TREE SPECIES COMPOSITION FOR SQUIRREL-OBSERVATION RECREATIONAL ACTIVITY IN BOTANICAL GARDEN, PUTRAJAYA

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ABSTRACT

Squirrel is one of the important natural components in urban ecosystems. It commonly inhabits urban parks in many cities of Peninsular Malaysia. The understanding of how they use trees is essential in creating wildlife habitats for supporting wildlife-oriented recreational activities in urban parks. Direct observation through focal animal sampling was employed in order to understand the tree composition which influences squirrel's behaviours in Botanical Garden, Putrajaya. The result shows that squirrels mainly forage and feed in fruits and flowers bearing trees. Inasmuch, this paper suggests the tree species composition which is suitable for squirrel's habitat in urban parks

Keywords*:Tree species, Composition, Urban park, Wildlife-oriented recreational activity*

INTRODUCTION

Parks generally accord people the prospects to engage with nature and also involve in physical activities. The prospects are more in the outdoors for improvement in both mental and physical health. These mental and physical health benefits act as mutual motivation for people to use parks and other recreation services through engaging in some of which may be, walking, hiking or cycling (Santos et al., 2016). All of the various activities such as playing, resting and entertainment-oriented leisure are essential for the positive improvement of people's lives. Niemelä et al. (2010) listed some possible outdoor recreation activities which recreational ecosystem services are comprised of; nature observation, photography, boating, swimming, fishing, education, picking wild berries and mushrooms, Owing to the fact that, the mode of engaging in any of these activities depend on an individual's preferences, Yli-Pelkonen (2013) elucidated a few ways in which people may be engaged. He cited that, a person can achieve a 'feel-good feeling' just by sitting or standing in one place, moving slowly and gaining recreational experiences through smelling, listening to, or looking at nature. He then concluded that such engagements would lead to relaxation and calmness which could consequently lead to stress relief.

Konijnendijk et al. (2013) define urban park as "delineated open space areas, mostly dominated by vegetation and water, and generally reserved for public use. They are mostly larger, but can also have the shape of smaller 'pocket parks' and are usually locally defined (by authorities) as parks". Braquinho et al. (2015) on the other hand define urban park as a "large green areas which are located within the city, are intended for public use and include landscape features such as trees, shrubs, extended grassy areas, playgrounds or water bodies". These definitions clearly showcase that parks are designed for people to enjoy tranquil and peaceful environment spaces as well as to engage in leisure and recreational activities.

Human contact with nature in the urban park environment could be experienced in many ways such as viewing natural scenery, being in a natural state, dealing with plants and animals, participating in recreational activities, conducting environmental conservation work, or participating in therapeutic programs based on nature, among others (Maller et al., 2005). In terms of recreational values, urban parks are also important in urban ecosystems as

they provide habitat for wildlife such as birds, small mammals, amphibians or reptiles (Shine and Koenig, 2001; Morrison et al., 1994). Fuller et al. (2007) and Luck et al. (2011) postulate the interactions with urban wildlife are also important for human health and wellbeing.

Therefore, this study seeks to provide a basic understanding of the needs to include wildlife-oriented recreational activity through wildlife habitat creation in an urban park. It will enhance the opportunity for urban residents to participate in a squirrel-observation recreational activity in the urban park.

LITERATURE REVIEW

People have testified to feeling more connected to nature when engaging in a common activity such as watching birds in their gardens as discovered by Cox and Gaston (2018). That was as a result of the tremendous satisfaction they derived from attracting wildlife to their gardens, which in turn go to satisfy their sense of wonderment for the natural world (Goddard et al., 2013). In attesting to that, ecologists have ascertained that an estimated 12.6 million households across the UK revealed feeding birds as their most popular activity. That case was found to be similar in other countries like the United States and Australia (Jones and Reynolds, 2008; Lepczyk et al., 2012). All of those cited studies and many more (Cimprich and Ronis, 2003; Hansen-Ketchum et al., 2009; Akpinar, 2016; Burrows et al., 2018) acts as a confirmation for the ultimate assertion that, relationships with nature are good for physical and mental human health. For these conditions to be created, sustained, and the benefits enjoyed, robust management plans are needed to effectively conserve the resources, which are urban animals and green spaces.

Wildlife-Oriented Activity in Urban Park

The importance of urban parks for human wellbeing through recreational activities has been recognized (Yung et al., 2017; Wüstemann et al., 2017). For example, the richness of birds, butterflies, and plants species is seen as to have a positive emotional effect for its observers (Dallimer

et al., 2012). In a general sense, people's perception of quality of life was positively related to their exposure to ecosystem diversity, such as flowers, rivers, or animals Ogunseitan (2005). Inasmuch, Bjerke et al. (2006) suggest that observing wildlife is a motive often mentioned for recreational activities in urban areas. This is due to the recreational benefits associated with wildlife. The positive emotional state associated with wildlife experience is a component of the benefits. Studies have revealed that a positive impact on wildlife experience can uplift the mood and emotion. For example, Curtin (2009) found that watching wildlife made participants feel the wonderment and awe beyond articulation, experiencing a state of 'flow', and sensual awakening. The feel also includes the psychological benefits of it with the key themes including time to stand and stare, voyeurism and contemplation, spiritual fulfilment and feeling of wellbeing. Also, Curtin and Kragh (2014) explain how such experiences contribute meaning to a person engaging in nature which allows them to find peace from the pressures of modern life. Therefore, wild settings offer the opportunity to view animals in their natural habitat, the captive setting offers a substitute for wild animal encounters, and therefore this can have benefits for human wellbeing.

