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Technical Note

Awareness of Spontaneous Urban Vegetation: Significance of Social Media-Based Public Psychogeography in Promoting Community Climate-Resilient Construction: A Technical Note

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Abstract: Traditional urban green spaces offer numerous benefits to the environment and residents, but their high social resource expenditure on exploitation and maintenance makes them insufficient to face the threats of global climate change and the rapid pace of urbanization, further raising numerous other socio-environmental issues. Spontaneous urban plants have a superior ability to mitigate urban environmental crises due to their ability to maintain urban biodiversity and provide ecological benefits with minor cost and effort of maintenance. However, these values are often overshadowed by their stigmatized image and aesthetic characteristics that are not widely appreciated by the general public. To promote the future utilization of spontaneous plants at the community level, this study explores how, from the perspective of individual psychology, aesthetic appreciation of spontaneous plants can serve as a pivotal element in motivating environmental participation, thereby fostering urban resilience. Public psychogeography, with its focus on the emotional and behavioral interactions between individuals and their urban environments, can be instrumental in promoting community climate resilience by enhancing place attachment and inspiring collective action towards sustainable urban living. Through study, the project conducted by Future Green Studio, based in New York City, raised public interest and awareness based on psychogeography theory and presented a way of using social media posts, not only as a reflection of the public's aesthetic appreciation of spontaneous urban plants but also as a data collection instrument of their geo-location and ecological properties. The result of the social media engagement activities enabled the establishment of a growing interactive digital open database, covering all of New York City. This database succeeded due to its efficient data collection methods, which resulted in more robust stakeholder engagement as compared to conventional community engagement efforts. The research argues that when residents are empowered to document and learn about their environment, they can become active agents in the creation of sustainable, resilient, and aesthetically enriched urban ecosystems. The success of this initiative offers a replicable model for other cities and demonstrates the potential for collaborative efforts in environmental restoration and education.

Keywords: spontaneous urban plants; interactive public engagement; social media; psychogeography; community climate sustainability

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1. Introduction

1.1. Urban Green Maintenance Dilemma

Global climate change and unprecedented complexities in global urbanization are linked closely with the environmental changes that humanity is facing [1]. Urbanization causes environmental degradation, threats to biodiversity, accelerating pollution, overcrowding, and strains on resources, both in the form of sprawl and densification [2].

Meanwhile, climate change exacerbates these negative effects through increasing extreme weather events such as heatwaves, floods, and storms [3].

Researchers have proved the effectiveness and crucial role of constructing and improving the quality of urban green space in mitigating adverse environmental impacts and reestablishing native biodiversity [4,5]. Urban greenery, including parks, gardens, street trees, and vegetation, offers numerous benefits to the urban environment and dwellers, such as improving air and water quality [6,7], reducing urban heat islands [8], and promoting human well-being [9], which are collectively known as ecosystem services [10]. Therefore, urban greenery has become a fundamental component of urban planning and design, especially in more developed cities [11]. Urban landscape practitioners employ vegetation as media to build up residents' eco-friendly mindsets and facilitate their healthy lifestyles [10,11]. With the requirement to meet these needs, the survival and sustainability of urban greenery are constantly facing various challenges.

Firstly, even though people have tried to save land and reduce natural resource consumption by replacing urban sprawl with urban densification, this, on the other hand, results in an intensified strain on the amount of green space within cities [2,12]. While planning and management strategies can compensate for this situation to a certain extent, green spaces are usually not yet prioritized in urban development projects when it comes to practice and competition for exploitation. Their proportion of the overall urban environment remains insufficient to support the needs of the city as a whole [13].

Secondly, urban residents and administrators tend to perceive artificially manicured plants of certain species as more aesthetically pleasing as opposed to unkempt native or adaptive greenery [14]. Among all the plant species, ornamental plants take up the largest proportion of introduced species, followed by plants for agricultural or forestry purposes [15]. Hence, the flora of urban green space particularly relies on human interventions like planting, weeding (including using herbicides), watering, soil cultivation, and fertilizing [16] rather than their intrinsic ecosystem. Moreover, limited growing space, poor soil quality, urban contamination, and the increasing number of extreme weather events bring extra requirements to urban greenery, including the need to provide ecosystem services to build up urban environmental resiliency while satisfying ornamental expectations [17,18], which brings higher expenditure on investment and maintenance. These additional money, labor, and time costs thus exacerbate the environmental justice issues posed by green spaces [13,19].

These current dilemmas confronting urban greening mean that researchers and practitioners need to reconsider the realm of urban greening, the urban spaces it occupies, and the plant species it utilizes in order to respond to the challenges posed by climate change and anthropogenic pressure.

1.2. Urban "Weeds" and Environmental Restoration

Notably, when examining urban ecosystems, we can find many differences compared to natural ones. Cities are isolated ecological islands, and green spaces in cities are characterized by high habitat heterogeneity, which is affected by the city's surrounding landscape. High levels of urbanization bring a higher proportion of non-native plant species and anthropogenic processes that drive plant dispersal and foster plant diversity in cities [20]. It is hard to say these foreign vegetation species harm urban ecosystems since there exists a balance between the colonization and extinction of urban vegetation's biodiversity [21]. Urban habitats, such as parks [22], cemeteries [23], railways [16], and gardens [24], have great potential for biodiversity [25], in which each contains a unique mix of greenery. The composition of plant populations in cities is influenced by multiple urban drivers, including human management, climate, pollution, and land use change [26]. There are scholars who argue that the lack of guidance in translating green city strategies into practice is partly due to the generalization of different types of greenery in planning policies without considering their specific characteristics or qualities [27]. The homogenized use of plants can make it harder to apply greening to more urban spaces due to the constraints of the planting

environment. The problem is clearly reflected in the growing discussion of brownfield remediation and grey space revitalization.

