The criteria of urban trees regarding the issues of tree vandalism

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Abstract. Urban trees are a valuable asset for urban sustainability and provide a number of social and ecological functions. However, urban trees are exposed to intentional vandalism, which can cause poor tree growth and high mortality rates. This issue is particularly difficult to combat because urban tree managers have no way of identifying the characteristics of a tree that may increase the likelihood of vandalism. This study analyzes the data from 118 samples of 33 public reports of tree vandalism in order to understand better the criteria that affect tree vandalism in the Kajang district. A local public compliant database was used to assess which types of trees were vandalized more frequently. The data applied a quantitative analysis, and the social trends around urban tree vandalism were examined. This study discovered that three tree characteristics increased the likelihood of vandalism: the tree's position, the tree's values, and the tree's condition; these characteristics showed a strong positive correlation with urban tree vandalism. This study is intended to guide urban tree managers and tree caregivers to improve tree planting programs in order to ensure the sustainability of trees in urban areas.

1. Introduction

More people recognize the value and benefit of urban trees now than a decade ago [1,2,3]. Unfortunately, urban trees can be damaged by human activities and other factors as well [4,5]. Vandalism, whether intentional or accidental, compounds these human factors [6,5]. Even worse, vandalism has increased in the recent years. Ten to fifteen percent of trees in the city of Hong Kong have been vandalized [7], 30% of urban trees in a European country were vandalized in 2002 [7], and 42% of trees in Eastern Cape, South Africa have been totally vandalized [4]. Therefore, for an urban tree planting program to be successful, it is particularly important to understand the factors that provoke urban residents to vandalize trees.

The term tree vandalism is fairly strictly applied to physical manifestations of undesirable behaviour that leads to damage to the tree structure [8,9,10]. Urban trees being vandalised by carving

into the bark and stripping it apart, breaking the branches or stem and uprooting the younger trees [4,11,12]. An expanding body of literature on the factors which affect tree vandalism is available; some important factors are tree management practices [9,10,5] and identifying the location of vandalism [e.g., 7,6,4]. However, the factors which can always be made precise to predict human behaviour on the act of tree vandalism are still undetermined especially when related to the urban tree performance and their shortcomings. At present, there is insufficient information available on the relationship between the characteristics of urban trees and acts of vandalism, especially in tropical regions. More information on this relationship would guide urban tree managers to care more for the trees.

To announce these challenges, this study carried out a desktop case study of one municipal authority in Malaysia. The main objective of this study was to investigate the criteria that affect the incidence of urban tree vandalism. Specifically, the objectives were:

- To identify the criteria that motivate people to commit vandalism on urban trees.
- To determine the correlation between the characteristics of urban trees and acts of tree vandalism.

2. Material and methods
The data used in this study were taken from the Kajang Municipal Council's data on tree vandalism, which were sorted from the public tree complaint database. This database was developed by the Selangor state government for the purpose of improving the local authority's services. The database includes detailed information about publicly reported occurrences of urban tree vandalism, reported through phone calls, emails, and official letters. From 2014 to 2017, 33 incidents of tree vandalism have been reported. The criteria in this study announced 3 categories, and these categories are:

- *Tree location:* The location of the urban trees planted managed by the local authorities, including proximity to a residence house, a playground area, the main road serves as a street tree, commercial areas such as in pocket park and trees in a buffer zone to eliminate or reduce negative influence on the residential areas from their surroundings.
- *Tree values:* The tree species, which also indicates its experiential and utilitarian value.
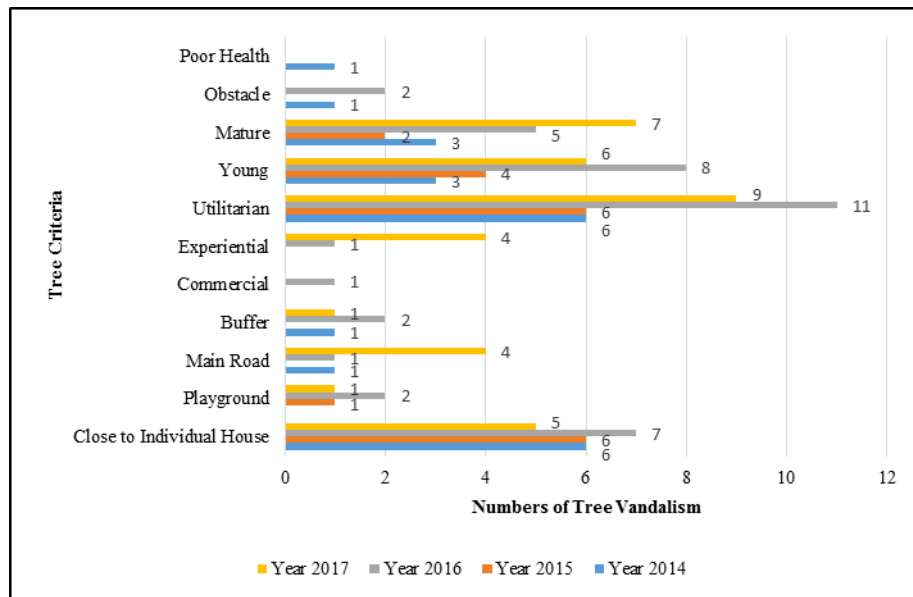- *Tree condition:* Tree maturity and safetiness and the presence of obstacles.