However, Dick and Hendee (1986) found that only 3% of visitors came specifically to urban parks to view wildlife. Nevertheless, 55% of the visitors made an observational response to wildlife. Most of these were orienting responses, but 20% were investigations of animals and 6% were contact-seeking with the wildlife observed. Hence, responses to wildlife may be mentally restorative. This view has been supported by Ulrich et al. (1991), who found that physiological stress reduction was faster and more complete when people were exposed to natural settings rather than to concrete urban environments. Conversely, Hernández-Morcillo et al. (2013) assert that wildlife-oriented recreation is an important cultural ecosystem service that provides people with an opportunity to contact with the natural world. In addition, people gain health and wellbeing benefits from seeing wildlife in their garden (Jones and Reynolds 2008; Cox and Gaston 2016), experiencing nature or watching specific animals or plants (Fischer et al., 2018), fishing, hunting, and wildlife-watching (Macaulay, 2016). In the city of Belo Horizonte (Minas Gerais, Brazil), many city parks have groups of black-tufted marmosets (Callithrix penicillata), which interact with park visitors (Leite et al., 2011). As such, Bjerke and Østdahl (2004) suggest that the most preferred animals are small birds, squirrels, butterflies,

hedgehogs, ducks, dogs and geese. Most people do not like beetles, wasps, snails, rats, mosquitoes and rats. It is assumed that the attraction towards small birds may be due to their songs, for example, summer signals and organic growth. Thus, among the various sounds in the environment, bird songs are the most preferred.

Furthermore, a multitude studies have also shown how being situated in nature and immersed in watching animal or bird behaviour allows participants to experience a sense of flow (Csikszentmihalyi, 1990), a peak experience (DeMares and Krycka, 1998), a loss of time (Curtin, 2009), and a deep sense of wonderment and connection with the natural world. For this, Kaplan (2001)emphasizes that even a beautiful landscape photograph experience can momentarily lift one's mood, wider dialogue with wildlife can restore people psychologically and enables opportunities for inner contemplation and change. The most profound and strongest attachments between people and natural occurrences create a "spiritual" experience where people feel connected to a greater reality that helps give meaning to their own lives (Schroeder, 1996).

Squirrels in Urban Park

Urban parks are crucial refugee zones for wildlife in the rapidly growing global environment. These parks provide crucial natural resources in ensuring the improvement and maintenance of urban biodiversity (Schütz and Schulze, 2015) as it is seen as an important habitat for wildlife in urban areas such as squirrels (Thorington and Ferrel, 2006). Squirrels, as the focus of this study, are one of the most familiar mammals found in urban areas (McCleery et al., 2008). For instance, red squirrels (Sciurus vulgaris) and eastern grey squirrels (Sciurus carolinensis) can be found in most urban parks in Europe (Parker et al., 2006; Babińska-Werka & Żółw, 2008) as well as plantain squirrel (Callosciurus notatus) in South East Asia including Malaysian cities (Thorington and Ferrell, 2006). This species is among the many species of animals that have adapted to life in urban environments (termed synurbization by Andrzejewski et al. 1978). Hence, the reasons for many squirrels in urban parks include park characteristics, abundant of food resources and few numbers of predators. In addition, most of the trees in urban parks are native species and matured. They also constitute with

high species diversity. Thus, it offers a suitable environment and habitat for urban squirrels (Babińska-Werka and Żółw, 2008; Parker et al.,2014).

Squirrel's Habitat in Urban Park

Peters et al. (2016) postulate that some of the plant species normally serve as "foraging hubs" when they are frequently visited by various animal species in a community. However, some are not as popular as hubs but have the quality of being concurrently used by disparate guilds of animal species (e.g., birds, bats, and/or primates) that would otherwise rely on contrasting groups of resource plant species. Therefore, such plants serve as "foraging connectors" in the plant-animal community (Mello et al., 2015). For instance, Aida et al. (2016) found that the abundance of woody trees planted in park areas was the most important driver for bird richness locally across all 80 urban parks in Klang Valley areas. This could be explained by the fact that such a habitat structure provides food and shelter to birds. Thus, the total number and height of woody trees may be important to some species in terms of food availability (McElhinny, Gibbons, Brack, & Bauhus, 2005), fruits and seeds (Stagoll et al., 2010).

In a similar vein, squirrels and trees have a 'symbiosis' relationship as they act as a key agent of seed dispersal through the use of fruiting bodies and the spread of seeds and spores in subtropical and tropical forests (Thorington et al., 2012:17-19). Therefore, foraging sites are crucial for the survival of animals. Individuals cue on characteristics of the forest that offer enough food resources and also provide safety. Additionally, large, mature trees with large and continuous canopies provide travel routes (Laurance and Laurance, 1999), protection, offer greater seed and fruit production to species using different story levels, and create different microclimates that support high biodiversity (Estrada and Coates-Estrada 1985; Bierregaard et al., 1992). Hence, this study aims to discover the tree species composition used by the squirrels which will support the squirrel-observation recreational activity in the urban park.

