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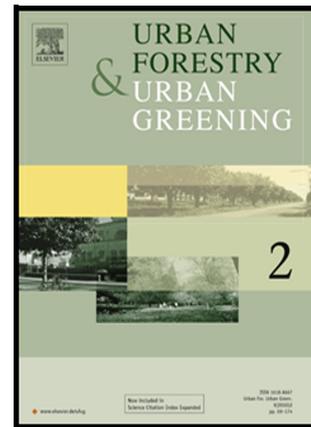
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# How managers and city dwellers relate to spontaneous vegetation in cities: towards an integrative approach

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## Authors contribution

**Muriel Deparis:** Conceptualization, Methodology, Formal analysis, Investigation, Writing – Original Draft, Visualization

**Nicolas Legay:** Conceptualization, Methodology, Investigation, Writing – Review & Editing, Supervision

**Francis Isselin-Nondedeu:** Writing – Review & Editing, Supervision

**Sébastien Bonthoux:** Conceptualization, Methodology, Investigation, Writing – Original Draft, Visualization, Supervision

## Abstract

The promotion of spontaneous vegetation is recognized as a promising way to develop urban biodiversity at multiple scales. However, enhancing spontaneous vegetation in highly anthropized spaces such as cities can lead to resistance from the various urban actors who plan, manage, and use the city. An integrated approach analyzing the links between ecological, psychosocial, governance, and management issues is thus required. Here we used complementary methods (focus groups, interviews) to analyze the relationships of municipal field operatives and city dwellers to spontaneous vegetation in the streets of a French medium-sized city. We show that municipal elected officials and service director move towards a biodiversity-friendly strategy, but that the management system at all hierarchical levels must be engaged with to achieve a shared and collaborative transition to sustainability. While field operatives are rather favorable to spontaneous vegetation, their practices and their ability to change are highly dependent on psychosocial, organizational, and technical parameters that have to be aligned with ecological objectives. Concerning city dwellers, the majority holds a positive view of spontaneous vegetation, yet a considerable proportion of them seem indifferent to this vegetation. The provisioning of ecological information *in situ* (i.e., stickers with plant information on pavements) moderately improves their perceptions of spontaneous street vegetation. This educational approach should be accompanied by other approaches to amplify the effect for changing attitudes. These differing results are of timely interest to help devise and build an integrated socio-ecological system, and to find social and organizational levers to improve people–nature relationships in the city.

**Key words:** communication campaign, focus groups, operational management, street maintenance, vegetation perception, weeding management

# 1. Introduction

The current context of accelerating urbanization generates important issues in biodiversity conservation (McKinney, 2006), the well-being of city dwellers (Soga & Gaston, 2016) and the relationships between human activities and ecological functioning (van den Bosch & Ode Sang, 2017). In this context, it is imperative to find approaches that support the transition of urban systems towards sustainability. To that end, the promotion of vegetation that grows and colonizes the city freely (hereafter called spontaneous vegetation) is recognized as a means to enhance urban plant diversity at multiple scales (Salisbury et al., 2021) as this vegetation provides breeding sites, refuges, and food resources for many animal species (see Bonthoux et al., 2014 for a review; Twerd & Banaszak-Cibicka, 2019 for bees; Villaseñor et al., 2020 for birds). However, promoting spontaneous vegetation in highly anthropized spaces such as cities can lead to resistances from the various urban actors who use, plan, and manage the city. Planners and managers can anticipate negative reactions of the public associated with a feeling of abandonment, and an excessive difference between traditional management and spontaneous vegetation (Hoyle et al., 2017). They may also consider that they do not have enough time, money or equipment to change their practices, or they may be opposed to doing so because they believe that current practices are good and positive for biodiversity (Lampinen & Anttila, 2021). Indeed, supporting the transition of cities to more biodiversity-friendly management implies going beyond ecological knowledge and also investigating the urban socio-ecological system in depth (Kowarik, 2018), by linking ecological aspects with psychosocial, governance, and management approaches (Frank, 2017; Bretagnolle et al., 2019).

Recent studies have investigated the attitudes of city dwellers towards spontaneous vegetation in cities (Brun et al., 2018; Mathey et al., 2018). They show that perceptions are contrasted, ranging from negative to positive, depending on the contexts and respondents. City dwellers prefer vegetation with a diversity of structure and color (Fischer et al., 2018) over hard landscape (Bonthoux et al., 2019a). Nevertheless, orderly vegetation that is perceived as being

planted and maintained seems to be preferred against vegetation with messy aspects (Weber et al., 2014; Bonthoux, Voisin, et al., 2019; Hwang et al., 2019). Cues to care, which are immediately recognizable signs of human intention or presence (e.g., footpath, benches, plants in rows in urban green space), have been proposed as ways to facilitate relationships between the spontaneous characteristics of places and users (Li & Nassauer, 2020). They also can mitigate the feeling of insecurity and abandonment sometimes associated to the presence of spontaneous vegetation in streets (Säumel et al., 2016). Other studies show that people have little perception of spontaneous vegetation, and this phenomenon, not limited to cities, is called ‘plant blindness’ (Balding & Williams, 2016). It is explained by the fact that individual plants do not move like animals, grow in patches, tend to obscure each other, and are overall uniform in color (Balding & Williams, 2016). To promote positive city dwellers–spontaneous vegetation relationships, providing ecological information is a way to change the meaning and knowledge associated with plants, which could improve the acceptance of low management practices in urban areas (Unterweger et al., 2017).

Promoting spontaneous vegetation in urban public places also requires considering the governance and management systems of municipalities, to analyze their operationalization level of ecological measures (Dempsey & Burton, 2012; Hoyle et al., 2017). A few studies have examined the propensity of public managers to shift their practices toward extensively managed urban spaces (Duivenvoorden et al., 2021). These inquiries have focused on perennial meadows (Hoyle et al., 2017), urban plantings (Nam & Dempsey, 2019), low input turfgrasses (Barnes et al., 2020) and urban forests (Ordóñez et al., 2019). All these studies emphasized that the complexity of the management system must be analyzed in depth to move towards sustainable practices. Those studies showed that technical and scientific knowledge, the working conditions of public managers, the organization of municipal services, financial aspects, and user feedback are important determinants for better understanding managers’ attitudes and practices vis-à-vis vegetation (Hoyle et al., 2017; Nam & Dempsey, 2019; Barnes et al., 2020). Further, while the analysis of the decision-making processes of elected officials and municipal service managers is developing, this

rarely includes surveying the field operatives who are daily maintaining the urban vegetation.

