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Microclimate of Ayer Hitam Forest, Selangor

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ABSTRAK

Mikroklimatologi hutan ialah satu proses penilitian proses fizikal di sempadan lapisan atmosfera hutan pada sesuatu masa. Pemahaman terhadap prinsip biofizikal ini perlu dalam merangka sistem perhutanan yang mampan di mana sumber hutan boleh digunakan untuk pemuliharaan ekologi, sumber kayu, rekreasi, sumber air dan apresiasi estetik. Objektif kajian ini ialah untuk mencirikan mikroklimatologi Hutan Ayer Hitam. Kajian ini dijalankan di Kompartmen 6 Hutan Ayer Hitam. Parameter seperti suhu udara dan tanah, cahaya, kelembapan dan kelajuan angin dimantau pada tempoh kajian dijalankan. Data yang serupa juga diambil (kecuali cahaya) di stesyen kajicuaca UPM. Keputusan kajian menunjukkan stesyen kajicuaca UPM mempunyai suhu udara min dan maximum yang lebih tinggi dan suhu minimum yang lebih rendah jika dibandingkan dengan Hutan Ayer Hitam. Kelembapan min Ayer Hitam adalah lebih tinggi manakala julat harian adalah lebih rendah dibandingkan dengan stesyen kajicuaca UPM. Min suhu tanah pada semua kedalaman di Ayer Hitam adalah lebih rendah dibandingkan pada stesyen kajicuaca UPM. Keputusan daripada kajian ini menunjukan iklim mikro Ayer hitam adalah berbeza daripada stesyen kajicuaca UPM.

ABSTRACT

Forest microclimatology is the study of physical processes in the forest atmospheric boundary layer over time. An understanding of these biophysical principles is essential in the development of sustainable forest management system in which forest resources can be utilized for ecological protection, timber resources, recreation, water resources and aesthetic appreciation. The objective of this paper is to characterise the microclimate of Ayer Hitam Forest. The study was conducted at Compartment 6 of the Ayer Hitam Forest. Parameters such as soil temperature, light, humidity, wind velocity and air temperature were monitored hourly during the study period. Data on the same parameters (except light) were also obtained from the Universiti Putra Malaysia, meteorological station. The UPM meteorological station had higher mean hourly air temperature, recorded higher maximum and lower minimum compared to Ayer Hitam Forest. Mean relative humidity at Ayer Hitam was higher than at UPM meteorological station while daily range relative humidity was higher at UPM meteorological station compared to Ayer Hitam. Mean soil temperatures at all depths in Ayer Hitam Forest were lower compared to the UPM meteorological station. Result from the study shows that microclimate of Ayer Hitam is different from UPM meteorological station.

INTRODUCTION

Microclimate is climate of a small scale. It is concerned with the state of the atmosphere near the ground, the layer in which most animals and plants live. Heat exchange and water vapor transfer between this layer and the ground are active and are greatly affected by land use and micro-relief conditions. Thus, there is a great spatial variation with respect to temperature, humidity and other climate variables within a short

distance. On the other hand, climate describes the atmospheric conditions of general terrain in which the effects of land use and micro-relief are smaller and there is less variation over space.

Forest microclimatology is the study of physical processes in the forest atmospheric boundary layer over time. Lee (1978) defined it as the study of atmospheric processes which include energy and mass exchanges and transformations in a soil-plant-atmosphere continuum where physical stimuli are modified to a large extent by physiological factors. It focuses on the interrelatedness of environment and life process, but it is also concerned with physical effects and the forest's influence on the external environment. An understanding of these biophysical principles is essential in the development of sustainable forest management system in which forest resources can be utilized for ecological protection, timber resources, recreation, water resources and aesthetic appreciation. The objective of this paper is to describe and characterise the microclimate of Ayer Hitam Forest.

MATERIALS AND METHODS

Study Area

This study was conducted at Ayer Hitam Forest, Puchong, Selangor. Ayer Hitam Forest Reserve has been gazetted to University Putra Malaysia in 1996 by Forest Department of Selangor. The Forest was gazetted for forest education and research purpose. It is about 1,248 hectare and has six compartments.

The topography of the forest is rather undulating between 15 to 157 meter above sea level. This forest has been classified as a rich lowland dipterocap forest of *Kempas-Kedondong* and has been logged before in 1930 (Aminuddin 1978). After the logging operation, the Ayer Hitam Forest Reserve was classified as a secondary disturbed forest. The emergent canopy stand is about 20 meters above the ground. The secondary layers are between 12 to 16 meters above ground and the lower canopy consists of saplings and seedlings.

