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ECOLOGY OF RESERVOIR PARK, URBAN FOREST OF KUCHING CITY, SARAWAK: TREE SPECIES AND SOIL NUTRIENTS

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SUMMARY

Twenty five plots of 20 m x 20 m were established at both well managed park (WMP) and abandoned park (AP) of Kuching Reservoir Park for comparative study on floristic composition, biomass estimation and soil characteristics. All trees with DBH >4.5cm were enumerated and identified to species level. Total estimated above ground biomass of AP (mean= 234.95 ton/ha) was not significantly different with WMP (mean =177.64 ton/ha). Total species found in both sites were 58 species from 26 families including palms, bamboos, 12 species of ferns, five species of orchids and an ant plant were recorded from both sites. They were both native or indigenous and exotic or introduced plants such as commercial timber, protected, wild and cultivated fruit species. *Alstonia angustifolia* is the most important species in both sites due to its giant size as shown by its highest relative basal area (RD). The AP consisted of an understorey of small trees as a result of abandonment. WMP had clear understorey layeras a result of regular thinning of undesired plants. The mean thickness of Litterfall in AP is 2.68 cm which is significantly different from WMP 1.12 cm thick. The nutrients content such as N, P, K, Mg, Ca, Na, Zn, B, Fe and Cu are varied between both sites. Amount of N, C, P, Zn and Fe are higher in AP than WMP and vice-versa for other elements. The total leaf area index (LAI) of trees in AP is 2.01 m^2/ha and 1.76 m^2/ha for WMP.

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BACKGROUND

Forest structure and plant diversity vary between locations and between regions. The variations occur due to various factors such as

rainfall, soil nutrients, micro-climate, altitude, disturbance and survivorship of the species. Variation in species composition or structure often resulted from past disturbance (White, 1979; Veblen, 1989). Disturbance is partly responsible for spatial mosaics in vegetation and dynamics process (Whitmore, 1989; Goldammer & Jenkins, 1990). The changes can be determined from the life forms and the physiognomy of the plants (Grubb, 1977).

Urban soils are mostly considered as modified soils. Some patches of soils have no topsoil layer as a result of development activities. Soil in urban area constitutes a wide range of materials, including natural, contaminated and degraded soils with several varieties of substrates derived from industrial processes. It is often assumed that the provision and cycling of nutrients in these soils will be similar to the same processes occurring in the rural and agricultural soils (Pulford, 1991). The soil nutrient richness and its capability are useful factors for land-use planning and management (Bullock & Gregory, 1991). However, urban soil status is much influenced by industrial activity which inevitably caused substantial soil contamination through extensive application of pesticides, herbicides, fertilizers and asbestos wastes (Bullock, 1991).

There is paucity of ecological studies on the urban vegetation of Kuching City. This information is important to city planners in designing the urban landscapes and deciding extent and location of green zone. The existing urban forest in Kuching City occurs in patches; one such patch is Reservoir Park, which needs detailed scientific information to facilitate effective and efficient management for multiple objectives. Therefore, the objective of this study is to investigate the forest structure, species composition as well as determination of species dominance, estimation of above ground biomass and edaphic conditions of the urban forest at Reservoir Park, Kuching.

MATERIALS AND METHODS

Study area

Reservoir Park is one of the oldest parks in Kuching. It was established in 1886 (Chon, 1989) during the colonial period. It is situated

at the heart of Kuching City, just behind the Sarawak Museum. Originally and up through the end of the World War II, it was kept as a natural forest for the purpose of water catchment. Subsequently, after the reservoir was converted to a park, the existing forest was managed phase by phase. Underbrushing was conducted for a few years. Large trees were kept and much of the open space was revegetated with both introduced and indigenous species.

The Reservoir Park was landscaped as are most of the government quarters, prison, schools, civic center and residential area. It is believed that some parts of the park were left unmanaged since 1912 after a new water supply was built at Mt. Matang. Abandon Park (AP) were experiencing natural succession and regeneration whereas WMP were control from such processes. Some open space in the WMP were planted with ornamental plants and turf. The leaf litter in the WMP are removed daily by the DBKU workers.

Plot establishment and plant numeration

The tree survey was conducted at Kuching Reservoir Park in the green zone of Kuching North City Council (DBKU). Two sites at the same age were selected at 01^0 33.1955' N, $110^0$20.6048' E for Well-managed Park (WMP) and 01^0 32.9797 N, $110^0$20.7695' E for Abandoned Park (AP). At each site, 25 plots of 20 m x 20 m were established. Each plot was subdivided into four subplots of 10 m x 10 m. All trees with diameter ≥4.5 cm were enumerated and their specimens were collected for identification.

The determination for plant species dominance and plant diversity was carried out by adopting methods described by Brower *et al.* (1990) and Mabberly (1992) respectively. The biomass estimation was made by following the allometric correlation method developed by Yamakura *et al.* (1986) based on improvement on those described by Kato *et al.* (1978) and Ogawa & Kira (1977).

The canopy coverage was determined according to the procedure described by Brower *et al.* (1990). For the purpose of canopy coverage

assessment, 10 m x 10 m subplots were further divided to 5 m x 5 m. Edge of the most dense part of the canopy were measured perpendicularly with linear tape in two directions, north-south and east-west for each stand.

Soil analyses

The soil samples were collected for layer depths of 0-5 cm, 5-10 cm, 10-15 cm and 15-20 cm with 2.5 cm diameter auger. Three auger holes were made in each 5 m x 5 m subplot giving a total of 12 points in zigzag pattern per 20 m x 20 m plot. The samples from each subplot were homogenized to one composite per layer per site (Peterson & Calvin, 1965). The samples were air-dried in the laboratory for about two weeks, then ground and sieved through 2-mm mesh (Thomson *et al.*, 1992). These samples were used for various analyses including pH (Hesse, 1971; McLean, 1986), soil organic carbon (Dewis & Freites, 1970), moisture content (Nelson & Sommers, 1986), total nitrogen (N) (Anon., 1980; Beitz, 1974), CEC and base saturation (Anon., 1980), reserve element determination (Bailey, 1967; Valley, 1966), phosphorus (P) (Olsen & Sommers, 1986), potassium (K), sodium (Na), calcium (Ca), magnesium (Mg), as well as the Cation Exchange Capacity (CEC) and exchangeable cations.

RESULTS

Species diversity

Species diversity is important as it is believed to be the gene pool, population, communities and ecosystems with the ability to adapt and response to the environmental uncertainty (Baker *et al.,* 1992). The diversity of the urban forest is much lower than primary forest. The number of tree families found at both sites are not much different. AP comprised 19 families, 29 genera and 34 species, whereas WMP comprises of 17 families, 26 genera and 32 species (Table 1). These represent a very low composition of flora in comparison with that observed in a natural lowland rainforest. As a comparison, a 23 hectare plot of primary forest in West Malaysia harbors 52 families, 139 genera