APPLYING THE RUDIMENTARY METHOD FOR CULTURAL ECOSYSTEM SERVICES PROVISION THROUGH URBAN SQUIRREL MOVEMENTS

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ABSTRACT

The availability and accessibility of green spaces such as forests, landscapes, parks and gardens are important, as it is part of our ecological environment. It offers ecosystem services for the benefits of people such as reduction in water and air pollution, regulating urban macro and microclimate, carbon dioxide sequestration, educational and recreational. The cultural ecosystem services serves as medium where people is in contact with nature which is important for human health and well-being. It provides benefits such as spiritual enrichment, aesthetic experiences, inspiration, and educational values. Hence, the objective of this study is to identify tree characteristics that are frequently found in urban forest parks in Malaysia that afford squirrel movements. Visual observation, photography and video recordings were used to observe squirrel activities for an indicated period of time. Squirrel routes were observed from its first spotted location until the squirrel is out of sight. The routes were then mapped using Google Earth to obtain accuracy. Results show that squirrel route selections are influenced by factors such as fruit bearing trees, point of food source as well as nesting resources and area. This method has contributed to the basic understanding of route selection by urban squirrel in the urban forest park.

1. INTRODUCTION

Urbanization has causes many natural areas converted into built-up areas in order to fulfill people demands on residential, commercial as well as industrial areas. Thus, in rapidly urbanizing cities, interacting with nature is important (Keniger et al., 2013). Natural areas such as urban parks, greenways as well as greenbelt are crucial in urban ecosystem as they provide ecosystem services such as climate regulation, carbon dioxide sequestration or reduction in water and air pollution as well as recreational use. These services are essential for human health and well-being in urban environment. Urban parks play an important role in providing cultural ecosystem services that offer urban residents to interact directly with nature. They are places which suitable for birds and small mammals such as squirrels.

According to Thorington & Ferrell (2006), tree squirrels are an agent of seeds dispersal and known as ‘ecosystem engineer’ and also an important link in the ecological food chain as a prey item worldwide. Hence, tree squirrels in urban ecosystem play an important role by significantly contribute to urban biodiversity stability. However, these services are negatively impacted by the land use change and planning (Cilliers et al., 2012). Its exploiting nature by creating habitat loss, species extinction and simplification (Chen et al., 2014; McKinney, 2006).

Besides the provision and regulating services, cultural services such as spiritual and religious enrichment, aesthetics, recreation and educational activities also have a positive impact on the quality of life of urban dwellers (Savard, Clergeau, & Mennechez, 2000; Tynon & Rosenberger, 2014)Everyday contact with nature will benefits people in many ways. For instance, jogging or cycling in the park, reading a book at the corner of the garden or watching animals are the activities that positively associated with physically and mentally well-being (Douglas, 2012).

Therefore, the question of this study is what tree characteristics that associated with the choice of traveling route or a path frequently taken by the squirrels in urban forest park? Inasmuch, the objective of this study is to identify tree characteristics that are frequently used in urban forest park in Malaysia that afford squirrel movements.

Squirrels are belong to the order Rodentia and family of Sciuridae which can be divided into five subfamilies: i) Sciurilinae, ii) Ratufinae, iii) Sciurinae,

iv) Callosciurinae and v) Xerinae. In South East Asia region including Malaysia, a group of tree squirrels forms by forth subfamily, the Callosciurinae. It means "beautiful squirrels" (Thorington & Ferrell, 2006).

Five genera of Callosciurus namely, *C. caniceps* Gray, *C. notatus* Boddaert, *C. nigrovittatus* Horsfield, *C. prevostii* Desmarest, are an arboreal species which native to Malaysian rainforest (Saiful & Nordin, 2004; Thorington & Ferrell, 2006). Among these, *C. notatus* (Plantain) squirrel is the most commonly found in many urban parks in many cities in Malaysia because they are extremely adaptable to urban environment. The two cream and black stripes on the sides easily identify this species with the orange belly as well as the lack of a pale spot behind the ear (Figure 1).

Fig. 1: *Callosciurus notatus* (Plantain) squirrel commonly found in urban parks of Malaysian cities.

2. MATERIAL AND METHODS

2.1 Study Area

This study was conducted in Urban Forest Park, Johor Bahru, Malaysia. As a man-made forest, it consists of 20 hectare of mixed tree species and surrounded by variety of different land cover types such as lakes, roads, residential areas, and government institutions as well as schools ground.

The urban forest ecosystem provides many ecological services and benefits to cities and communities including energy conservation, contributing to global biodiversity, and maintaining hydrologic and nutrient cycles. It also fulfills important needs for urban community such as energy conservation, beauty, and recreation in the city (Duryea, 2000).

Fig. 2: Satelite image of Urban Forest Park in Johor Bahru city, Malaysia.

2.2 The Rudimentary Method

Ad libitum sampling or preliminary observation is applying in this study in order to obtain basic understanding on squirrel movement pattern in urban park before a more detail and complex processes can be conducted. Movement or travel behavior is defined as traveling through the parks using one or various storey level (Palmer & Koprowski, 2014). The pattern is recorded with the aid of 8'x32" binocular and Canon Full HD 42X optical zoom digital camera on monopod. Plant species used during the traveling activities were noted down.