METHODOLOGY

Study Area

In Peninsular Malaysia, the distribution of plantain squirrel (Callosciurus notatus) is in the northern, southern and central regions (Thorington and Ferrel, 2006) (Figure 1) and this species is highly adaptable in urban environment (Baker and Lim, 2012), which is termed as synurbization by Andrzejewski et al. (1978) and Babiñska-werka et al., (1979). Urban parks are common in urban areas and play an important role in offering opportunities for human and wildlife interactions (Nilon et al., 1999). Thus, this study chose to observe plantain squirrel's behaviour patterns in three urban parks representing the three regions which are Taiping Lake Garden, Perak, Botanical Garden, Putrajaya and Hutan Bandar, Johor Bahru (Figure 2).

Figure 1: Green color shows the geographical distribution of plantain squirrels population

Source: Thorington et al. (2012)

The parks were also selected based on the differences of their age; matured, moderate and young as the vegetative cover ranges from sparse

to dense in forested sections of the parks. A pilot study was conducted to ensure the plantain squirrels can be found in all three parks. Thus, this study found that plantain squirrels can be sighted in Taiping Lake Gardens, Perak which is 125 years old and located at the north region, Hutan Bandar, Johor Bahru is 25 years old and located at the southern region and Botanical Garden, Putrajaya is 9 years old which located at the central region. Hence, for the purpose of this paper, the youngest park which is Botanical Garden, Putrajaya was selected as it is one of the largest botanical gardens in the country with over 700 species of plants from over 90 tropical countries in South America, Africa, and the Asia Pacific regions. It is often used as a venue for environmental education programs, recreational activities, and research and as an ecotourism destination.

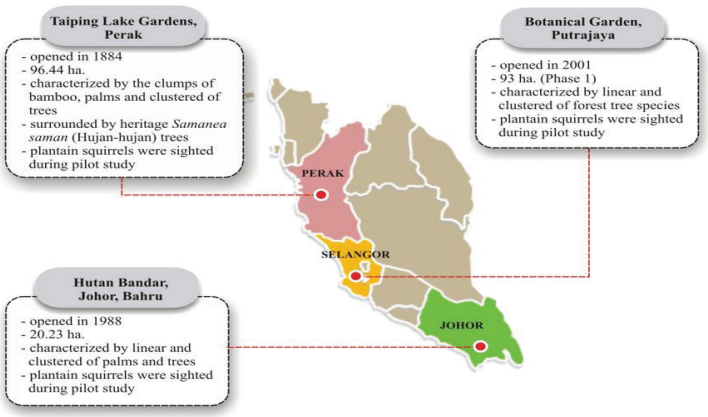

Figure 2: Geographical location of three urban parks representing northern, central and southern region. Botanical Garden, Putrajaya is located at the central region of Peninsular Malaysia

Focal Species

The plethora of research in urban areas focused on avian species (Strohbach et al.,2009; Khera et al., 2009; Dallimer et al., 2012; Yang et al., 2015; Shimazaki et al., 2016) and/or iconic species and less research has been focused on mammals, reptiles, amphibians, invertebrates and aquatic species (Garden et al., 2006). According to Thorington and Ferrel (2006), in Southeast Asia there are the beautiful tree squirrels, the giant tree squirrels, four species of pygmy squirrels, a large number of flying squirrels,

and several more specialized squirrels. For this, Southeast Asia is known as the "squirrel headquarters of the world" because of the extraordinary diversity there (Figure 3).

Figure 3: The distribution of squirrels around the globe. The red circle shows the distinction species diversity is found in South Asia continent
Source: Thorington and Ferrel (2006)

In addition, tree and flying squirrels are important ecosystem engineers and play a significant role in the regeneration of forest around the world (Thorington and Ferrell, 2006; Koprowski and Nandini, 2008). Albeit the majority of the tree and flying squirrels eat seeds and nuts of trees, they also can act as agents of dispersal of tree seeds. For example, Red squirrels (Sciurus vulgaris orientis) collected and transported Korean pine cones away from seed sources and scatter-hoarded seeds in clumps of 2-4 seeds under litter on the ground (Hayashida, 1989). Eurasian red squirrels (Sciurus vulgaris) are important pre-dispersal and post-dispersal seed predators of Arolla pine seeds (Zong et al., 2010). Prevost's squirrels (Callosciurus prevostii) was observed carried Aglaia sp. (Meliaceae) seeds beyond the parent crown trees at Pasoh Forest Reserve in Negeri Sembilan (Becker and Wong, 1985). Nevertheless, Deng et al. (2004) found some species of Tamiops such as the Striped squirrel (Tamiops swinhoei hainanus) collect nectar from ginger plants (Alpinia kwangsiensis). Similarly, the species of Dusky stripped squirrel (Funambulus sublineatus), for instance, often visited the flowers of Cullenia exarillata (Devy, 2006).

