BIOMASS, LITTER PRODUCTION AND SELECTED NUTRIENTS IN *BRUGUIERA PARVIFLORA* (ROXB.) WIGHT & ARN. DOMINATED MANGROVE FOREST ECOSYSTEM AT KUALA SELANGOR, MALAYSIA

By

MAHMOOD HOSSAIN

Thesis Submitted to the School of Graduate Studies, Universiti Putra Malaysia, in Fulfilment of the Requirements for the Degree of Doctor of Philosophy

December 2004

Dedicated

To

My Parents and Memory of My Grand Parents,

My Wife Sonchita for Years of Love and Care,

My Sweet Daughter Borno

Abstract of thesis presented to the Senate of Universiti Putra Malaysia in fulfilment of the requirements for the degree of Doctor of Philosophy

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Chairman: **Misri Kusnan, Ph.D.**

Faculty: **Science**

This study was carried out to investigate the standing biomass, litter dynamics and selected nutrients in soil, water and plant components in a *Bruguiera parviflora* dominated naturally growing unmanaged mangrove forest ecosystem in Kuala Selangor Nature Park, Malaysia. This study was initiated during September 2001 and ended on August 2003. The total above and below-ground biomass of *B. parviflora* seedlings, saplings and trees were 144.47 t/ha and 19.93 t/ha, respectively, and the net primary productivity of this forest was 27.44 t/ha/yr. The annual amount of small litter production and small litter standing crop were 1035 g/m^2 and 337.72 g/m^2, respectively. *Bruguiera parviflora* leaf litter showed higher microbial degradation (60% of initial dry mass) in wet month (November 02) than the dry month (20.17% of initial dry mass, July 02), but leaf litter loss due to feeding plus mechanical breakdown did not vary in dry and wet months. Soil parameters (pH, redox potential,

air-dry moisture, organic matter, conductivity, salinity and cation exchange capacity) and nutrients (N, P, K, Ca, Mg, S, C, Cu, Fe and Zn) were measured in intermediate (March), dry (July) and wet (November) seasons and found relatively higher organic matter (12.03-12.56%) and cation exchange capacity (37.31-38.23 m.e/100 g) in the intermediate seasons (March 02 and 03). Higher conductivity (11.25-11.81 mS/cm) and salinity (57.64-59.03 m.e/100 g) were observed during the dry seasons (July 02 and 03). Comparatively higher content of N (3.49-3.50 mg/g), P (0.33-0.34 mg/g), K (6.86-7.06 mg/g), C (63.29-67.63 mg/g) and Fe (11929.44-12866.67 μg/g) in soil were observed during the intermediate seasons (March 02 and 03). Higher conductivity (55.83-71.00 mS/cm) was observed in infiltration water followed by river water (18.17-22.17 mS/cm) and relatively higher conductivity of rainwater, canopy drip, river and infiltration water was found during the dry seasons (July 02 and 03). Nutrients (NH_4, NO_3, PO_4, K, Ca, Mg and SO_4) in rainwater, canopy drip, stem flow, river and infiltration water fluctuate with the seasons and comparatively higher K, Ca, Mg, SO_4, Cu, Fe and Zn were observed in infiltration water followed by river water. Nutrients (N, P, K, Ca, Mg, S, C, Cu, Fe and Zn) in different components of *B. parviflora* seedlings, saplings and trees were measured in intermediate (March), dry (July) and wet (November) seasons and reported comparatively higher N, P, K, Ca, Mg and Fe in plant components during the intermediate seasons (March 02 and 03) and relatively higher sulphur was found during the dry seasons (July 02 and 03). Nutrients content in different components of seedlings, saplings and trees of *B. parviflora* showed positive correlations with the soil nutrients level. The annual uptake range of N, P, K, Ca, Mg, S, Cu, Fe and Zn was 109.34-129.67 kg/ha, 16.70-25.65 kg/ha, 39.69-66.71 kg/ha, 153.84-240.41 kg/ha, 48.30-68.27 kg/ha, 100.93-

177.05 kg/ha, 120.61-287.14 g/ha, 7981.31-14697.29 g/ha and 204.49-581.41 g/ha, respectively.

Abstrak tesis yang dikemukakan kepada Senat Universiti Putra Malaysia sebagai memenuhi keperluan untuk ijazah Doktor Falsafah

BIOJISIM, PENYEBARAN SARAP DAN NUTRIEN TERPILIH DALAM EKOSISTEM HUTAN PAYA BAKAU DIDOMINASI *BRUGUIERA PARVIFLORA* (ROXB.) WIGHT & ARN., DI KUALA SELANGOR, MALAYSIA

Oleh

MAHMOOD HOSSAIN

Disember 2004

Pengerusi: **Misri Kusnan, Ph.D.**

Fakulti: **Sains**

Kajian ini dijalankan bagi mengkaji jisim tetap, dinamik sarap dan nutrien terpilih dalam tanah, air dan komponen tumbuhan di dalam satu ekosistem hutan paya bakau semulajadi yang didominasi oleh *Bruguiera parviflora* di Taman Alam Kuala Selangor, Malaysia. Penyelidikan dilakukan dari bulan September 2001 hingga bulan Ogos 2003. Jumlah biojisim di atas dan dalam tanah bagi anak pokok, pokok muda dan pokok matang *Bruguiera parviflora* adalah masing-masing 144.47 t/ha dan 19.93 t/ha, dan produktiviti primer bersih adalah 27.44 t/ha/yr. Jumlah penghasilan tahunan sarap kecil dan sarap kecil tanaman dirian adalah masing-masing 1035 g/m^2 dan 337.72 g/m^2. Sarap daun *Bruguiera parviflora* mengalamai degradasi mikrob yang lebih tinggi (60% daripada berat kering asal) dalam musim hujan (November 2002) berbanding musim kering (20.17% daripada berat kering, Julai 2002) tetapi kehilangan sarap daun disebabkan oleh pemakanan dan perpupan mekanikal tidak berbeza dalam musim kering dan musim hujan. Parameter tanah (pH, potensi redoks,