Urban grey space refers to neglected, underutilized urban space, such as abandoned buildings, vacant lots, and unused alleys. In addition, brownfields stand for formerly contaminated lands in cities. Both typically lack vegetation and aesthetic appeal [28,29]. People have recognized the climate-resilience significance of their restoration and tried to find approaches to realize these goals with economic viability in mind successfully. These spaces are typically not ideal for plants often used in planning and design, but they are home to a wide range of urban "weeds" that grow spontaneously without being noticed [28,30]. These informal plants can easily grow into built spaces and resist extreme weather such as sunburn, drainage issues, droughts, and harsh winds [31].

Urban weeds, also called spontaneous plants, are plants that grow naturally in a particular area without any human intervention or cultivation [32]. They form habitats in sites previously developed or disturbed by humans for species of different scales and provide ecosystem functions comparable to many natural sites [28,33], regardless of massive and long-term anthropogenic stress, providing a promising shelter for urban biodiversity [34]. Global researchers have acknowledged their contribution to inner-city climate resilience through autonomous phytoremediation in grey space and brownfields [32,35,36]. On the one hand, this natural-based solution has the ability to adjust to hydroclimate change and control the speed of urban sprawl through land recovery and reuse [28]. On the other hand, effective brownfield redevelopments produce less greenhouse gas and require less financial expenditure than new greenfield land development and city planning paradigms, therefore evolving them into green infrastructure [28,32,36]. There are also other emerging discussions on their aesthetic enrichment, psychological well-being, and cultural and social significance in various indigenous and local traditions [37]. However, these benefits are still balanced by concerns over invasive species, with some studies focusing on the monitoring and management of "invasive" spontaneous urban plants to safeguard local ecosystems [38–41]. Therefore, the global discourse encapsulates spontaneous urban plants as an integral component of sustainable urban landscapes, while requiring a higher level of dialectical dynamic management and broader knowledge dissemination [42–44].

While spontaneous urban plants have the great potential to aid in the restoration of ecosystem services and biodiversity in cities [37], unlike scholars who have recognized the values of spontaneous urban plants, the public has long neglected them for their unappreciated ornamental value and their consistent intrusion into the well-managed green space, regardless of their inherent ability to facilitate community resilience [45–47].

In fact, spontaneous plants have a direct relationship with the public on a more intimate community scale compared to plants within green spaces derived from typical top-down urban planning efforts. The spread of spontaneous plants across urban habitats makes it impracticable for specialized agencies to record and manage them accurately. However, their low cost, easy planting, and numerous intrinsic ecological values make them very accessible to ordinary citizens. These qualities are crucial for achieving a balance between ecological advantage and social equity. They can be employed by community-oriented strategies to promote environmental sustainability and community participation, which could positively influence social contact among neighbors and allow residents to maintain a more direct connection with nature [48], as well as promote human well-being and be better appreciated by the public [49]. Therefore, it is more important for urban residents to get reacquainted with these mediocre, unsung environmental transformers. Nevertheless, even for common plants, not many people have knowledge of their morphological characteristics and ecological properties, not to mention this informal vegetation. How to make people change their stereotypes about spontaneous plants and help them learn to appreciate the plants' value is one of the primary problems to be solved.

1.3. Environmental Actions and Psychology of Public Engagement

Public engagement is another significant topic for environmental action under climate change and urban planting planning and implementation [50]. Engaging the public is usually a method to reduce project budgets and increase long-term self-directed sustainability [51]. It is insufficient to tackle climate challenges only via technological innovations and official interventions. Public attitudes toward climate change can greatly influence the pace of public decision-making about mitigation and adaptation response [52]. Therefore, the success and effectiveness of environmental solutions also emphasize studying human behavior and psychological insights [53].

Current phytoremediation and management of grey spaces and brownfields, as one mission of the United States Environmental Protection Agency (EPA), seldomly discusses site values or the pivotal cost in their plans, and rarely considers human involvement and benefits, thus easily causing uneven distribution and environmental injustice [54]. The public does not resonate with the communications from advocators and researchers, decreasing their engagement willingness, and resulting in the separation between authority anticipations and actual local power devoted to climate actions. Place attachment and place identity are essential psychological components for effective public engagement in climate strategies [55,56]. Place identity is a multifaceted concept encompassing individuals' perception and emotional attachment towards a particular place or environment. It plays a crucial role in shaping people's behaviors, attitudes, and sense of belonging [57], and place attachment is a field of scholarship that examines the emotional links between humans and places [58]. However, few research and practices realize this importance and are able to merge psychological attachment into urban planting restoration planning to improve the quality of participation practice. This gives a hint that removing the stigma of urban weeds and learning about their knowledge should also be based on the development of local place attachment.

It also implies the obstacle of widely implementing spontaneous plant remediation. Despite their significant role in urban ecological restoration, spontaneous urban plants often go unnoticed and underappreciated in efforts to revitalize city environments. Public perceptions have yet to fully embrace these resilient species as valuable components of urban greenery. To shift this narrative and harness these plants' ecological benefits, we must prioritize transforming societal attitudes toward recognizing their worth. Engagement and participation from the community should be the cornerstone of this transformation. The journey begins by moving beyond the conventional approach of top-down knowledge transfer from experts to the public. Instead, we should cultivate an appreciation for the aesthetic and ecological value of spontaneous vegetation through experiential and participatory learning methods. Developing a workflow that includes interactive workshops, citizen science initiatives, and urban biodiversity programs can help bridge the gap between academic understanding and public sentiment. By fostering an aesthetic appreciation in tandem with ecological awareness, we can lay the groundwork for spontaneous plants to be not only accepted but celebrated as integral to urban environmental health. Consequently, the inquiry shifts to the possible methods and tools: How might attitudinal change and aesthetic perception with knowledge building among the general public to spontaneous urban plants be accomplished effectively?