Linking these social and technical issues with ecological urban elements in an integrative framework can help to identify the relationships and feedbacks between urban actors and spontaneous vegetation, as well as promising opportunities and obstacles to develop positive people–biodiversity relationships. Two conceptual models are used in the field of landscape planning and management to address, in a systemic way, the governance and management of urban open places (Randrup & Persson, 2009; Dempsey & Burton, 2012; Jansson et al., 2019). Combining several previous theoretical frameworks, Jansson et al., (2019) proposed a model with three interconnected elements: “users and city dwellers”, “public actors and organization”, and “urban open spaces”. Users and public actors are connected through “discourses”, and both actor groups are related to urban open spaces via “power and resources” that depend on the modes of governance (Jansson et al., 2019). In their “Place keeping model”, Dempsey & Burton (2012) argue for the need to think deeply about the management of urban projects to insure the long-term provisioning of social, environmental and economic benefits of urban spaces for future generations. This model is composed of interconnected management dimensions, namely maintenance, partnership, governance, funding, policy, and evaluation (Dempsey & Burton, 2012). Both models have been conceptualized to better understand the organization and interconnection of actors who decide, manage and use public places in city, but as of yet without direct links to biodiversity conservation issues. In this paper, we used both models to analyze in an integrative way the social and management system related to spontaneous vegetation in streets.

Streets are ubiquitous urban spaces designed and managed by the municipality, traversed daily by its inhabitants, whose pavements harbor a diverse spontaneous vegetation (e.g. 307 plant species on pavements of a French city, Bonthoux et al., 2019a). This street vegetation provides ecological resources for various animals and represents an opportunity to understand and foster the relationships between city dwellers and nature (Weber et al., 2014; Bonthoux et al., 2019b). Although this vegetation is associated with many services, a few disservices may reduce its

acceptability (Säumel et al., 2016). In the traditional view of the city, streets and pavements are kept bare and thought for the movement of city dwellers without any connection to nature. However, as recent national laws in several European countries banning pesticides in urban public spaces concern streets ([www.pesticide-free-towns.info](http://www.pesticide-free-towns.info)), municipalities are modifying their weeding practices, leading to a thorough rethinking of human relationships to spontaneous vegetation.

In this study, we analyzed how municipal service directors, field operatives and pedestrians relate to spontaneous vegetation in streets. Based on data collected in the medium-sized city of Blois, in central France, we combined different approaches. First, we investigated the history of the weeding in streets and the associated perception of spontaneous vegetation by municipal service directors. Then, we analyzed the parameters influencing the current attitudes and practices of municipal field operatives toward vegetation. Based on aforementioned studies of urban space management, we hypothesized that these attitudes are influenced by multiple determinants such as funding and technical parameters (Dempsey & Burton, 2012), how the governance of municipal services is organized (Randrup & Persson, 2009), and relationships with city dwellers (Jansson et al., 2019). Finally, in partnership with the municipal service in charge of weed control, we set up a field experiment to assess and modify pedestrians' perception of spontaneous vegetation. We hypothesized that providing ecological information *in situ*, on stickers placed on pavements near the plants, would improve the pedestrians' perception of plants.

## 2. Methods

### 2.1. City's context and history of the cleanliness service

Our study took place in Blois, France (47°34'59"N, 1°19'59"E). Agriculture land and two large forested massifs, to the west and to the south, dominate the surrounding landscape. The river Loire crosses the city from east to west (Fig. 1). Almost 50 000 people live in this city, whose urban area is ca. 22 km<sup>2</sup>. The historical center dates from the medieval and Renaissance period, is mainly

pedestrianized, with a high stake for the image of this area, considered as the showcase of the city by the municipality. Indeed, Blois is an important tourist city, with its castle and the Loire classified as a UNESCO heritage site. The rest of the city is mainly composed of residential pavilion areas. A large industrial area extends north of the city to the highway. Blois also has a very extensive neighborhood of collective residential buildings. The challenges of spontaneous vegetation management are different in these neighborhoods, which do not serve the same urban functions and are home to different socio-economic populations.



**Figure 1.** On the left, photographs of the experiment: [clockwise from top-left] one of the A5 stickers; stickers stuck to the street pavement and the thermal burner device used by the cleanliness service to weed streets; [Author 1] and one field operative of the cleanliness service affixing the stickers; stickers *in situ*; one side of street in the experiment with stickers in place; [Author 4] and [Author 1] during a focus groups with three field operatives. On the right: map showing the four sectors of the cleanliness service of Blois (France) and the non-weeded streets in the experiment. In the black streets, interviews with pedestrians were conducted; in white streets, no interviews were

made (too few pedestrians or stickers had been ripped off). CE: center-east sector; CS: center-south sector; W: west sector, N: north sector. Note that the ‘flying team’ does not have a defined geographical sector.

Since 2015 our research team has studied the diversity of spontaneous vegetation of streets and city dwellers’ perceptions of this vegetation (Bonthoux et al., 2019a; Bonthoux et al., 2019b). From that time, our interactions with the municipal cleanliness service in charge of weed control have matured through several work meetings and informal conversations (about 3 meetings held per year). To deepen the information collected on the historical relationship between the municipality and spontaneous vegetation, we conducted two 1-h individual semi-structured interviews in 2020, one with the director of the cleanliness service and another with the elected official in charge of biodiversity for the municipality. Interview guides were made to understand the recent change in the municipality’s orientations towards biodiversity, the change in the organization and practices of the cleanliness service, and the relations between this municipal service and others (Appendix 1).