Hence, plantain (Callosciurus notatus); the tree squirrel was selected for this study as they are also commonly found in urban parks in many cities in Peninsular Malaysia (Thorington and Ferrel, 2006). It is a diurnal species

with measuring of head and body length of 237.8 mm (female), 233.6 mm (male), tail 175.0 mm (female) and 186.5 mm (male) (Thorington et al., 2012). As its name implies, Callosciurus notatus means "beautiful squirrel", it is easily identified by the two cream and black stripes on the sides, the orange belly, and the lack of a pale spot behind the ear. The upper side is brown (Figure 4). Plantain squirrels effortlessly 'flies' from bough to bough in death-defying leaps. This behaviour fascinates many animal lovers.

Figure 4: Callosciurus notatus (plantain squirrel) from the subfamily Callosciurinae in Botanical Garden, Putrajaya

Observing Squirrel's Behavior

Eating category of activity refers to squirrel's foraging and feeding habits. Foraging behaviour is when the squirrels search for foods from one tree to another, or in the same tree but from one storey to another. Feeding behaviour is when the squirrels stop at one point to consume the foods. Types of food from different tree species such as fruits, flowers, leaves or insects which were consumed by the squirrels were noted during focal observations. Individual trees used by the squirrels were also identified.

Plantain squirrels were located by systematically patrolling the study area along the line transects during the daylight hours. In order to detect squirrels occurrences, line transects method was used prior to focal animal sampling method (Palei et al., 2015; Palmer and Koprowski, 2014; Saiful and Nordin, 2004; Devan, 1982). Specific line transects were plotted along the footpath which provided a clear view of as much vegetation as possible. Line transects were measured by using measuring tapes and labelled at a few random lengths from TR1 to TR7 in Botanical Garden, Putrajaya (Figure

5). Seven research assistants were recruited and trained to help with the field research. In addition, the daily briefing was conducted to ensure the quality control during the administration of the behavioural observation. Twice a day from 0700-1200 hours and 1600-1900 hours observations were carried out along these transects. The observer walked slowly along the line transects. The walk started as soon as after the first light as this is the time for squirrels most likely to be active (Gurnell et al., 2009).

Focal animal sampling was used once a squirrel was spotted. Once spotted, an observer sat quietly in one place and the focal squirrel was observed until it was out of the observer's sight (Figure 6). An observation was considered as one sighting. Squirrel's behaviour and tree elevation and species were recorded and food items consumed were also noted. The tree position where the last position of the focal squirrels can be seen before it was out of sight was then recorded in the site plan to determine the final point in the sampling radius. Thus, based on the pilot survey, 25 meter radius plot was determined for each sampling plot with the highest squirrel's occurrences (Figure 7). The field observation started from September to October 2015. The training for research assistants' observation responsibility was conducted in August 2015 for a month. The data-set collected was coded and analysed using IBM SPSS version 23 and Microsoft Office Excel 2010. For the purpose of this paper, the results were presented in the frequency of sightings by using the bar chart in Microsoft Office Excel 2010.

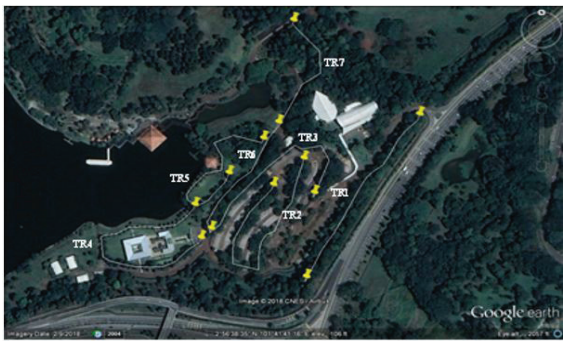

Figure 5: Transect line for detecting squirrel's activities in Botanical Garden, Putrajaya

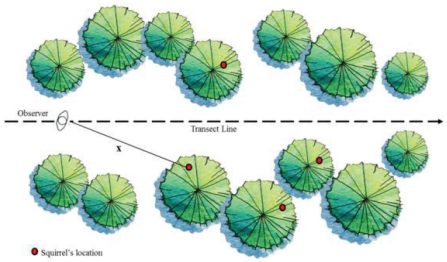

Figure 6: Transect line for detecting squirrel's occurrences. Once the squirrel was spotted, the observer sits quietly at one place at the estimated distance (x) as long as it does not disturb the squirrel's behavior

Figure 7: Four observation plots (I – L) with the highest squirrel's sighting

RESULTS AND DISCUSSIONS

Plantain squirrels are highly arboreal when foraging and feeding. They were commonly found in trees which fruits were abundant during the period of activity. Most trees showed flowering and fruiting during the observation period. Figure 8 shows that in the plot I, forage activities were mostly found in Calophyllum inophyllum trees (14 sightings) followed by Messua ferrea (10 sightings). They fed mostly on the fruits of Calophyllum inophyllum and insects in Messua ferrea. However, plantain was found feeding only in Calophyllum inophyllum trees (12 sightings) due to the abundant fruits available.