kelembapan udara, bahan organik, konduktiviti, saliniti dan keupayaan penukaran kation) dan nutrien terpilih (N, P, K, Ca, Mg, S, C, Cu, Fe dan Zn) diukur semasa musim perantara (Mac), musim kering (Julai) dan musim hujan (November) dan didapati kandungan bahan organik (12.03-12.56%) dan keupayaan penukaran kation (37.31-38.23 m.e/100 g) ini adalah tinggi dalam musim pertengahan (Mac 2002 dan 2003). Manakala bacaan konduktiviti (11.25-11.81 mS/cm) dan saliniti (57.64-59.03 m.e/100 g) yang tinggi didapati semasa musim kering (Julai 2002 dan 2003). Kandungan yang tinggi bagi N (3.49-3.50 mg/g), P (0.33-0.34 mg/g), K (6.86-7.06 mg/g), C (63.29-67.63 mg/g) dan Fe (11929.44-12866.67 μg/g) dalam tanah didapati semasa musim pertengahan (Mac 2002 dan 2003). Konduktiviti yang lebih tinggi (55.83-71.00 mS/cm) didapati dalam air infiltrasi dan diikuti air sungai (18.17-22.17 mS/cm) dan bacaan konduktiviti adalah relatif lebih tinggi didapati pada air hujan, titisan air kanopi, saliran air, air sungai dan air infiltrasi semasa musim kering (Julai 2002 dan 2003). Nutrien (NH_4, NO_3, PO_4, K, Ca, Mg dan SO_4) dalam air hujan, titisan air kanopi, saliran air, air sungai dan air infiltrasi berbeza mengikut musim dan kandungan K, Ca, Mg, SO_4, Cu, Fe dan Zn yang lebih tinggi didapati dalam air infiltrasi dan diikuti oleh air sungai. Nutrien (N, P, K, Ca, Mg, S, C, Cu, Fe and Zn) dalam komponen anak pokok, pokok muda dan pokok matang *B. parviflora* diukur bagi musim pertengahan (Mac), musim kering (Julai) dan musim hujan (November) dan didapati bahawa kandungan P, K, Ca, Mg dan Fe yang tinggi dalam komponen tumbuhan semasa musim perantara (Mac 2002 dan 2003) dan nisbah sulfur yang tinggi didapati semasa musim kering (Julai 2002 dan 2003). Kandungan nutrien dalam komponen anak pokok, pokok muda dan pokok matang *B. parviflora* menunjukkan korelasi positif dengan tahap nutrient dalam tanah. Julat penyerapan tahunan N, P, K, Ca, Mg, S, C, Cu, Fe dan Zn adalah masing-masing 109.34-129.67 kg/ha, 16.70-25.65

kg/ha, 39.69-66.71 kg/ha, 153.84-240.41 kg/ha, 48.30-68.27 kg/ha, 100.93-177.05 kg/ha, 120.61-287.14 g/ha, 7981.31-14697.29 g/ha dan 204.49-581.41 g/ha.

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Finally, I express my respect to my parents and parents in law for their inspiration and encouragement for getting higher degree. I would like to express my humbly apology to those persons, who helped me but may not find their names in my narration here.

I certify that an Examination Committee met on 10 December 2004 to conduct the final examination of Mahmood Hossain on his Doctor of Philosophy thesis entitled "Biomass, Litter Production and Selected Nutrients in *Bruguiera parviflora* (Roxb.) Wight & Arn. Dominated Mangrove Forest Ecosystem at Kuala Selangor, Malaysia" in accordance with Universiti Pertanian Malaysia (Higher Degree) Act 1980 and Universiti Pertanian Malaysia (Higher Degree) Regulations 1981. The Committee recommends that the candidate be awarded the relevant degree. Members of the Examination Committee are as follows:

Umi Kalsom Bt Yusuf, Ph. D.
Associate Professor
Faculty of Science
Universiti Putra Malaysia
(Chairman)

Jambari Bin Hj Ali, Ph. D.
Associate Professor
Faculty of Science
Universiti Putra Malaysia
(Member)

Abdul Rahim Ismail, Ph. D.
Professor
Faculty of Science
Universiti Putra Malaysia
(Member)

Dato' Dr. Abdul Latiff Mahmad, Ph. D.
Professor
Faculty of Science and Technology
Universiti Kebangsaan Malaysia
(Independent Examiner)

GULAM RUSUL RAHMAT ALI, Ph.D.
Professor/ Deputy Dean
School of Graduate Studies
Universiti Putra Malaysia

Date:

This thesis submitted to the Senate of Universiti Putra Malaysia and has been accepted as fulfilment of the requirement for the degree of Doctor of Philosophy. The members of the Supervisory Committee are as follows:

Misri Kusnan, Ph.D.
Lecturer
Faculty of Science
Universiti Putra Malaysia
(Chairman)

Saberi Othman, Ph.D.
Professor
Faculty of Science and Technology
Universiti Pendidikan Sultan Idris
(Member)

Japar Sidik Bujang, Ph.D.
Associate Professor
Faculty of Science
Universiti Putra Malaysia
(Member)

AINI IDERIS, Ph.D.
Professor / Dean
School of Graduate Studies
Universiti Putra Malaysia

Date:

DECLARATION

I hereby declare that the thesis is based on my original work except for quotations and citations which have been duly acknowledged. I also declare that it has not been previously or concurrently submitted for any other degree at UPM or other institutions.

Signature

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MAHMOOD HOSSAIN

Date:

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