## *2.2. Focus groups with field operatives*

### *2.2.1. Set up and running*

We analyzed the attitudes and practices of field operatives with respect to spontaneous vegetation on pavements. The municipal cleanliness service comprises five teams of field operatives -between 6 to 10 people per team (mean 7.8 people), including each team director. Four of the five teams are associated with a specific geographic sector (Fig. 1), the fifth being a “flying” team that steps in as back up for certain jobs. We interviewed each team individually in a focus group discussion (Nyumba et al., 2018). In total, because of absences, two-thirds of the service staff participated in the focus groups (27 field operatives). The five teams were interviewed during three consecutive days in May 2021. Each focus group lasted 2 h; the number of field operatives in each group varied from 3 to 8. Following the recommendation of Nyumba et al. (2018), we established dual moderator

focus groups, with [Author 1] and [Author 4]. The focus groups took place in the streets or in field operatives' facilities, depending on weather condition.

As the facilitator asked the questions and led the interview, the moderator ensured that everyone had an opportunity to speak. In particular, the moderator would ask some participants by first name to get them more involved. The moderator also tried to notice physical gestures or attitudes, looking for signs of approval or disagreement. The moderator could then reopen the discussion in the group to confirm these physical attitudes, addressing the group in a general way ("Does everyone agree with what has just been said?"), or by directly question field operatives. As the team director could be present during a focus group, we tried to mitigate possible dominance effects by encouraging field operatives to express any contrary views or thoughts, thereby ensuring that all opinions were freely shared (Nyumba et al., 2018).

To build the interview grid, we made a qualitative content analysis (Mayring, 2014) of literature about parameters structuring field operatives attitudes and perceptions regarding their work and the vegetation management. Based on that analysis, we identified four general themes used to guide our discussion with focus groups (Table 1): their work perception, the relation with the inhabitants, the organizational parameters and relations with hierarchy, their perception and opinion about spontaneous vegetation. We added introducing words in the guiding theme (Table 1) to initiate the discussion in groups and all the questions were open-ended.

### 2.2.2. *Data analysis*

We recorded the contents of focus groups and then transcribed it in the four identified themes. Contents were then coded according to new categories that were refinements of initial themes (Table 1). This refinement was based on inductive qualitative content analysis (Cho & Lee, 2014). These categories are those used in the results. Inspired by Lampinen and Anttila (2021), each field operatives' statement was assigned to "positive", "negative" or "neutral" connotation. For example, statement as "*weeding, I do not love that much*" was assigned to negative opinion of "Vegetation

management-weeding” category whereas “*with [the parks and gardens field operatives], we work it out, we get on well*” was assigned to positive opinion about “Organizational parameters-between services”. Then we counted these positive, neutral or negative statements to know the majority opinion of the field operatives for the different categories. In the results, we illustrated each category with a given statement from a field operative, chosen to be representative of the common opinion held.

General themes guiding focus groups	Questions asked during focus groups	Categories used to organize responses
Presentation	To begin with, can you introduce yourself? How long have you been working in this municipal service in Blois? Where did you work before? What is your vocational background?	Presentation <ul style="list-style-type: none"> <li>• Personal presentation</li> <li>• Professional career before this position</li> </ul>
Opinion on their work, work perception	Can you tell us about your daily work? How do your activities change with the seasons? How has it changed since you started working in the service? What do you like and dislike most about your job? Are there things that could be improved?	Work perception <ul style="list-style-type: none"> <li>• Representation and experience</li> <li>• Material fact</li> <li>• Dynamic and change in the job</li> </ul>
Relation with the inhabitants	During your days at work, do you sometimes discuss/exchange with the inhabitants? Do you receive any complaints from inhabitants?	Relations with the inhabitants <ul style="list-style-type: none"> <li>• Informal talk</li> <li>• Complaints</li> <li>• Formal communication</li> </ul>
Organizational parameters and relations with hierarchy	During your days at work, do you sometimes discuss/exchange with the elected officials? Do you have any interaction with the field workers of other municipal service?	Organizational parameters <ul style="list-style-type: none"> <li>• Between services</li> <li>• With elected represents, with hierarchy</li> <li>• Internal organization of the sector and with other sectors</li> </ul>
Perception of spontaneous vegetation	What do you think of the vegetation on the pavement? What do you think of allowing plants to grow freely on the pavement? Would you be interested in training in ecology/botany?	Vegetation management <ul style="list-style-type: none"> <li>• Weeding</li> <li>• Amenities for plants</li> <li>• Personal opinion about vegetation</li> </ul>

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What do you think of the communication  
action that has been put in place?  
Would you be in favor of generalization  
of action promoting vegetation in streets?

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**Table 1** Guiding questions, classified by theme, for focus groups with cleanliness field operatives and categories used to analyze statements.

### *2.3. Communication about spontaneous vegetation and interviews with pedestrians*

#### *2.3.1. Set up and running*

We designed a study with the implication of the cleanliness service, to understand the pedestrians' attitudes towards spontaneous vegetation and to evaluate the impact of *in situ* information about plants on these attitudes. We installed stickers on the pavement of 15 streets in Blois. Streets were chosen, in collaboration with the director of the municipal cleanliness service, because of their high levels of spontaneous vegetation irrespective of the weeding effort applied there. As the different neighborhoods in Blois are contrasted in term of amount of spontaneous vegetation, but also regarding socio-demographic profiles of inhabitants and pedestrian attendances, selected streets were in different neighborhoods (Fig. 1). These 15 streets were not weeded from January to September 2021. During April, stickers conveying information about spontaneous plants growing on these streets were stuck flat on the ground in the immediate vicinity of the plants. Stickers represented 13 plants among the most frequent in Blois (according to Bonthoux et al., 2019b, Appendix 2). Stickers were illustrated with hand-drawn pictures of the plants, mentioned both its French and Latin names, and some ecological information, such as their role as host plants for insects (information taken from Muratet et al., 2017, see Appendix 3). We pasted stickers in a 100-m section on one side of each selected street. In addition, two signs (Appendix 2) that briefly presented the research approach were placed at the ends of the street sections (Fig. 1). The municipality funded the making of the stickers and signs.