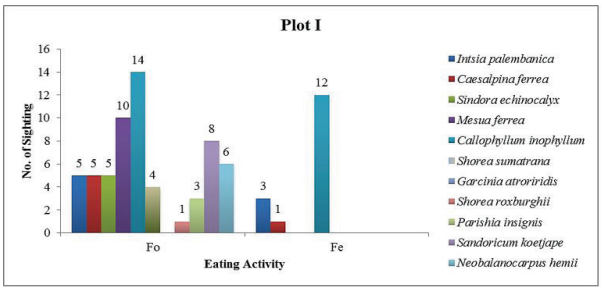

Figure 8: Number of sightings for squirrel's eating activities in plot I
Fo = forage, Fe = feed

As can be seen in Figure 9, plot J is dominated by flowering and leafy tree species such as Lagerstroemia speciosa, Bauhinia blakeana and Cassia fistula. Therefore, foraging and feeding activities in this plot are mostly sighted in these three species (14, 13 and 11 sightings). This shows the plantain's ability to change its daily diet based on the type of food available in that place. This is also in line with the generalist nature of the species. Feeding behaviour was also mostly performed in Cassia fistula tree (13 sightings) followed by Lagerstroemia speciosa tree (11 sightings). During the observation, the two species are producing an abundance of flowers and there was a plantain's drey built in Areca catechu. This result suggests that plantain may prefer to forage and feed in adjacent areas to avoid losing more energy due to handling.

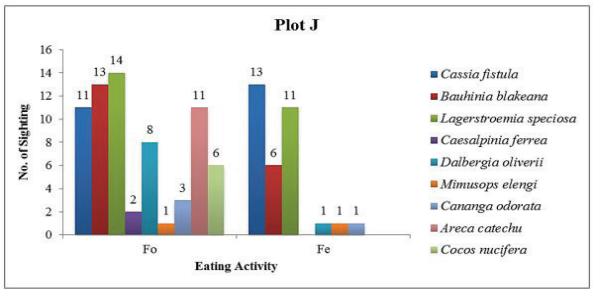

Figure 9: Number of sightings for squirrel's eating activities in plot J
Fo = forage, Fe = feed

Figure 10 shows that in plot K, forage activities were mostly observed in Livistona rotundifolia (17 sightings) followed by Xanthostemon verticillatus (14 sightings) and Shorea ovalis (11 sightings) trees. The types of food they eat are mostly fruits from Livistonia rotundifolia, flowers from Xanthostemon verticillatus and insects from Shorea ovalis. During the observation, Livistonia rotundifolia produced heavy fruit while Xanthostemon verticillatus was in heavy flowering. This result suggests that a plantain focuses on foraging and feeding activities extensively on trees which produce abundant fruits and flowers.

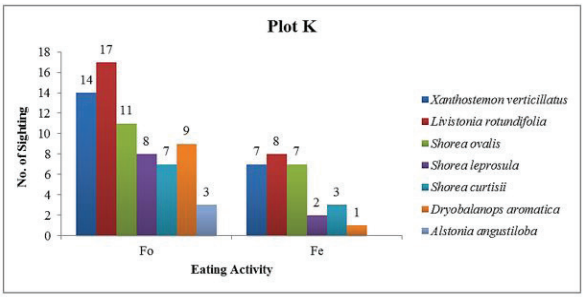

Figure 10: Number of sightings for squirrel's eating activities in plot K
Fo = forage, Fe = feed

Figure 11 shows that in plot L, forage activities are mostly observed in Calophyllum inophyllum (17 sightings) and Hopea odorata (13 sightings) trees. Plantains ate mostly insects which can be found in both trees. Calophyllum inophyllum was seen as the most feeding spot for plantain in this plot (7 sightings).

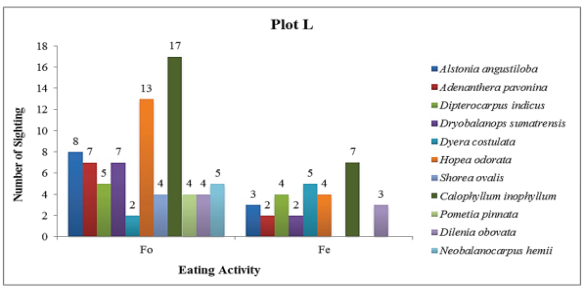

Figure 11: Number of sightings for squirrel's eating activities in plot L
Fo = forage, Fe = feed

The result reveals plantain mostly foraged and fed on the fruits of Calophyllum inophyllum and Livistonia rotundifolia and flowers from Cassia fistula and Lagerstroemia speciosa (Figure 12). They also fed on insects which inhabited Livistonia rotundifolia. In this regard, plantain squirrels obtained their needs for protein from the insects (Hafidzi, 1998; Thorington and Ferrell, 2006) that live in trees. This explains that plantain feeds on a wide variety of food items which is typical for this species (Thorington & Ferrell, 2006; Thorington et al., 2012). Therefore, as a native species, plantain squirrel is able to exploit numerous food items from various types of tree species. Therefore, while watching the squirrel's foraging activity, one could see plantain squirrels often go to the tip of branches and collect the fruits with its mouth and moves to the thick horizontal branches by holding the fruits mostly in the mouth and sometimes in the forelimb, where the branch is stiff and it is convenient for it to sit and feed. This is because the squirrel was selected its feeding places from a suitable perch.