2. Materials and Methods

2.1. Case Study: Spontaneous Urban Plants

This research explores a new way to reintroduce the public to urban spontaneous plants. Rather than the traditional one-way communication of the ecological value of spontaneous plants by academics to the general public, this approach allows residents to realize an aesthetic appreciation for spontaneous plants and the environments in which they grow. It also explores how this approach can be further directly linked to the restoration of urban environments.

The case we studied in this research is a project called "Spontaneous Urban Plants" (SUP) conducted by Future Green Studio, which presents an autonomous and collective way to gather information about spontaneous plants in New York City by the public. New York City offers a compelling case study for the examination of spontaneous urban flora due to its complex urban heterogeneity and dynamic disturbance regimes. The city's mosaic of diverse microenvironments, shaped by a rich history of ecological and anthropogenic influences, provides a multitude of ecological niches for a range of plant species. Coupled with the temperate climate, this diversity facilitates seasonal variations in plant colonization and survival. The significant cultural diversity within New York City's population has led to an eclectic mix of vegetation, often introduced both deliberately and inadvertently from various horticultural practices. Furthermore, New York's commitment to expanding green infrastructure—such as parks, green roofs, and street trees—enhances urban habitats for these plants. This unique convergence of factors makes New York City an ideal living laboratory for advancing our understanding of urban ecological dynamics and the value of spontaneous vegetation within metropolitan landscapes. The project was initiated in this context, enabling people to uncover alternative vegetation that has long been overlooked and showing a potential approach to urban design that can remove existing barriers in community-spearheaded environmental restoration programs. It records spontaneous plants' specific locations and ecological properties in the city in a public-engaging way via social media. The project aims to shift societal attitudes towards these urban "aliens" by combining psychological considerations, increasing the discussion around them, and recognizing their long-ignored values as beneficial ecological amenities. The studio hoped that by emphasizing the potential of these spontaneous plants to the public, the project could eventually shed light on their potential aesthetic and ecological value to residents, therefore incorporating civic energy into their implementation under conditions of climate change.

The program is based on public participation throughout, thus focusing more on field experience and building local identity and attachment. At the same time, the project responds to the significance of public participation by utilizing the Internet and social media as tools for collecting and communicating information. Figure 1 illustrates the integrated framework of psychogeography and community resilience behind this project that could support long-term community self-efficacy in the environmental restoration and implementation of spontaneous urban plants.

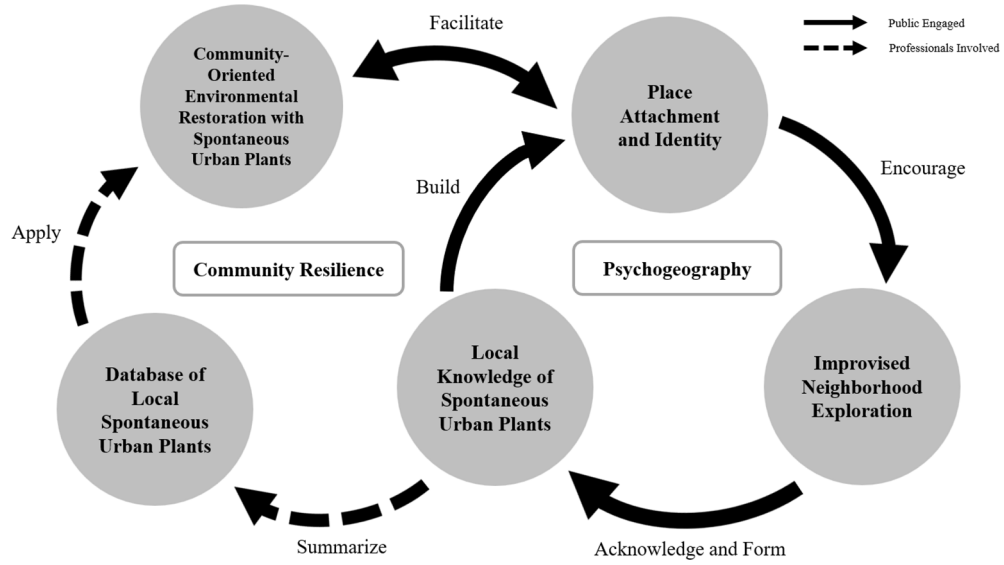

Figure 1. Integrated Framework of Psychogeography and Community Resilience Construction.

The ability of this method to provide urban planners and other environmental experts with the local context is also critical for sustainability development [59,60]. The results of

the project started with learning and identifying local spontaneous plants, as reflected in social media, and then visualizing the outcomes of the participation with the support of further information technology, ultimately forming an open database of spontaneous plants constructed by residents. Figure 2 demonstrates this process of constructing a knowledge system of spontaneous urban plants through public engagement.