Data Collection

Parameters such as soil temperature, light, humidity, wind velocity and air temperatures were monitored hourly during the study period, 17-23 November, 1986 (Table 1). Data on the same parameters (except light) were also obtained from the University Putra Malaysia meteorological station.

TABLE 1
Instruments and parameter observed during the study.

Parameter measured	Instrument	Position
Soil temperature	Soil temperature thermometer	5cm, 10cm and 20 cm and 30 cm depth
Air temperature	Hygrothermograph	1m
Light	Light meter	1 m
Humidity	Hygrothermograph	1 m
Wind Velocity	Anemometer	10 m

RESULTS AND DISCUSSION

Air Temperature

Air temperature hourly variation is shown in *Fig. 1.* At Ayer Hitam, air temperature increased from 0600 hour until 1400 hours and decreased until 0600 hour. Maximum air temperature was 27.7°C, recorded at 1400 hour while the minimum was 22.9°C recorded at 0500 and 0600 hour. At UPM meteorological station, maximum air temperature was 31.3°C recorded at 1400 hour while the minimum was recorded at 0500 hour. The UPM meteorological station had higher mean hourly air temperature, recorded higher maximum and lower minimum compared to Ayer Hitam Forest (Table 2). This may be due to the protective function of the forest in which during the day incoming solar radiation was being blocked by the vegetative cover while during the night, the vegetative cover prevented the energy being radiated out of the atmosphere.

Relative Humidity

The result of relative humidity is shown in *Fig. 1.* Maximum relative humidity at Ayer Hitam and UPM meteorological station was 97.8 % and 100 %, respectively, while the minimum relative humidity was 77.4 % and 60.2 %, respectively. Mean relative humidity at Ayer Hitam (87.6 %) was higher at UPM meteorological station (80.1 %) while daily range relative humidity was higher at UPM meteorological station (39.8 %) compared to Ayer Hitam (20.4 %). Diurnal variation of

TABLE 2.
Descriptive statistics of hourly air temperature and relative humidity at both sites.

	Air Temperature (°C)				Relative Humidity (%)			
	Max.	Min.	Mean	Range	Max.	Min.	Mean	Range
Ayer Hitam	27.7	22.9	25.3	4.8	97.8	77.4	87.6	20.4
UPM Met Station	31.3	22.1	26.7	9.2	100	60.2	80.1	39.8

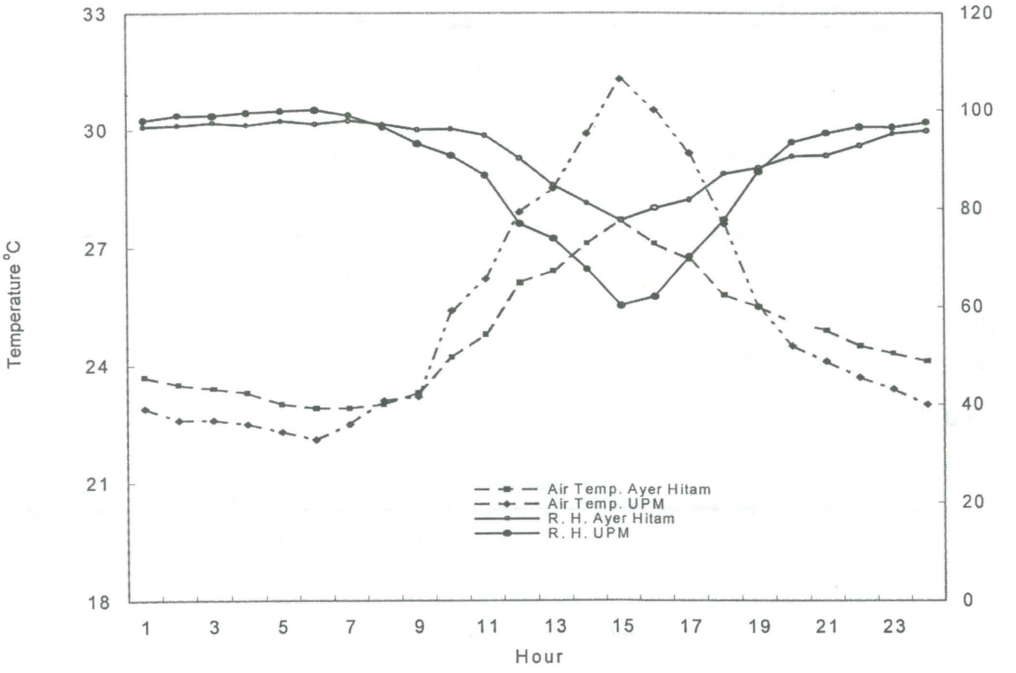

Fig. 1. Hourly Variation of air temperature and relative humidity at Ayer Hitam and UPM meteorological station.

relative humidity for both sites showed the same trend at which maximum relative humidity occurred in the morning, at 0500 hour for UPM meteorological station and 0600 hour for Ayer Hitam while minimum relative humidity occurred during the day at 1400 hour. As in air temperature, the low value of daily range of relative humidity shows the effect of forest in buffering the environment. Relative humidity is a function of air temperature and lower air temperature will lead to higher relative humidity.