Responses to vandalism and research needs reflected the information in the dataset on tree vandalism but were not based on the results of empirical studies. The data from this study were included into the Microsoft Excel 97 program, and basic mathematical and statistical calculations which were also performed. The resulting graphs have been analyzed. This study used inferential statistics by conducting a correlation analysis to clarify the nature of the relationship between characteristics of urban trees and tree vandalism.
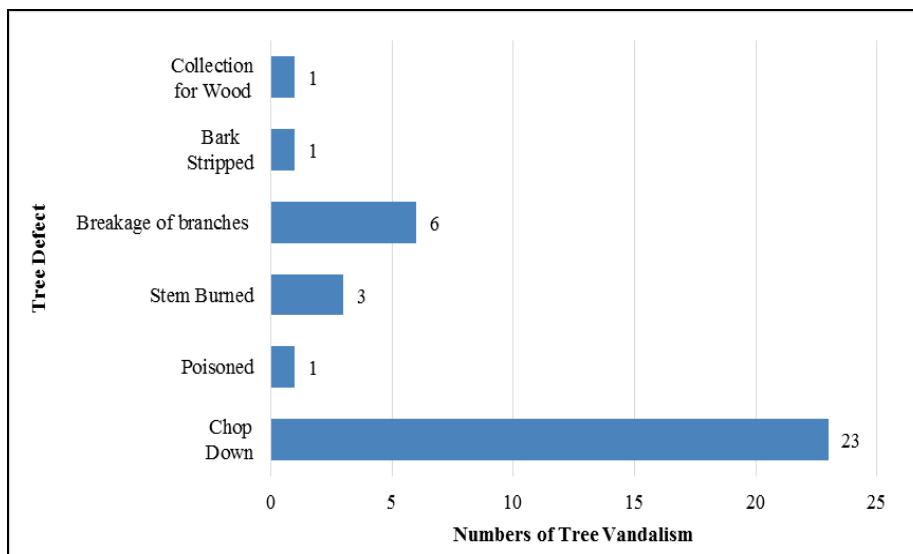
3. Result
This section describes the main results of the study. Tree characteristics are emphasized in particular as almost the entire data was acquired describing tree vandalism, and also is the category in which the most interesting variations between variables have been perceived.

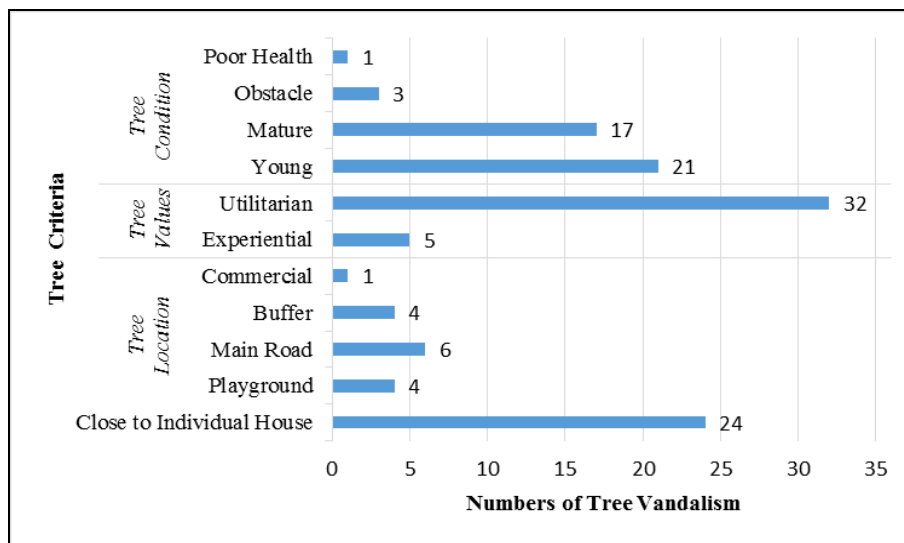*3.1. Availability and quality of information on the characteristics of vandalized urban trees*
The tree vandalism reports used in this study included eleven tree characteristics (**Error! Reference source not found.**). These were demonstrating a diverse range of the tree's location, the tree's values, and the tree's condition circumstances. For a utilitarian value criteria, a much larger sample of 118 amounted to 32 reports on vandalized urban trees were acquired from this study. Trees which were chopped down indicate the highest types of tree defect from acts of vandalism (figure 2). Most of the tree vandalism which occur are equivalent to the tree criteria with the numbers of 10–20 (**Error! Reference source not found.**3).