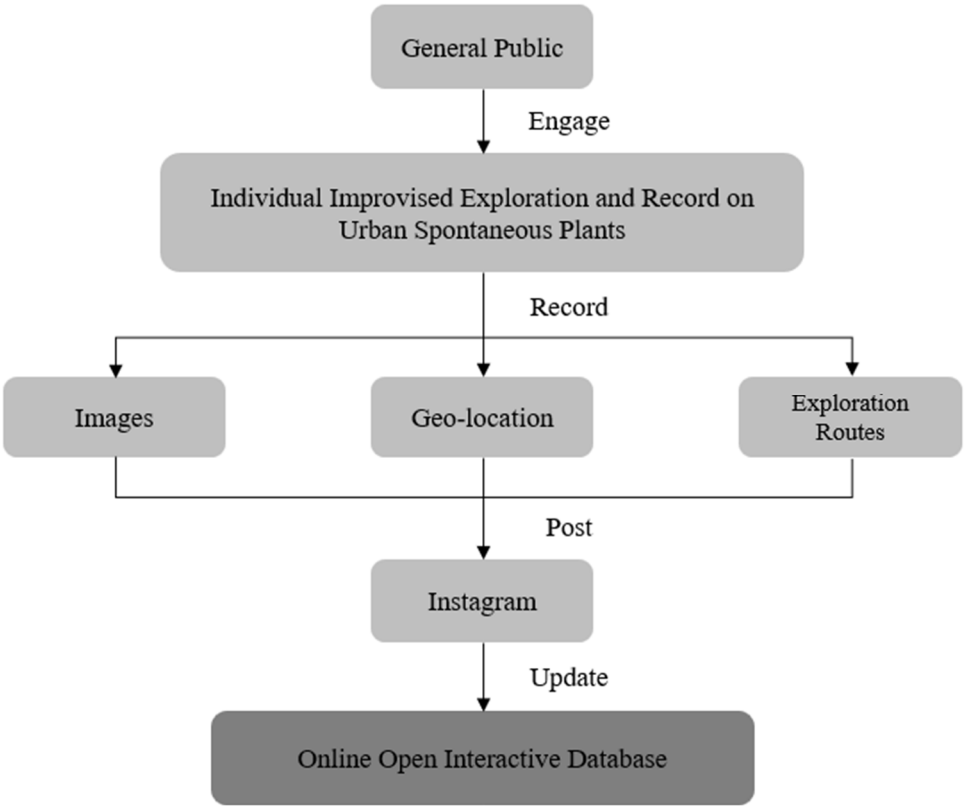

Figure 2. The Procedure of Database Construction.

2.2. Psychogeography: Spontaneous and Poetic Plants Recording

The core of the SUP program is to allow the public to discover the spontaneous plants in their daily lives and to transform these various personal experiential journeys of discovery into a database for SUP, thus allowing for the simultaneous collection of data and the educational significance of the program.

SUP is initiated through a collaboration of designers, landscape architects, horticulturists, researchers, students, and local residents. It references the concept of psychogeography from "the theory of the dérive" proposed by Debord in 1953 [61], which proposed a completely autonomous, improvisational approach to urban exploration and unfolding hidden meanings in the traversed city. Dérive, as an investigation method, can provide a unique and unconventional perspective on the city, allowing for new insights and discoveries. It can also help reveal the overlooked aspects of the city, such as forgotten spaces and spontaneous plants, that might not be uncovered through traditional site analysis. Meanwhile, dérive can encourage creativity and spontaneity of people in public space even without prior professional knowledge in urban study. David Seiter, the principal and design director of the studio, uses the method and the style of his own urban adventure journal to provide an example of how public engagement works: maps with hand-drawn action routes and notes on SUP explorations, matched with small paragraphs recording the location, weather, duration, and notes taken by city rambler. This playful approach is akin to a treasure hunt and helps to create a deeper connection between the individual and the city and gradually build up place attachment.

Place identity and psychogeography are related concepts that explore the connection between individuals and their surroundings. Psychogeography focuses on individuals' emotional and psychological experiences within urban environments [62]. It examines how individuals interact with and perceive their surroundings, particularly in relation to the influence of place on their emotions and behaviors [63]. It builds up the sense of self and belonging, therefore adding to the emotional tie with the local environment and sense of responsibility for environmental protection [64], thus increasing the chance of public willingness to participate.

One point needs to be mentioned, dérive may not be suitable for all research purposes, as it is not a systematic or rigorous method of data collection. It can be difficult to draw concrete conclusions or generalizations based on the experiences of a single individual or group. The record or the documentation of plants requires a high level of standardization for its generalization and application accuracy. Psychogeography may indeed be an ideal way to communicate the importance of spontaneous plants to the community, but because every person improvises and explores the city in different ways, the data collected may have different emphases and gaps. SUP clearly realizes the potential problem. Therefore, except for the dérive diary and the pictures of spontaneous urban plants, the corresponding plants' morphology and ecological properties are more of an encyclopedic interpretation and are pre-organized, and detailed instructions are prepared in advance for the subsequent public participation, including characteristics, life span, habitats, history, and eco-services. Each plant is explicitly denoted with its potential role in the urban ecosystem under these categories: wildlife habitat, carbon sequestration, noise regulation, edible, medicinal, stormwater retention, phytoremediation, erosion prevention, urban heat mitigation, and flood prevention.

2.3. Digital Informatization: Social Media and Online Database

Even though digitalization has helped the research on biodiversity make significant progress, the current data collection and organization processes of plant species can be challenging due to various reasons. For example, geographical and taxonomic biases or knowledge gaps might exist that limit the information's accuracy and reliability [59,65]. The lack of models for representing the morphological traits of plants and the barriers to advancing plant phenotyping techniques, including the gap between measured data and phenotypic values, lead to difficulty in scaling out the research and popularizing this knowledge [60,66]. The measurement and collection of urban spontaneous plants can be more challenging in this situation due to their marginalization in the city. The conventional methods, channels, and efficiency of plant knowledge dissemination are very limited, not to mention the fact that these urban wild plants lack a "formal record". Therefore, new methods and tools are required to collect and spread this plant knowledge effectively. SUP adopted another way of thinking that introduces insights into existing urban spontaneous plants through interactive public participation in constructing a repository for them and a related extended online service. In other words, the construction process of this wild plant dataset is primarily composed of two aspects: psychogeography-based investigation and citywide participation via social media.