Wind Speed

Wind speed at both sites were higer during the day than the night. Wind speed variation at Ayer Hitam forest is shown in *Fig. 2.* Maximum wind speed was 0.0720 m/s occurred at 1600 hour while there was no wind movement during the night. At UPM meteorological station, maximum wind speed was 2.17 m/s occurred at 1400 hour while minimum wind speed was 0.15 m/s occurring at 2300 hour. As a note, wind speed measurement at UPM meteorological station was taken at 0.5 meter height.

Light

Hourly variation of light intensity is depicted in *Fig. 3.* Light intensity increased from 50 lux at 0700 hour and reached maximum of 2460 lux at 1400 hour and decreased to 34 lux at 1900 hour.

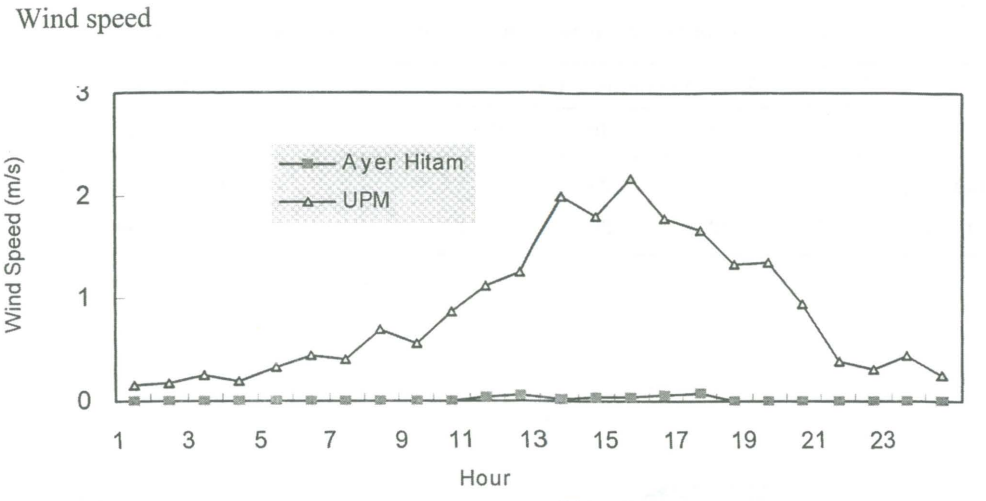

Fig. 2. Hourly variation of wind speed (m/s) at Ayer Hitam and UPM meteorological station.

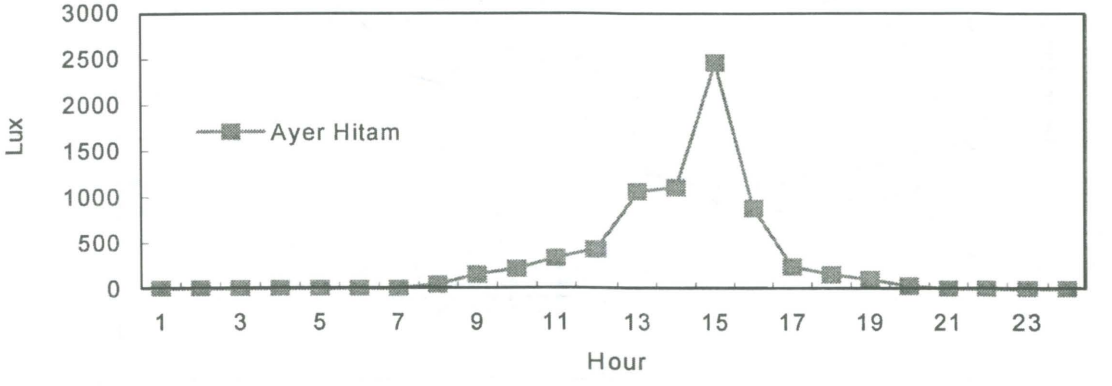

Fig. 3. Hourly variation of light intensity (lux) at Ayer Hitam.