From 3 May through 1 June 2021, during the growing season of the vegetation, pedestrians on these streets were interviewed by [Author 1], [Author 4], and [Author 2]. Each interview lasted ca. 10 min, and included a mixture of closed- and open-ended questions. Different themes were addressed: the pedestrians' perception of spontaneous vegetation in the street, their opinion about the accompanying stickers, and their opinion on the reducing of weeding (Appendix 4). Interviews finished with socio-demographic questions.

### *2.3.2. Data analysis*

We analyzed the data of open-ended question with deductive qualitative approach (Cho & Lee, 2014). Based on content of questionnaire, we identified the positive, negative or neutral opinion expressed for each theme of our questionnaire, and the underpinning thematic of answer. We then coded answers according to those thematic, presented in results.

## **3. Results**

### *3.1. Change in the municipality–spontaneous vegetation relationship*

The interviews with the elected official in charge of biodiversity and the director of the cleanliness service informed us about the change in municipal weeding strategies. Until 2012, the streets of Blois underwent regular chemical weeding by a company contracted by the municipality, to have very clean pavements with no vegetation. Since then, the municipality has progressively suppressed the use of chemical herbicides to weed out public places, including streets. This decision anticipated the French law of 2017 called “Labbé law”, which forbidden public authorities to use chemical herbicide on public spaces (promenades, forest paths, roads, streets). Since 2012, the mechanical weeding of streets in Blois is the responsibility of the municipal cleanliness service whose role until that time was exclusively to collect waste and clean up public spaces. This weeding task was not assigned to the municipal service responsible for maintaining green spaces (the green spaces service), which do not deal with hard landscape such as streets. In lieu of chemical pesticides, the

cleanliness service practiced frequent mechanical and thermal weeding. However, the service realized that mechanical weeding would never be as effective as chemical one. The progressive habituation to the presence, even modestly so, of spontaneous vegetation on street pavements has gradually triggered a change of vision of the service directors on the pavement vegetation and, accordingly, alternatives were pursued. Since 2017, the municipality of Blois developed the “*Flowered pavements operation*” which consisted in having some inhabitants take charge of the pavement in front of their homes. Under this operation, flower seeds are given to the residents for sowing in the gaps between the pavement and wall. In 2022, about 500 households participated in the operation. Since 2018, the new director of the cleanliness service wanted to continue to reduce the intensity of managing spontaneous vegetation in certain streets, to lessen the workload of its field operatives and to promote the flora in the city. This change in attitude towards spontaneous vegetation was reinforced by the arrival in 2020 of new elected officials who had an ecological agenda. Although the service and elected officials have learned that city inhabitants perceive spontaneous vegetation less negatively than they thought (Bonthoux et al. 2019b), they continue to search ways to change the attitudes of inhabitants towards spontaneous vegetation (hence this study).

### *3.2. Focus groups with field operatives of the cleanliness service*

We met 27 field operatives of the cleanliness service (demographic information are in Appendix 5). Field operatives’ statements were organized in three structural themes: general conditions of their work; their interactions with inhabitants and other municipal services and officials; and their opinions about spontaneous street vegetation, the weeding task, and urban vegetation in general.

#### *3.2.1. Meaning and conditions of their work*

To describe their work, field operatives cited a multiplicity of tasks. Some tasks are considered as normal and part of their work role (e.g. clearing litterbins, sweeping, collecting rubbish, cleaning up graffiti and tags). In every group, field operatives expressed their pride in contributing to the

cleanliness image of Blois and its inhabitants' appreciation of their city. Some other tasks, such as raking leaves and weeding, were presented as being rather sudden and abnormal, because they did not match their personal representation of their work:

*"At the beginning, I thought it was illogical that we were the ones doing the weeding, our base is the sweeper, we turn into gardeners." CS1*

Some tasks are seasonal (raking leaves, weeding) and field operatives are free to decide when these tasks are required, based on their observation of streets. Some groups faced particular tasks (e.g. to deal with a lot of abandoned furniture in streets) not faced by others, and the need for weeding or clearing litterbins differs among geographic sectors. In the field operatives' mind, these geographical particularities were linked to the socio-economic characteristics of the inhabitants of different city sectors. Linked to the multiplicity of tasks, the field operatives explained that they use different tools. Some field operatives described and defined themselves in their work according to these tools:

*"I am a sweeper driver, I also do the [thermal] burning [of weeds] and I drive the [truck]." N4*

The type of tool used could determine whether some tasks are simpler or more complex:

*"Burning is less hard than hoeing, with hoeing sometimes it's hard to pull out plants, must weed them by hand, on your knees, even on all fours." CE5*

Several field operatives cited the evolution of tools, particularly the arrival of lighter, self-propelled or electric tools that are quieter, as the main change they have observed in recent years in the service.

### *3.2.2. Interactions with inhabitants and organization between services*

The field operatives talked a lot about their interactions with inhabitants (Fig. 2). Inhabitants complimented and thanked them during their work in streets, contributing to the field operatives' well-being:

*"[We're] happy with the positive feedback from people, it's a personal reward. We like it when people express their satisfaction, thank us [...] it's good for those who work." V2*

Inhabitants are also curious about the field operatives' tools:

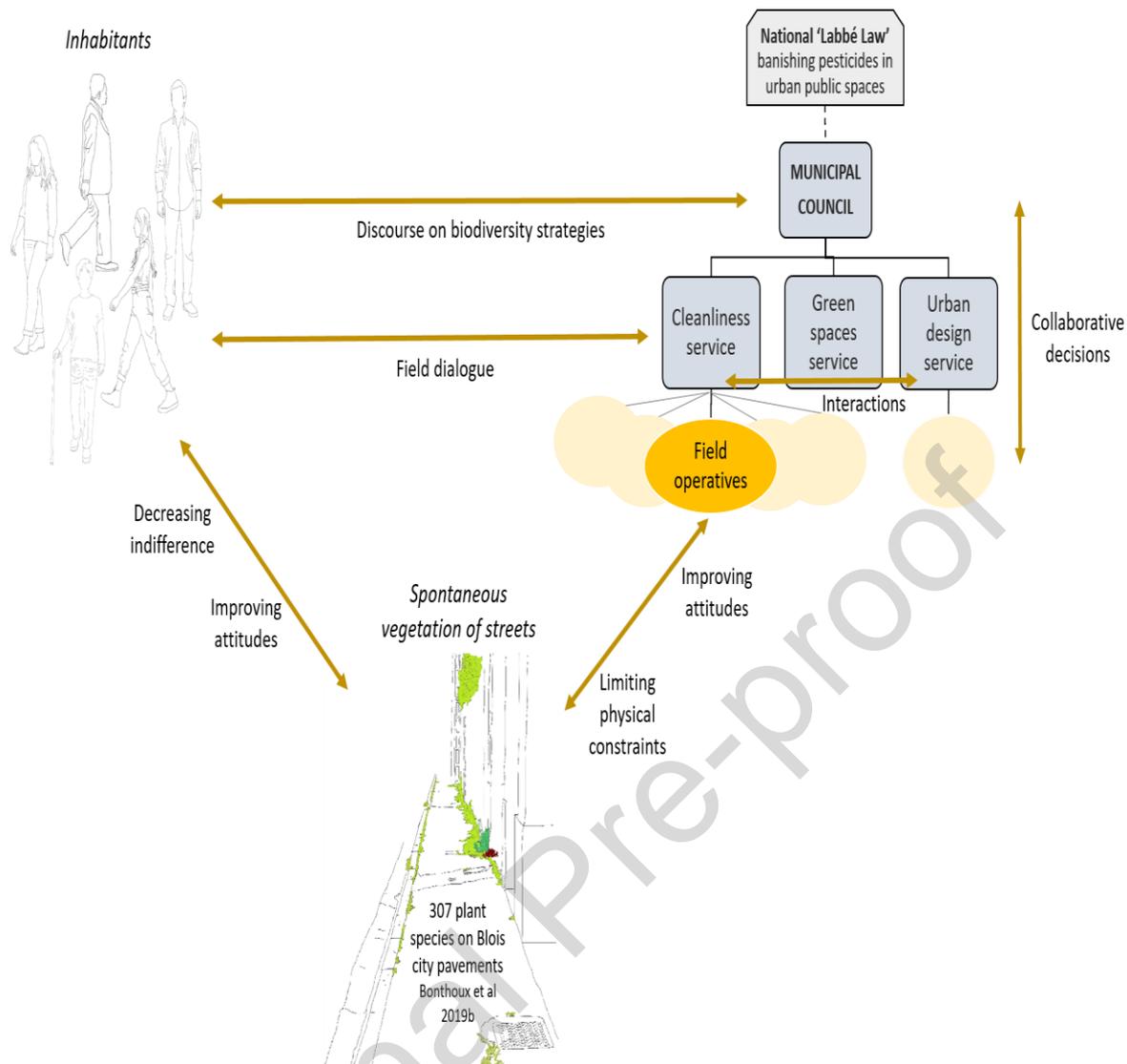
*"[Inhabitants] are attracted to the tools, [the thermal burner]. They look, are interested, always nice." CS2*

In addition, inhabitants express few complaints during the informal talks with them; just two field operatives in one group testified of direct complaints. Most complaints are expressed through the city's Rapid Response Service (RRS), which lets inhabitants report any problem to the municipal services, which are obliged to answer within 72 h. Some field operatives in different groups find that the use of RRS can be abusive, when used by some inhabitants to ask for weeding yet the condition of the streets does not warrant it. RRS is also seen as a potential constraint to change weeding management:

*"It's too easy, phone call to weed [...] calls for useless things." N4*

*"If there was more vegetation, we would have plenty of RRS." CS1*

The field operatives did not talk about the other requests they received via RRS.



**Figure 2.** The relationships among urban spontaneous vegetation in streets, the municipality, and its inhabitants (adapted from Jansson et al., 2019). Alongside the arrows are ways to improve these relationships and therefore the integration of spontaneous vegetation in the city.

When asked about it, most field operatives said they have few or no interactions with elected officials. This absence of a direct relationship creates a feeling of abandonment for some of them:

*"It would be nice to have [hierarchy's] opinion, compliments from the hierarchy." V2*

*"We don't have a relationship with them, we're at the bottom." N4*

A few field operatives, albeit in different groups, did tell us they have already received direct weeding requests from elected officials for specific areas of the city. Even if this behavior is unusual, the field operatives who shared it seemed angry, finding it at odds with the city's political display:

*"It's tiring, there is no ecological approach, we cut everything, we burn, we kill everything. Contradiction between ecological speech and actions. It's a pity, we say ecology, ecology... [...] Reflex [to weed] is contradictory to what is asked to us." CE1*

The field operatives talked much about a lack of interactions with the other municipal services of green spaces and urban facilities (Fig. 2). They all considered that weeding task should be borne by the green spaces service, because as plants are not rubbish, weeding is not a cleanliness task *per se*:

*"Weeding is one job, cleaning is another. There is no relationship between the cleanliness service and the green spaces service." O5*

However, they face many vegetation-related tasks because their service is in charge of asphalted and sandy areas, whereas the green spaces service is responsible for maintaining city areas covered with topsoil (e.g., parks). Many field operatives found this division unsuitable, forcing them to make gardening gestures or use gardening tools:

*"There are places where you need a lawnmower, but it's not a cleaning service tool." O5*

Two groups have unofficial arrangements with the green spaces service, exchanging tasks with them, because of common facilities or personal relationships. These interactions had positive impacts on their work, and all field operatives were in favor of doing common work with the green spaces service:

*"We arrange with green spaces service to split up, we see them every day in the field, we need more inter-service relationships, more dialogue." N4*

Two groups also explained precise difficulties caused by the absence of coordinated decision-making between the cleanliness and urban facilities services. Field operatives explained that some streets design attributes (i.e., positioning of trees, distance between lawns and building) made it difficult to use certain tools (particularly the sweeper) or can damage tools. Field operatives must then do the waste collection on foot, which is longer and more painful. If new arrangements for more plants are not positioned in collaboration with the cleanliness service, they can damage tools. Therefore, that should be an obstacle to vegetated arrangements:

*"Lack of dialogue with urban development. They do not think about us when they do the development, you have to think about the volume to get the sweeper through. If we modify the base of the walls (add plants), we must also modify the entire sidewalk to think about the cleanliness." N2*