As described by Future Green Studio, the project was initiated with the activity on Instagram, where people uploaded photos of spontaneous plants they found in any corner of the city by tagging posts with #spontaneousurbanplants (Figure 3). Every photograph with the tag was submitted to the Spontaneous Urban Plants website for verification and species identification. Following identification, the plants in the photos would be assessed for their corresponding ecological benefits and drawbacks, such as their role in phytoremediation, adaptability to disturbances, contribution to reducing the urban heat island effect, or ability to capture carbon dioxide. Also, the metadata derived from each photograph is used to pinpoint the exact location of the plant and to showcase the plant's seasonality by referencing the timestamp from when the image was captured. As this collection grows, it will feature multiple images for each plant species, illustrating the

changes throughout the seasons and creating a visual timeline of flowering and seeding periods through the lens of photography.

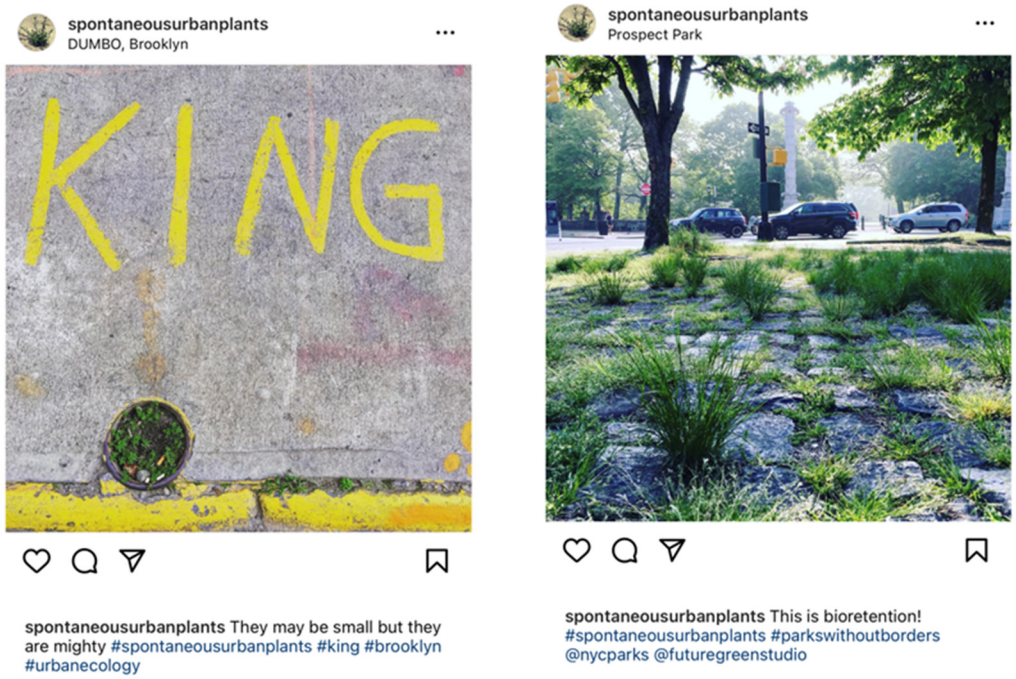

Figure 3. Social Media Engagement posts by @spontaneousurbanplants on Instagram (date of the post: 21 August 2018 (**left**); 19 May 2018 (**right**)).

This approach distinguishes Future Green Studio's work from other botanical data collection efforts as it prioritizes the unique lens of humanly perspectives over advanced but sterile technologies such as GIS, GPS, and remote sensing [60]. Collecting and analyzing data through social media harvesting is a reliable and objective approach that is not intrusive and is automated [67]. Unlike conventional methods, generating one single post within a few seconds can contain multiple pieces of information, including time, space, emotion, and objects [68]. Social media like Instagram has a high degree of popularity, has simple, functional pages, and is easy to get started. It can also save time, effort, and money and can handle large-scale data sources more easily [69]. Because of the unstable factors in human behavior, the plant type collection and picture information can be subject to errors, such as misrecognition or unclear photography. Nevertheless, this risk of this inaccuracy inherited in dérive can be mitigated by the wide-reaching public engagement on social media. At the same time, the accumulation of image information can increase the precision of plant identification [60]. This method can effectively enrich the public's emotional appreciation of spontaneous urban plants, promote greater community engagement with these valuable ecological amenities, and ensure their reliability theoretically [67].

Similarly, social media has been found to have a positive impact on place attachment and proved to have increased the attachment toward the natural environment [70,71]. These are exactly the attitudes we aim for the public to form toward spontaneous plants. Additionally, social media has a more significant impact than traditional media in influencing pro-environmental behaviors [72,73]. Research specific to Instagram shows that Instagram provides a special way to explore and engage with local communities. By using Instagram to showcase city-related content, there is a renewed emphasis on local places and their social opportunities. This, in turn, enhances users' connection to their sense of place and sense of community [74].

3. Result: Interactive Growing Open Database

The project was launched in 2014; by 2022, more than 1000 people had followed the project. There were over 5000 posts on Instagram with the tag, #spontaneousuranplants. The Future Green Studio built a website to summarize and visualize the result of the outreach. It also can be used as an experimental, interactive, and easily accessible database platform to plug in a more general population to these wild urban plants. As we can see from the map of public-recorded spontaneous plants on the database (Figure 4), every borough in New York City has residents who responded to the event, and a citywide information network of spontaneous plant locations was initially constructed. Figure 5 provides a zoom-in version of the map, and Figure 6 presents a diagram made by the Future Green Studio showing the predominant spontaneous urban plant species found with their ecosystem service properties. It is notable that, as mentioned earlier, spontaneous plants are plants that tend to grow in grey spaces or brownfields in the city, so this map is not just about the distribution of plants but also about the potential sites that can be renovated for the city to build ecological resilience and defenses against climate impacts, which provide a reference for the future implementation by planners or other experts.

