By conducting a study of preferences among kindergarten teachers, I acquired criteria for the evaluation of urban forest suitability for a visit with kindergarten children.

The results of the forest suitability model can be very helpful in urban forest and spatial planning. For long-term and sustainable changes in the accessibility and suitability of forests for visits by children (and other groups), it is necessary to plan at a strategic level. As the topic is transdisciplinary and covers both forestry and the educational sector, cooperation at a higher administrative level (ministries) in formulating guidelines through the needs of educational institutions would be welcome.

In urban areas, there is a great need for a high quality natural environment. Urban forest planning at city level should take into account the research results. The most suitable forest areas for visits with children should also be properly managed and maintained. Interventions at management level can be minimal, for instance leaving more dead wood, introducing diverse trees, ensuring adequate openness, enabling unobstructed access etc.

The model results can attribute to a (re)definition of educational function of forests in the proximity of schools and kindergartens in urban forest management plans. More radically, I could have said it the other way around: the results should affect urbanization – situating schools and kindergartens in the proximity of the urban forests most suitable for a visit with children. In the urban spatial planning practice, other criteria usually prevail. However, given the spatial planning trends aiming for closeness to nature as well as preservation and inclusion of its ecosystem services, we should still consider including urban forests more prominently in early children's education and supporting it with a proper planning of urban green infrastructure at all administrative levels. The research contribution can be used in related research areas. The presented model of forest suitability can be adapted beyond Slovenia to different spatial and social requirements and contexts.

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