Figure 1. Characteristics of urban trees and frequency of vandalism in the Kajang area, 2014 – 2017.
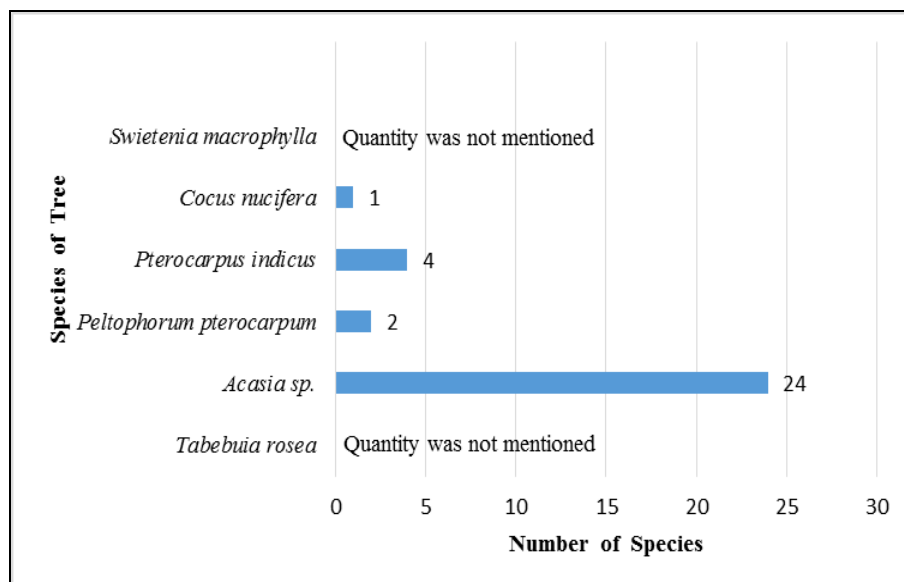

Figure 2. Types of tree defects related to tree vandalism act.

Figure 3. Tree vandalism reported for trees with different characteristics
(data were available for N = 33 reports of urban tree vandalism).

The availability and quality of data differed significantly. No reports of urban tree vandalism seemed to follow a standard which includes the characteristics of a tree. While only a few reported a complete information about the characteristics of a tree, most of the reports included at least some of the tree's characteristics. Most of the reports included the tree's position, values, and condition. However, other data, such as the tree's identity (e.g., some tree species), were only included in a few reports (**Error! Reference source not found.**4).

Figure 4. Species of trees vandalized.

Table 1 indicates the correlation analysis for all the characteristics of urban trees and the frequency of vandalism. The strongest correlation to vandalism was observing the utilitarian trees (*r = 0.99*). Trees in three types of locations were more likely to be vandalized than other trees: playgrounds,

buffer zones, and commercial areas. Trees with poor health were less likely to be vandalized. A weak relationship was observed between vandalism and a location near the main road.

Table 1. The correlation between urban tree characteristics and the acts of tree vandalism in the study.

	Tree Vandalism Incidence
1. Tree Location	
a. Proximity to a house	0.43
b. Playground	**0.85**
c. Main Road	0.30
d. Buffer	**0.85**
e. Commercial	**0.87**
2. Tree Values	
a. Experiential	0.41
b. Utilitarian	**0.99**
3. Condition	
a. Young	**0.98**
b. Mature	**0.67**
c. Obstacle	**0.64**
d. Poor Health	-0.52

Note. Bold coefficients are significant ($p < 0.05$).

4. Discussion and conclusions

This study is the first to collect information on the characteristics of vandalized urban trees in a Malaysian local area, specifically, in the Kajang Municipal Council area. The survey included all reports of acts of vandalism to urban trees from the entire Kajang region; it therefore provides a broad picture of the current situation regarding the management and survival of urban trees. The survey concentrated on public areas and may not represent the private areas, but it did cover a range of different urban areas.

In Malaysia, local municipalities have tree planting programs that aim to increase urban green spaces in order to protect the environment [11,12]. Unfortunately, tree vandalism can thwart this goal by negatively affecting the tree's health [14]. Previous studies have identified factors that may increase the vandalism of urban trees; these factors include a negative attitude [4], poor maintenance [5], and the vandal's socio-economic status [9]. The present study discovered that several characteristics of the urban trees can also increase the likelihood of vandalism, particularly the tree's location, the tree's values, and the condition of the tree. This was obvious from public datasets that there were acts of urban tree vandalism. The specific tree's criteria that exposed to tree vandalism act need to identify in order to ensure the sustainability of trees in urban areas. It was suggested where the tree in the early stages, trees for utilitarian purposes and trees planted approximately to the residence's house require intensive monitoring since they are highly vulnerable for acts of vandalism.

Urban trees planted in isolated locations [11] and poorer neighborhoods [10,4] are also more likely to be vandalized. However, this study brought evidence that urban trees in highly visible areas, such as playgrounds and commercial areas, are also more likely than other urban trees to be vandalized. Notably, there was no difference in the level of tree vandalism in these three areas.

This study used data on publicly reported incidents of urban tree vandalism in the Kajang Municipal area. The results of this study help clarify the current situation regarding urban tree vandalism in the Kajang Municipality. It can help guide tree management practices to improve urban tree management and successfully address the challenges facing urban trees.

Acknowledgments

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