2.2.1 Squirrel Observation

The observations were made from 15th to 19th September 2015. The data were collected from 0700hrs – 1100hrs and 1600hrs – 1900hrs during the squirrel's active periods. Their traveling behavior and types of trees used were recorded from its first spotted until it's out of sight. This is considered as one sighting, regardless the number of squirrel sighted (Devan, 1982; Saiful & Nordin, 2004). The observer stood at the observation point that was determined based on the first squirrel's spotted area.

Fig. 3: Google Earth photo (2014) of the observation point at squirrel's spotted area in urban forest park in Johor Bahru city, Malaysia.

2.2.2 Tree Characteristics

The area of where the observation was conducted is composed of planted trees most notably *Shorea leprosula*, *Saraca thaipingensis* and *Polyantha longifolia*, palms such as *Livistonia rotundifolia and Elaeis guineensis* as well as shrubs *Calathea lutea* and *Eugenia orelana* that could potentially influence squirrel movements. Thus, this study recorded the types of species and storey level (<5m; ground and lower), midstory (5-15m) and canopy (>15m). These data will determine the tree characteristics that influence the squirrel traveling pattern (Palmer & Koprowski, 2014) as watching animal behavior is a part of cultural ecosystem service provision.

3. ANALYSIS

3.1 Squirrel Movements Pattern

Throughout the study, the squirrels were observed traveled from one tree to another by selecting fruit bearing trees for their foraging and feeding needs. These are major activities which essential for warm blooded animal before they can perform other regular activities (Rao et al., 2015).

Figure 4 shows the elevation view of overall movement pattern of squirrels which use all the storey levels to travel or move between the first spotted locations towards two food source points before it's lost. Canopy connectivity is significantly support the movement as it is crucial for the locomotion of arboreal animals (Rao et al., 2015).

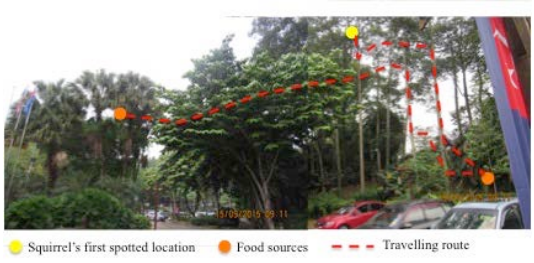

Fig. 4: Movements pattern from squirrel's first spotted location using all the storey levels

Figure 5 shows choices of route based on collective squirrel's activities in a cluster of trees. The squirrel was observed resting on tree branches of *S.thaipingensis* due to its dense canopy which covers it from hot temperature during day time. They feed on the *S.leprosa* trunk perhaps because it is close to *E.guineensis* as their food source. The squirrels were also selected palm tree like *L.rotundifolia* as their main source for nest material. This study found that this is the only plant species which produce fiber material that suitable for building the nest.

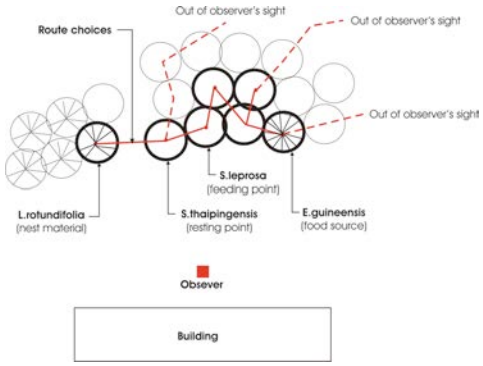

Fig. 5: Squirrel's route choices based on collective activities performed in a cluster of trees

3.2 Tree Characteristics

Table 1 shows plant species that influence the route choices. It is also influence by the other types of behavior such as forage, feed as well as collecting nest materials. The storey levels provide different facilities to the squirrels according to their activities.

Table 1: Plants species which influence the squirrel's traveling behavior.

Plants species	Activity	Storey Level
Tree		
Shorea leprosula	Travel and feed	Midstory & canopy
Saraca thaipingensis	Travel and rest	Midstory & canopy
Palm		
Livistonia rotundifolia	Travel, forage, feed and nest material source	Canopy
Elaeis guineensis	Forage	Lower

Figure 6 shows the tree characteristics, which influence the choices of route of the squirrels in urban park. For example, trees like *S.leprosa* and *S.thaipingensis* provide places for feeding and resting. Palm species like *L.rotundifolia* and *E. guineensis* within the observation

area were the major source of food and nest material for the squirrels. The palms produce fruits and the squirrels have been foraged and feed on it repeatedly.

Shorea leprosa (feeding point)

Livistonia rotundifolia (food source)

Saraca thaipingensis (resting area)

Livistonia rotundifolia (nest material)

Fig. 6: Plants that influence the squirrel movement along the chosen route

4. CONCLUSION

A total of 31 sightings, the squirrels have chosen the trees, which produce food source and feeding point, dense canopy cover which suitable for resting place and palms fiber for nest material sources together with the canopy continuity. Result shows that these tree characteristics influence the choices of route for squirrel movement in urban forest park. It also suggests that this method may help to predetermine the tree characteristics requirement for supporting squirrel movement pattern in urban park before a more detail focal animal sampling work can be applied.

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