

## ABSTRACT

Three sampling stations with various environmental quality gradients in Ulu Gombak Forest Reserve, Selangor, Peninsular Malaysia were selected in this study: Sungai Gombak, Anak Sungai Gombak and Sungai Batu 19. A total of six genera of ephemeropteran nymphs were found from the mentioned streams: *Baetis* sp. (Baetidae) (232), *Thalerosphyrus* sp. (Heptageniidae) (925), *Camponeuria* sp. (Heptageniidae) (1432), *Neurocaenis* sp. (Tricorythidae) (471), *Platybaetis* sp. (Baetidae) (12) and *Prosopistoma* sp. (Prosopistomatidae) (1). The most dominant family of ephemeropteran nymphs is Heptageniidae while *Neurocaenis* sp. (Tricorythidae) were the only nymphs that showed significant difference in abundance between all three streams ( $p=0.05$ ) using student t-test. Margalef's Richness Index suggested that Sg. Gombak has the highest diversity of ephemeropteran nymphs (0.66), where as Shannon's Diversity Index and Simpson's Index of Diversity showed the diversities were the same in Sg. Gombak and Anak Sg. Gombak.

Eight physicochemical parameters (illuminance, pH, water temperature, dissolved oxygen, conductivity, nitrate, phosphate and ammonical nitrogen) were measured for the purpose of assessing water quality and abiotic parameters at the study area and evaluating the potential of mayfly nymphs' abundance and environmental parameter correlation. Results of the water quality study showed that the various sampling stations had different values with regards to the Interim National Water Quality Standards for Malaysia (INWQS). pH was the only environmental parameter that showed a statistically significant positive linear association with the abundance of mayfly nymphs in all three streams (Sg. Gombak:  $r=0.57$ ,  $p=0$ , Anak Sg. Gombak:  $r=0.64$ ,  $p=0$  and Sg. Batu 19:  $r=0.64$ ,  $p=0$ ).

Control strains of *Baetis* sp. and *Camponeuria* sp. nymphs were chosen for biochemical assay. The difference in protein content between both *Baetis* sp. and

*Camponeuria* sp. were found to be insignificant ( $p=0.29$ ). Three biochemical enzymes activity for non-specific esterase, acetylcholinesterase and glutathione-s-transferase was studied. The *in vitro* inhibition potency of organophosphate pesticides (Dichlorvos, Malathion and Fenitrothion) and heavy metals (mercury, cadmium, lead and copper) on non-specific esterase and acetylcholinesterase extracted from *Baetis* sp. and *Camponeuria* sp. nymphs were compared. All the tested compounds exhibited high inhibition potency to non-specific esterase and acetylcholinesterase of *Camponeuria* sp. than *Baetis* sp. with Dichlorvos being the most potent inhibitor. Acetylcholinesterase bimolecular rate constants ( $K_i$ ) were measured for each inhibitor compound with different concentrations for both *Baetis* spp. and *Camponeuria* spp. The bimolecular inhibition rate constant value of Dichlorvos (DDVP) for both *Baetis* sp. and *Camponeuria* sp. were significantly higher than other tested inhibitors, with  $p=0.03$  using student t-test.

## ABSTRAK

Tiga stesen penyampelan dengan ciri-ciri persekitaran yang berbeza di sekitar Hutan Simpan Ulu Gombak dipilih dalam kajian ini iaitu Sungai Gombak, Anak Sungai Gombak dan Sungai Batu 19. Sebanyak enam genus larva ephemeroptera dijumpai: *Baetis* spp. (Baetidae), *Thalerosphyrus* sp. (Heptageniidae), *Campsoneria* sp. (Heptageniidae), *Neurocaenis* sp. (Tricorythidae), *Platybaetis* sp. (Baetidae) dan *Prosopistoma* sp. (Prosopistomatidae). Heptageniidae merupakan famili ephemeroptera yang paling banyak ditemui di kawasan kajian manakala melalui analisis ujian-T didapati *Neurocaenis* sp. (Tricorythidae) merupakan satu-satunya genus ephemeroptera yang menunjukkan perbezaan yang signifikan ( $p=0.05$ ) dalam bilangan larva yang ditemui di ketiga-tiga kawasan kajian. Daripada data yang diperolehi, Indeks Margalef menunjukkan Sg. Gombak mempunyai tahap kepelbagaian larva ephemeroptera yang tertinggi manakala Indeks Diversiti Shannon dan Indeks Diversiti Simpson memberikan nilai diversiti yang sama di Sg. Gombak and Anak Sg. Gombak.

Bacaan bagi lapan parameter fizikal-kimia iaitu cahaya, pH, suhu air, kandungan oksigen terlarut, konduktiviti, nitrat, fosfat dan nitrogen diambil untuk menganalisa kualiti air serta parameter abiotik di kawasan kajian serta untuk mengkaji potensi sama ada parameter alam sekitar mempengaruhi bilangan larva ephemeroptera. Berdasarkan Interim National Water Quality Standards for Malaysia (INWQS), hasil kajian menunjukkan stesen-stesen penyampelan mempunyai nilai kualiti air yang berbeza-beza. Hanya pH didapati mempengaruhi bilangan larva ephemeroptera di ketiga-tiga stesen penyampelan. Ini dibuktikan dengan analisis Pearson yang dijalankan (Sg. Gombak:  $r=0.57$ ,  $p=0$ , Anak Sg. Gombak:  $r=0.64$ ,  $p=0$  dan and Sg. Batu 19:  $r=0.64$ ,  $p=0$ ).

Hanya strain kawalan larva *Baetis* sp. and *Camponeuria* sp. dipilih untuk kajian biokimia. Perbezaan kandungan protein dalam kedua-dua strain larva *Baetis* sp. and *Camponeuria* sp. didapati tidak signifikan ( $p=0.29$ ) melalui analisis ujian-T. Aktiviti spesifik bagi tiga enzim biokimia iaitu esterase, asetilkolinesterase and glutathione-s-transferase dianalisa. Kajian perencatan oleh pestisid organofosfat (Dichlorvos, Malathion and Fenitrothion) dan logam berat (merkuri, kadmium, plumbum dan kuprum) secara *in vitro* ke atas enzim esterase dan asetilkolinesterase dari larva *Baetis* sp. and *Camponeuria* sp. telah dijalankan. Keputusan perbandingan kepekatan perencat menunjukkan larva *Camponeuria* sp. mempunyai kerintangan yang lebih tinggi terhadap enzim esterase dan asetilkolinesterase berbanding larva *Baetis* sp. manakala Dichlorvos merupakan perencat yang paling toksik. Penentuan nilai pemalar bimolekular perencat ( $K_i$ ) bagi asetilkolinesterase dijalankan menggunakan kepekatan yang berbeza bagi setiap perencat. Nilai  $K_i$  didapati paling tinggi melalui pendedahan perencat Dichlorvos terhadap *Baetis* sp. dan *Camponeuria* sp. berdasarkan analisis ujian-T pada aras keertian  $p=0.03$  yang dijalankan.