ABSTRACT

This study was aimed to evaluate the effects of environmental variables specifically, dam impoundment, riparian zone and water quality on the fish assemblages, growth, and their spatial shift in diet at upstream and downstream of the reservoir, as well as to document fish succession in Murum reservoir. As the impoundment of Murum reservoir starts, the stream ecosystem, type of habitats and water quality gradually change as the environment changes. Samplings were conducted from May 2014 to December 2015 at four areas located in the vicinity of Murum Dam: downstream of Murum River, Dam site, inundated areas of Pleiran River and Danum River. Water quality and fish fauna were studied. Types of land uses, riparian habitat characteristics and other environmental variables were also enumerated, and were found to be spatially and temporally different. Fish fauna samplings were carried out at 17 stations by using three-layered nets, monofilament gill net of various mesh sizes and electroshocking technique. Land use changes and degradation of riparian zone in Murum catchment were shown to have influences on water quality and eventually affecting fish communities of the newly impounded reservoir. In the case of newly impounded Murum reservoir, the two major catchments of the reservoir, Pleiran and Danum, have shown significant disturbances due to logging, forest and oil palm plantations and subsistence farming. Two-way Analysis of Variance (ANOVA) showed that there are significant differences ($p<0.05$) in quality of upstream and downstream waters of Murum Dam at spatial and temporal scales. A total of 8773 fish individuals representing 58 species belonging to 11 families were caught from stations below and above Murum Dam. Fish populations were dominated by the family Cyprinidae (63.6%). The highest number of species was recorded in downstream of Murum River with 34 species, followed by inundated area of Pleiran River (31 species) and the dam site (25 species). The lowest number was recorded at the inundated

area of Danum River (23 species). Overall, *Oreochromis niloticus* was the most numerically abundant species (33.0%) and is widely distributed in the whole area. This is followed by *Barbodes binotatus* which comprised 16.8% of the total individuals caught. About 20 fish species were indicators for the whole Murum catchment at different impoundment or filling phases. Composition and assemblages of fish were influenced by fluctuation of water level, conductivity, Chl-*a*, and BOD_5. This study also found that the growth of *B. binotatus*, *O. niloticus*, *Hampala bimaculata*, *Barbonymus collingwoodii*, and *Lobocheilos falcifer* varied at spatial and temporal gradients. The growth of the fish declined from positive allometric growth to negative allometric growth, throughout the impoundment and as water level fluctuates. Temperature, conductivity, pH, turbidity, dissolved oxygen, total suspended solids, Chl-*a*, transparency and water level are physicochemical parameters that contributed to the variation in fish growth in Murum waters. Stomach content analysis showed that *H. planiceps*, *H. bimaculata*, *H. macrolepidota* and *C. apogon* consumed a wide range of foods and W_i was highly loaded with small predators thus suggest that they are carnivores. *Tor douronensis* and *Barbonymus schwanenfeldii* are classified as omnivores. The feeding habit of *O. niloticus* and *P. waandersi* was best represented by aquatic plant, detritus and digested items and are categorised as herbivores. The results imply that conversion of forested area at riparian corridor to open area and fluctuation in water level has led to changes in physicochemical characteristics, and subsequently might have resulted in habitat partitioning by the fish species according to their environmental tolerance limit.

Keywords: Tropical reservoir, fish composition, land use change, riparian zone, fish succession

Ekologi Komuniti Ikan Air Tawar Berhubung dengan Variabel Persekitaran di Empangan Kuasa Hidroelectrik Murum, Belaga, Sarawak