Figure 4. Map of Recorded Urban Spontaneous Plants on the Website. (Source: https://www.spontaneousurbanplants.org/, accessed on 7 November 2021 by Future Green Studio https://futuregreenstudio.com/design/spontaneous-urban-plants/, accessed on 7 November 2021).

The database website consists of six sections—"About", "Map", "News", "Profiles", "Services", and "Book" (Figure 7). Together, they form an online encyclopedia of spontaneous urban plants in New York City about their spatial distribution, name and category, features, and relations with urban environments. The "About" section includes an overview that explains the significance of delving into the study of SUP. This part concisely describes current directions and discussions on the roles these plants play in different aspects, involving the thinking of urban aesthetics, appreciation, and construction. The page sets out a comprehensive outline for related social and spatial scales, topics, and people who participated through a brief introduction to Future Green Studio and the scholars who inspired it. It introduces the method of using Instagram as a main tool to catch public attention and encourage them to join, thus improving the depth and breadth of data collection.

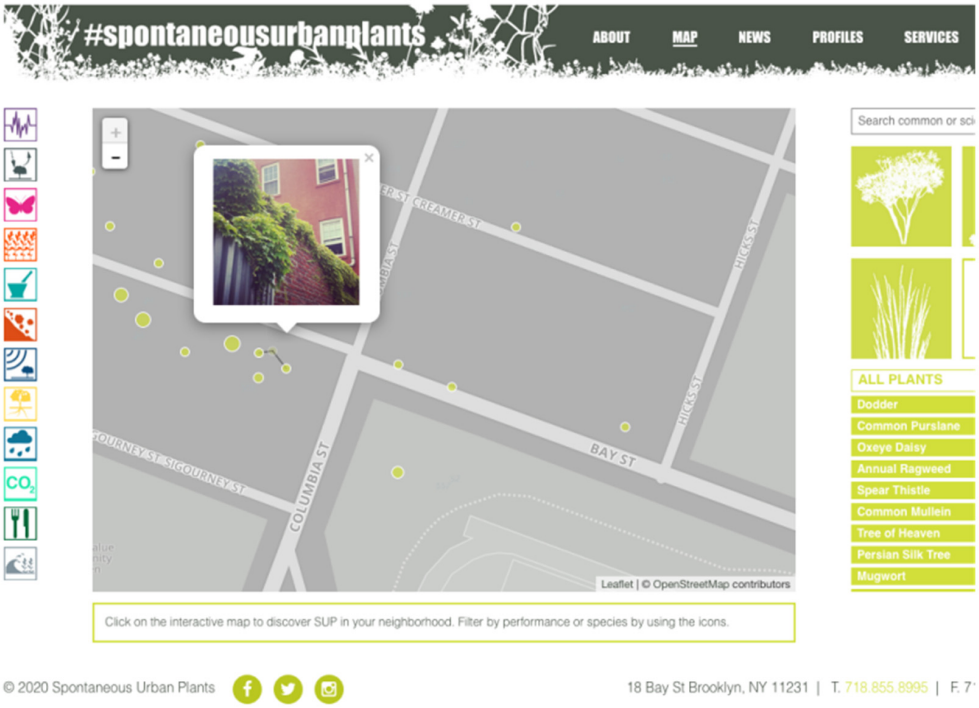

Figure 5. Zoom-in Map of Recorded Urban Spontaneous Plants in the New York City. (Source: https://www.spontaneousurbanplants.org/, accessed on 7 November 2021 by Future Green Studio https://futuregreenstudio.com/design/spontaneous-urban-plants/, accessed on 7 November 2021).

Figure 6. Predominant Spontaneous Urban Plants Species and Ecosystem Services Properties (Source: Future Green Studio).

The result of social media engagement and dérive has been presented under the "Map" column; an interactive map and conditional filter boxes function as a crucial part of the web tool for its practicality, offering users the chance to both input and receive output. The large number of participants enables individual improvisation behavior to cover an ideal range of city areas automatically. The data from Instagram provides geo-location and through different keyword filtration combos, viewers can learn more about the distribution of one or several types of spontaneous plants. Using common names and classifying them as "Trees and Shrubs", "Herbaceous and Flowers", and "Grasses" enables people to easily replenish and access information even without a background in botany. Meanwhile, the map provides precise locations of the plants and their habitats, and each with a live photo to help users visually connect them to their daily lives. The linear icon column on the left side visualizes the influence of SUP on eco-system services, with an explanation and photo of the plants under different service categories. The "Profiles" section presents all the collected spontaneous plants in a gallery view to give visitors an overview of the recorded plants and

their growing environment and appearance. Supplementary and background information is provided in the "Services" section, which elaborates on the different ecological services provided by wild plants and the systems behind them. It links to the bottom note under the interactive map, which effectively provides a brief conclusion to these ecosystem services.