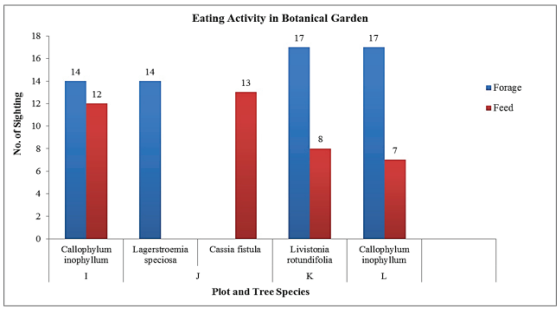

Figure 12: Number of sightings for most tree species used for eating activity by the squirrels in all plots in Botanical Garden, Putrajaya

CONCLUSION

In an urban ecosystem, recreation in the park is an activity that is of particular importance to the urban residents. Observing squirrel activities in urban park engage visitors to the squirrel's activity in the park as this small mammal has a certain specific dimension in order for people to engage with wildlife-oriented recreational activity. The squirrel behaviours were influenced by tree species composition available in the park. Hence, landscape architects and designers together with park management team should plan for the inclusion of wildlife through careful selection of plants, particularly in the

foraging areas provision. By focusing on the composition of trees for their habitat in urban park design and management, the significance of wildlife-oriented recreational activity in urban parks can be one of the added values for the fascinating experiences among park users.

Notwithstanding, the findings of this study successfully showed the significant results for the selected study area. However, there are still some limitations that need to be addressed. It should be noted that the composition of the tree species is only the small part of some other indicators which also has its influence on the squirrel's behaviour pattern in urban parks. Therefore, measures related to other plant species such as shrubs or groundcovers should also be given special attention. The transdisciplinary approach to research could measure more plant parameters and would provide more comprehensive results in this area of study and recommended for further research.

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REFERENCES

Aida, N., Sasidhran, S., Kamarudin, N., Aziz, N., Puan, C. L., & Azhar, B. (2016). Woody Trees, Green Space and Park Size Improve Avian Biodiversity in Urban Landscapes of Peninsular Malaysia. *Ecological Indicators,* 69, 176–183.

Akpinar, A. (2016). How is Quality of Urban Green Spaces Associated with Physical Activity and Health? *Urban Forestry and Urban Greening,* 16, 76–83.

Andrzejewski, R., Babińska-Werka, J., Gliwicz, J., & Goszczyński, J. (1978). Synurbization Processes in Population of Apodemus agrarius

I. Characteristics of Populations in an Urbanization Gradient. *Acta Theriologica,* 23, 341–358.

Babiñska-werka, J., Gliwicz, J., & Goszczyński, J. (1979). Synurbization Processes in a Population of Apodemus Agrarius . II . Habitats of the Striped Field Mouse in Town 1. *Acta Theriologica, 24*(30), 405–415.

Babińska-Werka, J., & Żółw, M. (2008). Urban Populations of the Red Squirrel (Sciurus vulgaris) in Warsaw. Fennici — Ann. Zool. *Fennici, 45*(45), 270–276.

Bierregaard, R. O., Lovejoy, T. E., Kapos, V., Augusto, A., Hutchings, R. W., & Jr., R. B. (1992). The Biological Dynamics of Tropical Rainforest Fragments A Prospective Comparison of Fragments and Continuous fForest. *BioScience, 42*(11), 859–866.

Bjerke, T., & Østdahl, T. (2004). Animal-related Aattitudes and Activities in an Urban Population. *Anthrozoos, 17*(2), 109–129.

Bjerke, T., Østdahl, T., Thrane, C., & Strumse, E. (2006). Vegetation Density of Urban Parks and Perceived Appropriateness for Recreation. *Urban Forestry and Urban Greening, 5*(1), 35–44.

Burrows, E., O'Mahony, M., & Geraghty, D. (2018). How Urban Parks Offer Opportunities for Physical Activity in Dublin, Ireland. *International Journal of Environmental Research and Public Health, 15*(4). http://doi.org/10.3390/ijerph15040815

C. Braquinho, R. Cvejić, K. Eler, P. Gonzales, D. Haase, R.Hansen, N. Kabisch, E., Lorance Rall, J. Niemela, S. Pauleit, M. Pintar, R. Lafortezza, A. Santos, M., & Strohbach, K. Vierikko, Š. Ž. (2015). *A Typology of Urban Green Spaces, Eco-System Provisioning Services and Demands*, 10, 67.

Cimprich, B., & Ronis, D. L. (2003). An Environmental Intervention to Restore Attention in Women with Newly Diagnosed Breast Cancer. *Cancer Nursing, 26*(4), 284–292.

Cox, D. T. C., & Gaston, K. J. (2016). Urban bird feeding: Connecting

People with Nature. *PLoS ONE, 11*(7), 1–13.

Cox, D. T. C., & Gaston, K. J. (2018). Human–nature Interactions and the Consequences and Drivers of Provisioning Wildlife. Philosophical Transactions of the Royal Society B: *Biological Sciences*, 373(1745). http://doi.org/10.1098/rstb.2017.0092

Curtin, S. (2009). Wildlife tourism: The Intangible, Psychological Benefits of Human-wildlife Encounters. *Current Issues in Tourism, 12*(5–6), 451–474.

Curtin, S. C. (2009). Wildlife Tourism: The Intangible, Psychological Benefits of Human-Wildlife Encounters, (904001844).

