UNIVERSITI PUTRA MALAYSIA

COPPER (CU) AND ZINC (ZN) IN THE FOOD WEB OF INTERTIDAL MANGROVE ECOSYSTEM OF SUNGAI PULOH, MALAYSIA

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By

UDECHUKWU BEDE EMEKA

Thesis submitted to the School of Graduate Studies, Universiti Putra Malaysia, in Fulfillment of the Requirements for the Degree of Master of Science

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Abstract of thesis presented to the Senate of Universiti Putra Malaysia
in fulfillment of the requirements for the degree of Master of Science

COPPER (CU) AND ZINC (ZN) IN THE FOOD WEB OF INTERTIDAL MANGROVE ECOSYSTEM OF SUNGAI PULOH, MALAYSIA

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Chair: Prof. Ahmad Ismail, PhD

Faculty: Science

The purpose of this study was to assess the copper (Cu) and zinc (Zn) levels in the intertidal mangrove sediment of Sungai Puloh (SGP) and Sungai Tengi (SGT). Another aim was to assess the bioaccumulation pattern of Cu and Zn in a food web of Sungai Puloh intertidal mangrove ecosystem. For the first goal, intertidal surface sediment samples were collected from four stations in each of the two intertidal mangrove ecosystems of Sungai Puloh (SGP N 03° 04.786´ E 101° 23.903´) and Sungai Tengi (SGT N 03° 24.682, E 101° 9.971´) in Selangor, between January and March, 2009. For the second objective, different components of intertidal mangrove ecosystem (mangrove leaves, roots, phytodetritus-algae and detritus, surface sediment, crabs, snails and fish) were collected from six stations in Sg. Puloh mangrove between August and December, 2009. The samples were determined for Cu and Zn by using an air-acetylene flame Atomic absorption Spectrophotometer (Analyst 800 model, by Perkin-Elmer) and presented in μg/g dry weight basis. The results revealed that

both SGP and SGT with mean Zn concentrations (302.64 ± 5.33 µg/g) and (870.73± 61.04 µg/g) respectively were contaminated by Zn, while only SGP showed elevated levels of Cu (67.17±4.95µg/g), and receives more anthropogenic inputs of Cu (27.0%) and Zn (63.4%) compared to SGT with anthropogenic inputs of Cu (13.2%) and Zn (31.4%) with a significant difference ($P < 0.05$). It was also found in Sungai Puloh that there is a positive correlation between the trophic chains with evidence of biomagnifications of Cu in *Uca annulipes* – phytodetrtus chain (biomagnifications factor BMF 2.83, $r = 0.422$ $P > 0.05$) and that of Zn was observed only in *Periophthalmodon schlosseri* gill – *U. annulipes* chain (BMF 1.53, $r = 0.130$ $P > 0.05$). In conclusion, Sungai Puloh intertidal mangrove surface sediment is moderately contaminated and receives more anthropogenic inputs of Cu and Zn compared to Sungai Tengi intertidal mangrove surface sediments. Even though Cu and Zn accumulate in the organisms and showed high concentration in SGP intertidal mangrove surface sediment, it has not reached its toxic level in the food web of this intertidal mangrove ecosystem. However, due to the economic importance of these mangroves in supporting a variety of marine and terrestrial life including local fishery activities, there is an urgent need to take actions by the appropriate authorities to protect SGP intertidal mangrove ecosystem from anthropogenic contaminants, while SGT intertidal mangrove ecosystem should be monitored periodically.

Abstrak tesis ini telah di persembahkan kepada Senat Universiti Putra Malaysia bagi memenuhi keperluan ijazah Master Sains