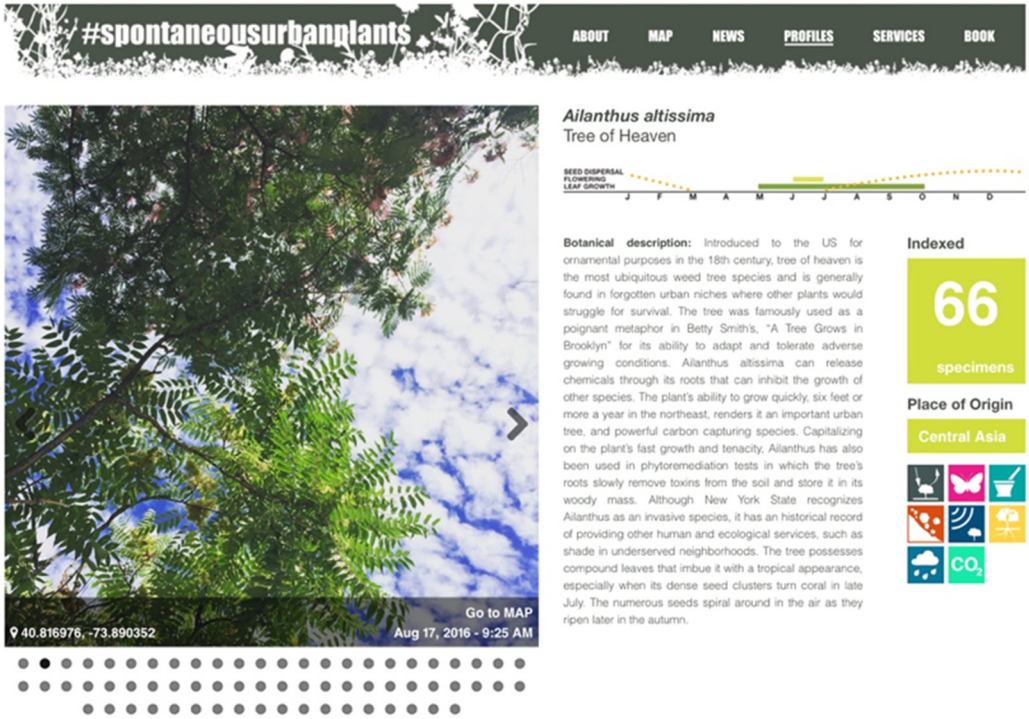

Figure 7. Structure of the Website (Source: https://www.spontaneousurbanplants.org/, accessed on 7 November 2021 by Future Green Studio https://futuregreenstudio.com/design/spontaneous-urban-plants/, accessed on 7 November 2021).

When we examine the growth potential of the established dataset in the future, we see that the project has proven its feasibility in advocating for residents to discover and collect locations of these scattered urban spontaneous plants via social media. People who join this event can not only learn about their restoration properties but also learn about their edible and ornamental value to human individuals [28]. In the process of investigating, people started paying attention to overlooked community spaces and developed a better acquaintance with their local environment. As participants attempted to photograph these spontaneous plants and their habitats from the best possible angles, people were, in fact, building an appreciation and attachment to the space.

4. Discussion

The Interactive Growing Open Database project driven by social media presents a transformative approach to urban environmental engagement, illustrating how community participation, coupled with digital platforms, can redefine ecological consciousness in urban settings. Launched in 2014, the project's trajectory to 2022 reveals a promising public response, with over 1000 followers and 5000 Instagram posts tagged with #spontaneousurbanplants. The initiative underscores a crucial pivot in individual-level environmental data collection, fostering a participatory science model that blends citizen observation with data visualization. The distributed pattern of recorded spontaneous plants across New York City's boroughs demonstrates an inclusive and citywide commitment to ecological documentation. By channeling these collective inputs through an accessible online platform, the project has enabled the public to contribute to scientific knowledge while fostering a sense of stewardship over their immediate environment. The multi-faceted website serves not just as a repository but as a dynamic educational tool,

demystifying botanical science and bridging the gap between professional ecologists and the general public, by classifying plants into user-friendly categories and providing rich visual content that removes the barriers to botanical literacy.

At the same time, the website not only maps the presence of urban spontaneous plants but also highlights potential zones for urban renewal and ecological fortification. Such a map is a testament to a groundswell of urban ecological awareness and points toward a network of sites ripe for intervention to bolster the city's resilience against climate impacts. As an extension and experimental interactive interface, the online database for "#spontaneousurbanplants" has the potential to provide the public with accessible and engaging learning and contributing experiences, as well as aiding landscape practitioners in their design implementation by providing the reliable local context of spontaneous plants. Although the website is in the concept phase and still developing, it shows its potential to be a powerful means to demonstrate the database collected from social media and will get the general public on board more easily, thanks to its refreshing user interface and intelligible summary of information. Therefore, the project has further proven the practicality of digital interactive engagement in facilitating ecological restoration and raising public environmental awareness.

In addition to presenting the taxonomy, geolocation, and ecological property of the various species of spontaneous urban plants, the project also provides a philosophical foundation for the public and landscape practitioners to understand these plants comprehensively. The implications of this project stretch beyond mere data accumulation to a broader public environmental and climate awareness. The assembled database delineates an intricate relationship between urban residents and the spontaneous vegetation thriving amidst concrete and steel. As participants engage with the platform, taking photographs and sharing insights, they are not just documenting urban flora; they are redefining the aesthetic narrative of the city. This engagement promotes a deeper connection to their neighborhoods, transforming anonymous spaces into familiar habitats. It is a form of community-building that roots itself in ecological interaction, where beauty and utility are discovered in the most unassuming corners of urban landscapes. This approach could potentially revolutionize how residents perceive and interact with urban nature, encouraging a shift from passive indifference to active participation and appreciation, therefore evoking place identity and attachment which fuel environmental actions.

The success of the interactive growing open database and SUP project overall, catalyzed by social media engagement, exemplifies a participatory approach that could reshape landscape research. Its method of crowd-sourced data collection and visualization not only deepens public ecological literacy but also provides a practical framework for integrating community input into urban design and planning. This platform bridges the gap between the public and ecological data, offering a compelling model for future research to leverage in fostering environmental stewardship and advancing urban biodiversity. As such, the project not only contributes to the understanding of spontaneous urban plants but also serves as a prototype for policy advocacy and the creation of climate-resilient urban spaces. Its demonstrated impact on community engagement and place identity underscores the value of participatory science in environmental research, setting a precedent for how urban green spaces might be collaboratively designed and managed to enhance ecological and social well-being.