*"Need to anticipate management in sidewalk developments." V4*

### 3.2.3. Field operatives' attitudes towards spontaneous vegetation

Another theme we addressed during our focus groups was attitudes of field operatives towards spontaneous vegetation and the meaning of their weeding task (Table 1). Around a dozen of field operatives expressed themselves in favor of spontaneous vegetation, outlining that vegetation was neither rubbish nor pollution:

*"Vegetation is not a pollution [whereas abandoned] papers are." O5*

*"Droppings and litter garbage cans are dirty, not weeds." CE6*

*"Flowers are an enrichment, they are not a neglect." N2*

Five field operatives stated that spontaneous vegetation betrayed a lack of management:

*"Weeds, herbs don't look clean." V3*

*"It lacks maintenance." N3*

However, all the field operatives agreed that a “white city” (“une ville à blanc” i.e., a city without spontaneous vegetation) is impossible. They surmised that the majority of inhabitants wanted little or no spontaneous vegetation and would carry out more weeding than the service does if that task relegated to them instead. Field operatives asked for more communication targeting inhabitants to explain the municipality’s position about street vegetation management. Thus, they supported the implemented communication campaign using stickers, believing it could make inhabitants more tolerant towards street vegetation by providing knowledge about plants:

*“When you know the plants, you change the opinions. Developing more communication will change opinions. I agree for more communication.” V4*

*"Have more information in the local newspaper, on social networks." CE1*

The field operatives appreciated the current political direction of the service being orientated to doing less weeding. As noted above (§3.2.2.), some stated that weeding contradicts the current official position of the municipality about ecology and urban biodiversity. Further, all field operatives were in favor of more vegetation, supporting new flower arrangements or agreeing with current ones, like flowered pavements. They cited precise parts of the city where, in their opinion, there were under-exploited opportunities for vegetation establishment. But they stressed that such vegetation arrangements ought to be maintained and must not complicate the cleaning routine of pavements:

*“People have to maintain, otherwise it's only weeds." CE8*

*"It is necessary to maintain these amenities." N1*

They also said that the discontinuous aspect of vegetation on pavements was not aesthetic and complicated their weeding of streets. Thus, some field operatives asked for continuous flowered pavements.

### 3.3. Communication about spontaneous vegetation and interviews of pedestrians

Due to the voluntary deterioration of some stickers, the low pedestrians attendance of some streets, the very rainy weather and a low response rate (49%), only 68 people in 8 streets responded (see Appendix 6 for demographic information). Only 11 respondents noticed the signs accompanied the stickers (Appendix 2) and just three had an opinion about it; hence, this part of the interview (use of signs) was omitted from the analysis.

Thirty pedestrians (44%) expressed a positive opinion about spontaneous vegetation and 17 (25%) pedestrians disliked it (Table 2 and Appendix 6). Thirty-six pedestrians (52%) declared there is a noticeable difference regarding presence and quantity of spontaneous vegetation between streets of the experiment (non-weeded) and the other in the city (weeded), of which 23 held a positive opinion about it.

Forty-six pedestrians (67%) noticed the presence of the stickers and 29 of them (63%) had a positive opinion about it (Table 2 and Appendix 6). Pedestrians mainly highlighted the educational aspect of stickers, citing almost exclusively the plants' names, ecological information, and drawings as retained elements. Of those who noticed the stickers, 17 told us that their opinion of these plants was changed by the stickers, mainly because of the new information they learned.

Theme	Question	Answer categories and number of respondents*	Example statement(s)
Perception of spontaneous vegetation	What is your opinion about this vegetation?	Generally positive: 30	"I love it, I wish there was more of it"; "Very nice, positive, but what effect on the surface in the long term?"
		Balanced opinion: 10	"It doesn't look super clean, but it looks green. Between two"
		Generally negative: 17	"It grows a little bit randomly, there is no maintenance"; "I'd rather even plant hollyhocks"

	No opinion: 6	“I don’t pay too much attention to it, I never asked myself the question”
This street has not been weeded yet in 2021. Do you find it different from other streets in Blois? If so, in which aspects?	Notice no difference: 30	“No, not particularly”
	Generally positive: 23	“Yes, we can see that the herbs are present, it appeals but is not disturbing”; “More beautiful, we must not destroy, more beautiful than other streets”
	Generally negative: 13	“Yes, it is not clean, not pretty, it changes [compare to others streets]”; “Yes, because it is poorly maintained, from the school to the avenue, a lot of work has been done and the street is broken”
Opinion about the communication campaign	Have you noticed the stickers identifying the plants? Yes: 46 No: 22	
<b>If yes</b> What do you think of them?	Positive opinion: 29	“Interesting to look at these small sprouts”
	Generally negative: 12	“I did not find the plants”; “Not very clean, is the glue biodegradable? I would like to be sure it is”; “Not readable for my eyes”; “Didn’t know what it was, wondered if someone had lost their drawing board, or abandoned things. Are pretty but look like papers”
	No opinion: 5	“I see but I didn’t read”
<b>If yes</b> Which of the elements on the plant stickers caught your attention? Why?	General information: 18	“[I retained the] name of the plants because we say bad seeds without knowing them”; “Text on insects”; “Especially for those I did not know, name and design, by curiosity”
	Drawing: 7	“The visual, the drawing”
	Nothing: 13	“Nothing special, I had a quick look”; “I don’t remember”
<b>If yes</b> Do you think these stickers change your perception of the plants? If so, in which way?	Yes: 17	“Yes, you don’t see many herbs like that, didn’t even know it was called Vergerette”; “Yes, I will no longer weed out these plants in my garden because they are of interest to insects”
	No, already good opinion before: 7	“My perception is good about plants anyway, I have some at home. It doesn’t change my perception but it’s interesting, attractive”
	No: 6	
	No opinion:	“Yes, but don’t find it useful, another way of

General opinion about the experiment	In your opinion, keeping plants in streets is important (multiple choice question):	For their ecological interest, to provide resources for animal species: 43 in agreement	
		To reduce management by technical staff, improve their working condition: 23 in agreement	
		To make the streets less bare (mineral), more aesthetic: 20 in agreement	
		This action aims to welcome more plants, insect and birds into the city and to make the management of the pavements less painful for the municipal agents as they can no longer use herbicides. What is your general opinion on this action?	Supporting: 49
		Against: 8	“Don’t remove the plants but put in other prettier ones”; “Small savings under the guise of ecology with no real or voluntary impact on the city”
		Balanced opinion: 9	“Better if there were insects that landed on it, not annoying to have these grasses”

\* Answers beyond question’s scope are excluded

**Table 2** Results of pedestrians’ interviews (68 respondents). Answers were classified into different categories and illustrated by statements of respondents. Answers beyond the scope of the question are excluded from the count.