Curtin, S., & Kragh, G. (2014). Wildlife Tourism: Reconnecting People with Nature. *Human Dimensions of Wildlife, 19*(6), 545–554.

Dallimer, M., Irvine, K. N., Skinner, A. M. J., Davies, Z. G., Rouquette, J. R., Maltby, L. L., Gaston, K. J. (2012). Biodiversity and the Feel-good Factor: Understanding Associations between Self-reported Human Well-being and Species Richness. *BioScience, 62*(1), 47–55.

Dallimer, M., Rouquette, J. R., Skinner, A. M. J., Paul, R., Maltby, L. M., Warren, P. H.,Dallimer, C. M. (2012). Contrasting Ppatterns in Species Richness of Birds, Butterflies and Plants along Riparian Corridors in an Urban Landscape, 1–12.

DeMares, R., & Krycka, K. (1998). Wild-animal Triggered Peak Experiences: Transpersonal Aspects. *Journal of Transpersonal Psychology, 30*(2), 161–177.

Devan, E. A. (1982). *The Ecology of Urban Squirrels in Singapore*. Science, (Duckett), 1–4.

Dick, R. E., & Hendee, J. C. (1986). Human Responses to Encounters with Wildlife in Urban Parks. *Leisure Sciences, 8*(1), 63–77.

Estrada, A., & Coates-Estrada, R. (1985). A Preliminary Study of Resource Overlap between Howling Monkeys (Alouatta palliata) and other Arboreal Mammals in the Tropical Rain Forest of Los Tuxtlas, Mexico. *American Journal of Primatology, 9*(1), 27–37. http://doi.org/10.1002/ajp.1350090104

Fischer, L. K., Honold, J., Botzat, A., Brinkmeyer, D., Cvejić, R., Delshammar, T., Kowarik, I. (2018). Recreational Ecosystem Services in European Cities: Sociocultural and Geographical Contexts Matter for Park Use. *Ecosystem Services*, 31, 455–467.

Fuller, R. a, Irvine, K. N., Devine-Wright, P., Warren, P. H., & Gaston, K. J. (2007). Psychological Benefits of Greenspace Increase with Biodiversity. *Biology Letters, 3*(4), 390–394.

Garden, J., McAlpine, C., Peterson, A., Jones, D., & Possingham, H. (2006). Review of the Ecology of Australian Urban Fauna: A focus on Spatially Explicit Processes. *Austral Ecology, 31*(2), 126–148. http://doi.org/10.1111/j.1442-9993.2006.01578.x

Goddard, M. a., Dougill, A. J., & Benton, T. G. (2013). Why Garden for Wildlife? Social and Ecological Drivers, Motivations and Barriers for Biodiversity Management in Residential Landscapes. *Ecological Economics*, 86, 258–273.

Gurnell, J., Lurz, P., McDonald, R., Pepper, H. (2009). *Practical Techniques for Surveying and Monitoring Squirrels.* Forestry Commission, 1–12.

Hansen-Ketchum, P., Marck, P., & Reutter, L. (2009). Engaging with Nature to Promote Health: New Directions for Nursing Research. *Journal of Advanced Nursing, 65*(7), 1527–1538.

Hernández-Morcillo, M., Plieninger, T., & Bieling, C. (2013). An Empirical Review of Cultural Ecosystem Service Indicators. *Ecological Indicators*, 29, 434–444.

Jones, D. N., & S. James Reynolds. (2008). Feeding Birds in Our Towns

and Cities: A Global Research Opportunity. *Journal of Avian Biology, 39*(3), 265–271490.

Kaplan, R. (2001). The Nature of the View from Home: Psychological Benefits. *Environment and Behavior, 33*(4), 507–542.

Khera, N., Mehta, V., & Sabata, B. C. (2009). Interrelationship of Birds and Habitat Features in Urban Greenspaces in Delhi, India. *Urban Forestry and Urban Greening, 8*(3), 187–196.

Konijnendijk, C. C., Annerstedt, M., Nielsen, A. B., & Maruthaveeran, S. (2013). *Benefits of Urban Parks - A systematic Review.* International Federation of Parks and Recreation Administration, (January), 1–68.

Laurance, S. G., & Laurance, W. F. (1999). Tropical Wildlife Corridors: Use of Linear Rainforest Remnants by Arboreal Mammals. *Biological Conservation, 91*(2–3), 231–239.

Leite, G. C., Duarte, M. H. L., & Young, R. J. (2011). Human-marmoset Interactions in a City Park. *Applied Animal Behaviour Science, 132*(3–4), 187–192.

Lepczyk, Christopher, A., & Warren, P. S. (2012). Urban Bird Ecology and Conservation. *Studies in Avian Biology*, 45, 1–375.

Luck, G. W., Davidson, P., Boxall, D., & Smallbone, L. (2011). Relations between Urban Bird and Plant Communities and Human Well-Being and Connection to Nature. *Conservation Biology, 25*(4), 816–826.

Macaulay, L. (2016). The Role of Wildlife-associated Recreation in Private Land Use and Conservation: Providing the Missing Baseline. *Land Use Policy*, 58, 218–233.

Maller, C., Townsend, M., Pryor, A., Brown, P., & Leger, L. S. T. (2005). Healthy Nature Healthy People: 'Contact with Nature' as an Upstream *Health Promotion Intervention for Populations*, 21(1).