TEMBAGA (CU) DAN ZINK (ZN) DALAM WEB MAKANAN EKOSISTEM BAKAU, KAWASAN PASANG SURUT DI SUNGAI PULOH, MALAYSIA

Oleh

UDECHUKWU BEDE EMEKA

Mac 2011

Ketua: Prof. Ahmad Ismail, PhD

Fakulti: Sains

Tujuan kajian ini dijalankan adalah untuk (1) menilai tahap pencemaran logam kuprum (Cu) dan Zink (Zn) dalam sedimen di kawasan bakau yang mengalami pasang surut di Sungai Puloh (SGP) dan Sungai Tengi (SGT), (2) menilai pola bio-pengumpulan bagi logam kuprum (Cu) dan Zink (Zn) dalam jaringan makanan ekosistem bakau yang mengalami pasang surut di Sungai Puloh. Bagi tujuan yang pertama, sampel sedimen permukaan telah dikumpulkan dari empat buah stesen di setiap kawasan di Sungai Puloh (N 03° 04.786′, E 101° 23.903) dan Sungai Tengi (N 03° 24.682, E 101° 9.971′) antara bulan Januari dan Mac, 2009. Bagi tujuan kedua, beberapa komponen biota dan abiota daripada ekosistem bakau yang mengalami pasang surut telah di ambil daripada enam stesen berbeza di Sungai Puloh antara bulan Ogos dan Disember, 2009. Ini termasuk daun, akar, fitodetritus, sedimen permukaan, ketam, siput dan ikan yang mendiami habitat berkenaan. Kandungan logam Cu dan Zn dalam setiap sampel

ditentukan dengan menggunakan Spektrofotometer Penyerapan Atom (model 800 Analyst, oleh Perkin-Elmer) dengan nyala asetilena dalam unit mg/g berat kering. Keputusan kajian menunjukkan kedua-dua kawasan SGP dan SGT telah tercemar dengan logam Zink (dengan purata kepekatan Zn bagi SGP= 302.64 ± 5.33 μg/g dan SGT= 870.73 ± 61.04 μg/g). Bagi logam kuprum, hanya sampel dari SGP menunjukkan terdapatnya peningkatan logam berkenaan (dengan purata kepekatan Cu bagi SGP= 67.17 ± 4.95μg/g) berbanding kawasan SGT. Ini menunjukkan SGP lebih terdedah kepada input antropogenik yang mengandungi lebih Cu (27.0%) dan Zn (63.4%) jika dibandingkan dengan SGT yang lebih rendah input Cu nya (13.2%) dan Zn (31.4%) ($P < 0.05$). Selanjutnya, pengkaji menemui korelasi positif di antara rantai trofik yang berbeza di SGP dan ini dibuktikan melalui biomagnifikasi Cu dalam rantaian makanan di antara *Uca annulipes* dengan fitodetritus (dengan faktor biomagnifikasi, BMF 2.83, $r = 0.422$ $P > 0.05$). Manakala biomagnifikasi Zn hanya jelas dilihat dalam rantaian makanan di antara *Periophthalmodon schlosseri* dan *U. annulipes* (dengan faktor biomagnifikasi, BMF 1.53, $r = 0.130$ $P > 0.05$). Kesimpulannya, ekosistem bakau di SGP terutamanya sedimen permukaan yang mengalami pasang surut ini telah tercemar dan menerima lebih input antropogenik Cu dan Zn berbanding ekosistem bakau di SGT. Walaupun logam-logam seperti Cu dan Zn telah terkumpul di dalam organism-organisma di kawasan bakau SGP dalam jumlah kepekatan yang tinggi, namun tahap pencemaran logam-logam terbabit belum mencapai tahap toksik dan masih selamat untuk digunakan. Walaupun begitu, kepentingan ekosistem bakau di kedua-dua kawasan terhadap hidupan liar dan

ekonomi tempatan tidak dapat dinafikan. Justeru, terdapat keperluan mendesak bagi pihak berkuasa untuk melindungi ekosistem bakau SGP daripada pencemaran berterusan oleh bahan-bahan pencemar antropogenik serta pemantauan berterusan di kawasan SGT.

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Approval sheet 1

I certify that an Examination Committee has been set on the 18th of March, 2011 to conduct the final examination of Udechukwu Bede Emeka on his Masters thesis entitled "**Copper (Cu) and Zinc (Zn) in the food web of intertidal mangrove ecosystem of Sungai Puloh, Malaysia"** in accordance with Universiti Pertanian Malaysia (Higher Degree) Act 1980 and Universiti Pertanian Malaysia (Higher Degree) Regulations 1981. The committee recommends that the student be awarded the Master of Science Degree.

Members of the Examination Committee were as follows:

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Date: 27 June 2011

This thesis was submitted to the senate of Universiti Putra Malaysia and has been accepted as a fulfillment of the requirement for the degree of **Master of Science**. The members of the Supervisory Committee were as follows:

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Date:

DECLARATION

I declare that the thesis is my original work except for the quotations which have been duly acknowledged. I also declare that it had not been previously, and is not concurrently, submitted for any other degree at Universiti Putra Malaysia or any other institution.

UDECHUKWU BEDE EMEKA

Date: 18 March 2011

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