Two questions dealt with the general opinion of pedestrians about leaving spontaneous vegetation in streets (Table 2 and Appendix 6). The ecological interest in plants was the first reason why pedestrians are likely to accept spontaneous vegetation on pavements (50% of answers), and facilitating the work of field operatives was the second motivation (27% of answers). The last question of the interview invited the pedestrians to share and elaborate on their opinion about the presence of spontaneous vegetation in streets, after a quick presentation of its benefits. Forty-nine pedestrians (74%) expressed a positive opinion, mostly because there were against the use of

chemical herbicides, or in favor of biodiversity-friendly actions in the city. Nine pedestrians (14%) had a balanced opinion, in that they can support this kind of action but would prefer a more aesthetic approach to spontaneous vegetation in streets. Eight pedestrians (12%) were against the presence of spontaneous vegetation because they considered it not aesthetic.

## 4. Discussion

In this study, we tried to construct a socio-ecological model to analyze the relationships among the municipality, field operatives, inhabitants, and the spontaneous vegetation of streets in a medium-sized French city. Based on the interactions built since 2015 between our research team and the municipal service, we built two interconnected experiments, involving both field operatives and inhabitants. From our results, we can draw a portrait of field operatives' and inhabitants' perceptions of spontaneous vegetation, and of the parameters structuring these perceptions.

### 4.1. *Change in municipal strategy*

Through the example of spontaneous street vegetation, this study analyzed the barriers and opportunities to biodiversity consideration and conservation at the local governance scale of a city (Shih et al., 2020). Streets are widespread in the city and used by all publics, their study complements information on the acceptance of new management practices in green spaces such as parks (Hwang et al., 2019). Caused by bottom-up (new staff with positive attitude towards spontaneous vegetation) and top-down (new national law banning pesticides) factors, the municipal weeding strategy shifted from clear-cutting pavements to allowing grown of spontaneous vegetation in less than 10 years. Those changes are supported by field operatives, who are at the forefront of technical constraints and physical hardship, but are decided by municipal council and services' directors. Thus, we demonstrated the interests of analyzing the changes in relations to spontaneous vegetation at different hierarchical levels of the municipal organization (Homsy et al., 2019).

### 4.2. *Multiple factors mitigate field operatives–vegetation relationships*

We found that field operatives had mostly positive attitudes toward spontaneous vegetation on street pavements. Based on our results and literature, we believed these attitudes would be bolstered if this vegetation became integrated into design interventions (Bonthoux et al., 2019b; Li & Nassauer, 2020), and if such landscaping does not entail extra work time and does not impede the passage of cleaning tools. These relationships to vegetation are nevertheless directly and indirectly modulated by several psychosocial, organizational, and technical parameters. Those parameters must be considered to understand and transform the management system.

In our results, two kinds of psychosocial relationships are important for field operatives. First, it is important for them to have clear objectives that accord with their perceptions of work. Thus, they understand the meaning of what they do and can take pride and involvement in their activities (Ellickson & Logsdon, 2001). In the context of a changing management strategy, these elements seem to be of primary importance in facilitating the acceptance of new practices. Here, field operatives' perception of spontaneous vegetation is changing (Fig. 2), switching from a sign of insufficient management to an enrichment that should not be associated with dirt. Therefore, spontaneous vegetation is still not in conflict with their proud to make the city clean. Second, daily relationships with inhabitants are very important to field operatives, as found in another context (Hoyle et al., 2017). These relationships can enhance their work experience. However, they can also receive complaints about spontaneous vegetation, which is perceived as a lack of maintenance by some inhabitants. As our interviews with pedestrians show little opposition to spontaneous vegetation presence, maybe these complaints are expressed by a vocal minority of inhabitants who do not represent the overall attitude of urban population (Bonthoux et al., 2019b; Drijfhout et al., 2022). These complaints may skew the municipality's understanding of inhabitants' opinion, impeding implementation of new practices. Thus, field operatives consider municipality communication of ecological objectives to inhabitants as a key factor in the implementation of alternative management practices (Hoyle et al., 2017).

The organization of the management system was also a structuring parameter for the well-being of field operatives and the effectiveness of their practices, as found elsewhere (Jansson et al., 2019; Ordóñez et al., 2019). In our case, field operatives of the cleanliness service reclaimed more interactions with the green spaces service and between directors' service and field operatives, for a better consistency in task allocation. Some also mentioned a lack of dialogue with elected officials who are sometimes perceived as distant from practical and day-to-day concerns. Discussions should be engaged with the different levels of services to facilitate collective and individual appropriation of the changes in vision and practices. Collaboration and communication from elected officials and service director to field operatives and vice versa (Fig. 2), can facilitate the transfer of clear management policies while also drawing to attention to any technical constraints and ideas identified in the field (Mathers et al., 2015; Hoyle et al., 2017; Nam & Dempsey, 2019).

Finally, the practical and technical aspects of work are also important for field operatives' well-being and acceptance of spontaneous vegetation. These elements must be considered along with management strategies. Tools are of particular importance: they determined how field operatives defined themselves, they provide a way to interact positively with inhabitants and they directly modulate the acceptance of vegetation by the agents by making weeding more or less difficult. This result is consistent with the findings of Nam & Dempsey (2019) showing that the acceptability of vegetated facilities by managers is linked to the perceived effort required to maintain it. Surprisingly, the funding parameter has never been discussed in focus groups, whereas in other studies the need to lower management-related costs is prevalent (Barnes et al., 2020; Ramer & Nelson, 2020). In Blois, while the internalization of weed control in 2012 increased the costs of acquiring new equipment, the service director now believes that, in addition to the accrued ecological benefits, leaving spontaneous vegetation in place limits the costs of equipment and supplies (e.g., gas), a realization documented elsewhere (Hoyle et al., 2017). Accordingly, a portion of these saved funds could instead be used for public communication strategies, long-term ecological and social monitoring, and place-keeping of plant amenities (Dempsey & Burton, 2012).