McCleery, R. a., Lopez, R. R., Silvy, N. J., & Gallant, D. L. (2008). Fox Squirrel Survival in Urban and Rural Environments. *Journal of Wildlife Management, 72*(1), 133–137.

McElhinny, C., Gibbons, P., Brack, C., & Bauhus, J. (2005). Forest and Woodland Stand Structural Complexity: Its Definition and Measurement. *Forest Ecology and Management, 218*(1–3), 1–24.

Mello, M. A. R., Rodrigues, F. A., Costa, L. da F., Kissling, W. D., Şekercioğlu, Ç. H., Marquitti, F. M. D., & Kalko, E. K. V. (2015). Keystone Species in Seed Dispersal Networks are Mainly Determined by Dietary Specialization. *Oikos, 124*(8), 1031–1039.

Mihaly Csikszentmihalyi. (1990). *The Psychology of Optimal Experience*. In Harper & Row, New York (pp. 1–8).

Morrison, M.., Scott, T. A., & Tennant, T. (1994). Wildlife-Habitat Restoration in an Urban Park in Southern California.

Niemelä, J., Saarela, S.-R., Söderman, T., Kopperoinen, L., Yli-Pelkonen, V., Väre, S., & Kotze, D. J. (2010). Using the Ecosystem Services Approach for Better Planning and Conservation of Urban Green Spaces: a Finland Case Study. *Biodiversity and Conservation, 19*(11), 3225–3243.

Ogunseitan, O. A. (2005). Topophilia and the Quality of Life. *Environmental Health Perspectives, 113*(2), 143–148.

Palei, H. S., Sahu, H. K., & Nayak, A. K. (2015). Population Density, Diurnal Activity Pattern and Food Preference of Indian Giant Squirrel Ratufa indica in Similipal Tiger Reserve, Eastern India. *Mammal Study, 40*(4), 257–263.

Palmer, R. R., & Koprowski, J. L. (2014). Feeding Behaviour and Activity Patterns of Amazon Red Squirrels. *Mammalia, 78*(3), 303–313. http://doi.org/10.1515/mammalia-2013-0083

Parker, T. S., Gonzales, S. K., & Nilon, C. H. (2014). Seasonal Comparisons

of Daily Activity Bbudgets of Grey Squirrels (Sciurus carolinensis) in Urban areas. *Urban Ecosystems, 17*(4), 969–978.

Parker, T. S., Nilon, C. H., & Advisor, D. (2006). Habitat and Landscape Characteristics that Influence Population Density and Behaviour of Grey Squirrels in Urban Areas.

Saiful, A.A., & Nordin, M. (2004). Diversity and Density of Diurnal Squirrels in a Primary Hill Dipterocarp Forest, Malaysia. *Journal of Tropical Ecology, 20*(1), 45–49.

Santos, T., Nogueira Mendes, R., & Vasco, A. (2016). Recreational Activities in Urban Parks: Spatial Interactions among users. *Journal of Outdoor Recreation and Tourism, 15*(2012), 1–9.

Shimazaki, A., Yamaura, Y., Senzaki, M., & Yabuhara, Y. (2016). Urban Forestry & Urban Greening Urban Permeability for Birds: An Approach Combining Mobbing-call Experiments and Circuit Theory. *Urban Forestry & Urban Greening,* 19, 167–175.

Shine, R., & Koenig, J. (2001). Snakes in the Garden: An Analysis of Reptiles "Rescued" by Community-based Wildlife Carers. *Biological Conservation, 102*(3), 271–283.

Stagoll, K., Manning, A. D., Knight, E., Fischer, J., & Lindenmayer, D. B. (2010). Using Bird-habitat Relationships to Inform Urban Planning. *Landscape and Urban Planning, 98*(1), 13–25.

Strohbach, M. W., Haase, D., & Kabisch, N. (2009). Birds and the City: Urban Biodiversity, Land Use, and Socioeconomics. *Ecology and Society, 14*(2). http://doi.org/10.1063/1.354714

Thorington, R. W., & Ferrell, K. (2006). *Squirrels The Animal Answer Guide*. The John Hopkins University Press.

Thorington, R. W., Koprowski, J. L., Steele, A. M., & Whatton, J. F. (2012). *Squirrels of The World.* The John Hopkins University Press.

Wüstemann, H., Kalisch, D., & Kolbe, J. (2017). Access to Urban Green Space and Environmental Inequalities in Germany. *Landscape and Urban Planning,* 16, 124–131.

Yang, G., Xu, J., Wang, Y., Wang, X., Pei, E., Yuan, X., Wang, Z. (2015). Evaluation of Microhabitats for Wild Birds in a Shanghai Urban Area Park. *Urban Forestry and Urban Greening, 14*(2), 246–254.

Yli-Pelkonen, V. (2013). Importance of Recreational Ecosystem Services in Helsinki, Finland. Management of Environmental Quality: *An International Journal, 24*(3), 365–382.

Yung, E. H. K., Winky K.O., H., & Chan, E. H. W. (2017). Elderly Satisfaction with the Planning and Design of Public Parks in High-Density Old Districts: An Ordered Logit Model. *Landscape and Urban Planning, 165*(5), 39–53.