5. Conclusions

Challenges faced by urban greenery include limited space, poor soil quality, water availability shortages, high maintenance requirements, and a lack of public awareness and support, making them insufficient for sustaining long-lasting and cost-efficient urban ecological restoration. In this research, we elicit a general look into the role of spontaneous plants under the fragile status of traditional urban planned vegetation in the face of changing climate, decreasing biodiversity, constant rapid urbanization, and other severe environmental challenges. The SUP project shows its significance in challenging the

hegemonic assumptions in landscape architecture that dictate which species are deemed desirable and worthy of cultivation. The spontaneous growth of wild urban plants offers a subversive alternative to change the homogenized landscapes that dominate urban areas, as well as a powerful and effortless tool to mitigate climate impact. They offer urban landscape architecture design and planning new media and implementation strategies to highlight the value of ecological diversity and resilience.

In recognition of the significance of spontaneous urban plants and the crucial role of public attitude and participation in their widespread adoption, our exploration in search of effective strategies for altering the public's perception of urban spontaneous vegetation has been enriched by the SUP project. We completed an integrated framework of psychogeography and community resilience construction from the case study. The theory of psychogeography allowed the public to explore the environmental aesthetics and ecological significance of these plants by themselves in their daily living environment, hence gradually shifting the public's stereotypes of spontaneous urban plants. The framework also demonstrated a viable method of leveraging social media to spark public interest from an aesthetic perspective, subsequently laying the groundwork for knowledge-building and simultaneously enabling them to become actual contributors to community resilience construction.

This has successfully taken a new step forward in encouraging civic engagement in the landscape architecture field. It is a novel attempt at building community resilience under climate change, which, instead of being initiated, funded, and led by planners and designers, is grounded in the perspective set up by residents and the public's perception of their living space. It sheds light on the necessity and viability of collaborating psychological human behavioral study with the construction of urban diversity and the complexity of urban ecosystems in achieving an eco-sustainable and inclusive urban community.

Additionally, in this exploratory study, we have identified the pivot of social media in transforming individual urban spatial experiences—central to psychogeography—into visual, interactive, and referenceable data. The voluminous data it yields is sufficient to develop an open, interactive database, which, while engaging the public in the participatory process, also supplies urban planners and designers with reliable localized knowledge. This indicates that when residents have the capacity to document and comprehend the environment they inhabit, they become proactive contributors to the creation of sustainable, resilient, and aesthetically pleasing urban ecosystems. The success of this initiative offers a replicable model for other cities and other environmental actions and demonstrates the potential for collaboration in environmental restoration and the public force.

6. Limitations and Future Suggestions

The SUP project presents an innovative, participatory approach to documenting urban spontaneous vegetation, offering valuable insights into community engagement and environmental interaction. The exploratory nature of this case study has highlighted several areas that provide fertile ground for future research, reflecting the iterative process of scientific inquiry. The temporal dynamics of spontaneous urban vegetation is an aspect that this project has begun to uncover. Ongoing data collection and longitudinal studies would be valuable to capture the seasonal and long-term changes in urban plant ecology, providing a dynamic perspective on urban ecosystems. While the project has made significant strides in involving a broad spectrum of the urban populace, further research could enhance understanding of how to engage diverse demographics more comprehensively. This could lead to more inclusive and representative data that better reflects the full tapestry of urban ecological interactions.

The methodology, primarily reliant on citizen contributions, offers a preliminary framework that could be strengthened by integrating systematic validation measures. Such enhancements would not only improve data accuracy but also contribute to the robustness of citizen science as a tool for ecological monitoring.

Engagement depth, a critical aspect of the project, could be assessed through subsequent studies focusing on the transformation of passive digital interactions into active,

participatory experiences. Investigating the continuity of engagement could yield strategies for deeper community involvement and learning.

While the project has illuminated the potential of social media in altering public perceptions and behaviors towards urban vegetation, further empirical research is needed to substantiate these shifts. Subsequent studies could focus on measuring the tangible impacts of such participatory projects on urban ecological practices and policies.

The scalability and sustainability of the model proposed by this case study are promising areas for additional inquiry. Future research could explore the adaptability of this approach to varied urban settings and assess the long-term operational requirements of maintaining such community-driven databases.

In terms of policy influence, this initial foray sets the stage for a more in-depth analysis of how grassroots data collection can be effectively translated into policy action. This remains an essential avenue for research, bridging the gap between community engagement and policy implementation. Urban green space management should evolve to embrace the inherent value of spontaneous flora, incorporating strategies such as modified mowing regimes that permit wildflower growth, thereby enhancing urban biodiversity and ecosystem services. Concurrently, urban planning and biodiversity conservation policies should be aligned to safeguard and promote beneficial spontaneous species within the cityscape, integrating these plants into the fabric of urban green infrastructure. Such information should also be included in the open database for forming mutual information communication. Moreover, to stimulate public interaction with urban nature, using suitable methods and tools is as essential as cultivating ecological literacy and participatory stewardship. Educational initiatives and citizen science programs could collaborate with social media tools and present the result in an interactive and sustainable way. In tandem, the database can be further designed with systematic monitoring of urban vegetation dynamics, which can inform the adaptation of zoning and land-use policies, distinguishing between ecologically valuable plants and invasive species requiring management.

Finally, the ecological impacts of the documented spontaneous vegetation warrant further examination. While the current study did not delve into the comprehensive ecological consequences, subsequent research could provide clarity on the role of these plants within urban biodiversity and their integration into urban conservation strategies.

In essence, the exploratory nature of this case study opens several pathways for future research to build upon the foundational work presented. Each area identified for further study underscores the project's potential and reflects the evolving nature of urban ecological research.

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