As amenities on pavement could complex vegetation management and increase vegetation acceptance by city dwellers, the long-term management of those amenities is on particular importance for acceptance of new practices.

### *4.3. Impact of communication on pedestrians' perceptions*

More than half of the pedestrians held a positive to moderate opinion of spontaneous street vegetation and a third expressed preferences for non-weeded streets. These results confirm previous photomontage urban studies (Fischer et al., 2018; Bonthoux et al., 2019b). Pedestrians mentioned that their main motive for retaining spontaneous vegetation in streets was for supplying ecological resources, as habitats or food for animals. Reducing the drudgery of work for field operatives was much less cited, likely because interactions between pedestrians and field operatives are modest. Many pedestrians did not notice the spontaneous vegetation or did not express an opinion. This is consistent with the plant blindness concept, which posits that people do not notice plants in their environment. The fact that vegetation is not in any special amenities, and growing on pavement, which is an impervious element not normally considered as a space for plants' presence, could augment plant blindness outside traditional urban green spaces (Balding & Williams, 2016; Thomas et al., 2022).

The presence of stickers as educational element near the vegetation was well received by pedestrians though its impact on changing perceptions was moderate. This *in situ* information enabled the differing species to be highlighted and underlines their ecological role in cities. Nevertheless, few respondents said this information would change their attitudes toward plants. These results echo the critics of the "knowledge deficit" approach (Kidd et al., 2019): providing city dwellers with knowledge about vegetation is only the first step in changing attitudes toward it. Knowledge increase acceptability of biodiversity and biodiversity-friendly measures, but direct interactions with nature and plants, through time and various activities in urban green spaces for example, are also necessary (Fischer et al., 2020; Lumber et al., 2017). Then, we hypothesize that a

diverse suite of actions in tandem, from installing local cues to care to designing new urban forms and precipitating changes in social norms on a larger scale, are needed to accompany changes in attitudes towards more acceptability of spontaneous vegetation and alternative managements.

#### *4.4. Towards a place-based integrative approach to transform people–nature relationships*

This study was conducted in only one medium city and other future studies are required to evaluate the generality versus singularity of the results. Still, we think that the approach proposed here can be generalized to link ecological, social, and technical issues. This study shows that the municipal scale is relevant for developing integrated strategies for biodiversity conservation, linking national policies with local visions and applications. This has already been demonstrated as possible in the context of climate change adaptation (Gustafsson & Mignon, 2020). Inspired by existing models (Dempsey & Burton, 2012; Jansson et al., 2019), we collected and brought together different pieces of information into a single framework linking spontaneous vegetation in streets with the management system and city dwellers (Fig. 2). The combination of different methods (semi-structured interview with services managers, focus groups with field operatives, questionnaires with pedestrians) allows us to take in account the different reality of those groups, and to combine them to understand their interaction as a whole. In this system the ecological component, the consideration of city dwellers' well-being and workers' conditions are analyzed simultaneously, to move towards a biodiversity-friendly and a socially-valued future (Rosenzweig, 2003; Francis & Lorimer, 2011). As integrated landscape approaches are growing up, we nevertheless emphasize the importance of finely qualifying the biodiversity of places to identify the paramount ecological factors and issues at play (Bonthoux et al., 2019b; Reed et al., 2021). As we found in this study, the relationships in this system are dynamic and can evolve quickly in response to internal and external factors (Fig. 2). Importantly, researchers can adopt different postures in the evolution of this system. That is, they can be simple observers describing and analyzing the complexity of the relationships.

On the other hand, maybe they should be more experimentally involved, furthering changes to the system's dynamics by designing actions whose socio-ecological repercussions will then be monitored.

## 5. Conclusion

In this study we used complementary methods to analyze the relationship between municipal managers, city dwellers, and spontaneous vegetation in streets. We show that even when municipal strategies move towards a biodiversity-friendly strategy, the organization of the management system at all hierarchical levels must be explicitly considered to engage in a shared and collaborative transition to a greener city. Indeed, while field operatives are rather well disposed to spontaneous vegetation, their well-being and practices and the drudgery of their daily work all depend heavily upon psychological, technical, social and organizational parameters that should be aligned with ecological objectives. The majority of city dwellers harbor a positive view of spontaneous vegetation, albeit a large proportion of them seem indifferent to it. The provision of ecological information *in situ* moderately improves their perceptions of these plants. This educational approach of providing knowledge must be supplemented by other approaches (e.g., testing of new ecological arrangements, regulations) to amplify the overall net effect on changes to attitudes of city dwellers. These different results are valuable, as they could inform the construction of an urban socio-ecological model and help in finding robust social and organizational levers to improve people–nature relationships in cities. The results need to be validated by other studies in towns in France and around the world in order to try to change the mentality about vegetation on streets.

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## Authors contribution

**Muriel Deparis:** Conceptualization, Methodology, Formal analysis, Investigation, Writing – Original Draft, Visualization

**Nicolas Legay:** Conceptualization, Methodology, Investigation, Writing – Review & Editing, Supervision

**Francis Isselin-Nondedeu:** Writing – Review & Editing, Supervision

**Sébastien Bonthoux:** Conceptualization, Methodology, Investigation, Writing – Original Draft, Visualization, Supervision

#### **Declaration of interests**

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

The authors declare the following financial interests/personal relationships which may be considered as potential competing interests:

#### **Highlights**

- We studied field operatives and pedestrians' attitudes about street spontaneous vegetation.
- Work conditions and interactions with inhabitants structure field operatives' practices.
- Majority of pedestrians are not against spontaneous vegetation in streets.
- Ecological information moderately improves pedestrians' attitudes.
- Integrative approaches are needed to transform people-nature relationships.