ABSTRAK

Tujuan kajian ini dijalankan adalah untuk mengenalpasti kesan-kesan perubahan parameter persekitaran terutamanya pembentungan empangan, kawasan riparian dan kualiti air ke atas himpunan ikan, pertumbuhan, serta perubahan pada pemakanan di hilir dan hulu empangan, dan juga untuk mendokumenkan sesaran komuniti ikan di empangan Murum. Apabila pembentungan di Murum bermula, ekosistem sungai, jenis habitat dan kualiti air turut berubah kerana terdapat perubahan pada persekitarannya. Persampelan telah dijalankan daripada Mei 2014 hingga Disember 2015 di empat kawasan iaitu kawasan empangan, kawasan Sungai Pleiran dan Sungai Danum yang telah ditenggelami air, dan hilir Sungai Murum. Jenis-jenis penggunaan tanah, ciri-ciri habitat riparian dan pembolehubah persekitaran yang lain juga turut diambil kira. Persampelan ikan telah dilakukan di 17 stesen dengan menggunakan pukat tiga lapis, pukat insang pelbagai saiz dan teknik renjatan elektrik. Perubahan penggunaan tanah dan kemerosotan zon riparian di Murum telah terbukti mempengaruhi kualiti air dan seterusnya mengganggu komuniti ikan di kawasan yang baru sahaja diempang. Bagi kes Empangan Murum yang baru dibendung, dua kawasan tadahan yang utama di kawasan ini iaitu, Pleiran dan Danum telah menunjukkan gangguan yang paling ketara disebabkan aktiviti pembalakan, perladangan dan perladangan susbsistens. Terdapat perbezaan yang ketara dari segi ruang dan temporal pada kualiti air di kawasan hulu dan hilir empangan Murum. Sejumlah 8773 ekor ikan yang terdiri daripada 58 spesies dan 11 famili telah direkodkan dari stesen di hilir dan hulu Murum. Populasi ikan didominasikan oleh famili Cyprinidae (63.6%). Namun, bilangan spesies ikan yang paling banyak direkodkan di hilir Sungai Murum sebanyak 34 spesies, diikuti dengan Sungai Pleiran (31 spesies) dan empangan (25 spesies). Bilangan spesies

paling rendah direkodkan di kawasan Sungai Danum (23 spesies). Secara keseluruhannya, Oreochromis niloticus merupakan spesies yang paling banyak terdapat di kawasan Murum dan diikuti oleh Barbodes binotatus yang terdiri daripada 16.8% dari jumlah tangkapan. Sejumlah 20 spesies ikan merupakan spesies penunjuk untuk seluruh kawasan Murum pada fasa pembendungan yang berbeza. Komposisi dan himpunan ikan telah dipengaruhi oleh turun naik paras air, daya pengkonduksian air, Chl-a, dan BOD_5. Kajian ini telah menunjukkan tumbesaran B. binotatus, O. niloticus, H. bimaculata, B. collingwoodii, dan L. falcifer adalah berbeza mengikut kawasan dan masa. Secara amnya kadar tumbesaran ikan merosot, dari pertumbuhan alometrik yang positif kepada negatif, seiring dengan tempoh empangan dan turun naik paras air. Suhu air, daya pengkonduksian air, pH, kekeruhan air, oksigen terlarut, jumlah pepejal terampai, Chl-a, kejernihan air dan paras air merupakan parameter fisikokimia yang telah menyumbang kepada variasi pertumbuhan ikan di Murum. Analisa kandungan perut ikan juga telah menunjukkan H. planiceps, H. bimaculata, H. macrolepidota dan C. apogon memakan pelbagai jenis makanan dan W_i terdiri daripada pemangsa yang kecil, maka ikan-ikan ini adalah karnivor. Tor douronensis dan B. schwanenfeldii merupakan omnivor. Tabiat pemakanan O. niloticus dan P. waandersii termasuklah tumbuhan akuatik, gersik dan bahan-bahan tercerna lalu dikategorikan sebagai herbivor. Keputusan kajian ini menegaskan perubahan kawasan hutan di kawasan tadahan terutamannya di koridor riparian kepada kawasan terbuka dan turun naik paras air telah menyebabkan ciri-ciri fisikokimia berubah lalu menghasilkan pembahagian habitat oleh ikan berdasarkan tahap ketahanan dan kesesuaian ikan.

***Kata kunci**: Empangan tropika, komposisi ikan, perubahan penggunaan tanah, zon riparian, turutan ikan*