Soil Temperature

Soil temperature at 5 cm depth for the Ayer Hitam forest ranged from 25.2°C to 24.2°C with a mean of 24.7°C. For UPM meteorological station, it ranged from 31.3°C to 26.5°C with a mean of 28.9°C. Soil temperature at 10 cm depth for the Ayer Hitam forest ranged from 24.9°C to 24.1°C with a mean of 24.5°C while for UPM meteorological station soil temperature ranged from 28.4°C to 27.5°C with a mean of 28.0°C. At 30 cm depth, the hourly soil temperature for Ayer Hitam forest ranged from 24.7°C to 24.4°C with a mean of 24.6°C. For the UPM meteorological station, the hourly soil temperature at 30 cm depth ranged from 28.5°C to 28.0 °C with a mean of 28.3°C. Mean soil temperatures at all depths at Ayer Hitam were

TABLE 3.
Descriptive statistics of soil temperature at Ayer Hitam and UPM meteorological station.

	Soil Temperature (°C)			
	Max.	Min.	Mean	Range
Ayer Hitam				
5	25.2	24.2	24.7	1.0
10	24.9	24.1	24.5	0.8
20	24.8	24.3	24.6	0.5
30	24.7	24.4	24.6	0.3
UPM Meteorological Station				
5	31.3	26.5	28.9	4.8
10	28.4	27.5	28.0	0.9
30	28.5	28.0	28.3	0.5

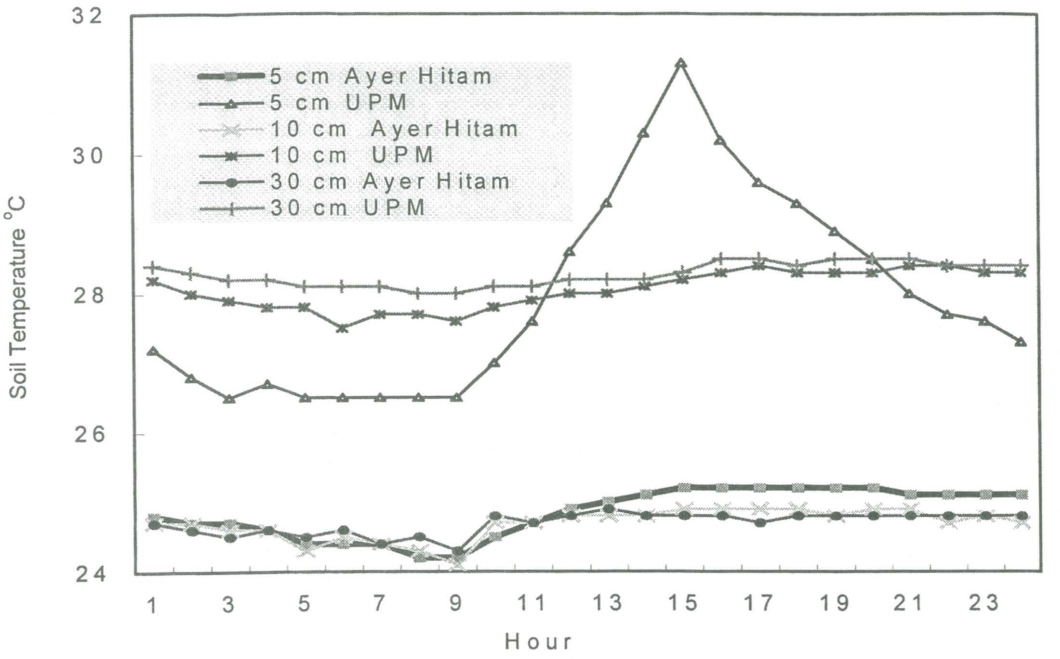

Fig. 4. Hourly variation of soil temperature at different depths at Ayer Hitam and UPM meteorological station

lowered compared to UPM meteorological station. The differences in soil temperatures between Ayer Hitam forest and UPM meteorological station were due to the canopy's shading effect. Fowler and Anderson (1986) showed the same trend in which maximum difference in mean soils temperatures between clearcut and forest areas was 7.7°C during the study period.

CONCLUSION

Results from the study show that the microclimate of Ayer Hitam is different from UPM meteorological station. Mean air temperature was lower while the mean relative humidity was higher compared to UPM meteorological station. Wind speed and soil temperatures were also lower in Ayer Hitam forest than at UPM meteorological station. The structure of the forest reduces the solar energy reaching the forest floor, lowering the air and soil temperature.

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