THE ASSESSMENT OF STREAM AND WATERFALL AT FRASER HILL USING WATER BEETLE AS INDICATOR OF ENVIRONMENTAL CHANGES

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INTRODUCTION

Biodiversity in Malaysia is a valuable asset that is still not fully explored by scientists in the aspects of economics and academics. The presence of variety of flora and fauna are not only has a high aesthetic value but also has great potential in medicine, research, industry and others. Realizing this, University Kebangsaan Malaysia and Wildlife in collaboration with local research institutions have taken the initiative to organize a scientific expedition to Fraser Hill where researchers from various fields get together to make relevant research to their area of expertise so that it will be used as a reference later to a deeper exploration in the future.

River is a natural resource that is vital to all life on the earth's surface. A river is a system comprising both the main course and the tributaries, carrying the one-way flow of a significant load of matter in dissolved and particulate phases from both natural and anthropogenic sources (Shrestha & Kazama 2007). Anthropogenic influences (urban, industrial and agricultural activities, increasing consumption of water resources) (Carpenter et al. 1998) as well as natural processes (changes in precipitation inputs, erosion, weathering of crustal materials) degrade surface waters and impair their use for drinking, industrial, agricultural, recreation or other purposes (Jarvie et al. 1998).

The quality of a river at any point reflects several major influences, including the lithology of the basin, atmospheric inputs, climatic conditions and anthropogenic inputs (Bricker & Jones 1995). The importance of the river not only limited to the daily needs but also important for moving operation that involves travel of a vehicle as well as in assimilation or carrying off the municipal and industrial wastewater and run off from agricultural land. Objective of this study is to assess the water quality of water resources in Fraser Hill based on 10 parameters Water Quality Index as determined by the Department of Environment Malaysia linked with the present of water beetles.

Beetles represent the world's most species animal and one of the largest orders of "aquatic" animals. However, the majority of Coleoptera is terrestrial, only a minor percentage can be regarded as "aquatic". Aquatic beetles are found to live in almost all kinds of aquatic habitats, such as rivers, springs, lakes, ditches, puddles, phytotelmata, seepages, ground water. Water beetles, especially Elmidae, are increasingly gaining recognition as biological indicators for water quality (saprobial index), habitat types, biological functionality and species and habitat conservation (Moog 2003; Jach et al. 2005b). A comprehensive list of saprobic valencies of the Austrian elmids was published by Moog and Jach (2003).
MATERIAL AND METHOD

This study was conducted at Fraser Hill, Pahang during the Corridor Raub-Bukit Fraser scientific expedition, where water quality and insect sampling was conducted on 16th till 21th of October 2014. The sampling stations selected for this study are listed in Table 1. Assessment of the river water quality and waterfalls was carried out by measuring the in-situ parameters. In-situ parameters include temperature (°C), pH, oxidation reduction potential (ORP), electrical conductivity (EC), dissolved oxygen (DO), total dissolve solid, salinity and the laboratory parameters include biochemical oxygen demand (BOD), chemical oxygen (COD) and ammonical-nitrogen (NH₃-N). All the sampling technique, sample preservation and analyzed were adopted from APHA (1999). Fourteen locations were visited whereby the first 7 is at Lasak trail and the remaining 7 is at Jeriau Waterfalls. The water quality status of each sampling location were determined using Harkin’s index (HI) (Harkin 1974). The HI based on a statistical approach or to be more exact, it is based on Kandall’s nonparametric multivariate ranking procedure (Harkins 1974). The index value is 0 for the best water quality according to Harkin’s Index. The higher the index value, the lower the water quality.

Sampling Method

Water beetles were collected by applying three methods, namely pitfall trap, sweep net and light trapping for nocturnal sampling based on method adopted by Abdullah (2005), Abdullah et al. (2008) and Abdullah and Sina (2009). A total of 20 pitfalls were set up in the day for 24 hours whereas 4 light traps were set up for 5 hours from 1800-2300 each night as suggested by Abdullah et al. (2008).

The pitfall traps consisted of a plastic jars (diameter 65 mm, volume 200 ml, depth 9.5 cm) partially filled with 70% alcohol. A dried leaf covered it from rainfall supported by wooden pegs at the side (Abdullah 2006). Four pitfalls were set up in a quadrat 1m from each other with the fifth placed in the middle of the quadrat. Sampling period was 24 hours.

The light trap consisted of a white mosquito net of size 1.8 m X 2.0 m X 2.0 m illuminated by a 160-watt mercury light bulb powered by generator Honda EU10i. Lighting hours were set for 1800-2300. Sampling was carried out at two locations namely Lasak Trail and Jeriau Waterfalls. Sweep net was randomly used in the stream and waterfalls to collect the samples.

Sorting, Preservation and Identification

The samples from all the traps were sorted out to family level by referring to Borror and DeLong (1971). The water beetles specimens preserved in 70% alcohol were pinned, dried in oven at the Toxicology Lab, University of Malaya and then were identified at Department of Agricultural Malaysia, Kuala Lumpur.

Data Analysis

All water beetles sampled were analysed using the Margalef’s (1), Simpson index (2) and Shannon’s (3) of biological diversity for comparison between study sites and trapping method. The water beetle samples were photographed using Leice microscope model EZ4D attached with digital camera and android camera.
RESULTS AND DISCUSSION

Water beetle is used as the indicator for the presence of organic waste in the trail and waterfalls by analyzing BOD and COD. The results showed that both parameters were within the permissible limit for Class I and II and the presence of organic waste is mainly from decomposition of forest litter. The highest BOD (2.22 mg/L) and COD (7.2 mg/L) value was recorded at station 13. The high BOD value compared to other stations indicates high microbial activity. The high values of these parameters are probably due to various contaminations, high amount of tourism and littering. Table 1 shows the water quality data collected from established water quality sampling stations during the scientific expedition.

Table 1. Water quality data within Fraser’s Hill.

<table>
<thead>
<tr>
<th>Sampling Location</th>
<th>Temp. (°C)</th>
<th>pH</th>
<th>ORP</th>
<th>EC (mS/cm)</th>
<th>DO (mg/L)</th>
<th>TDS (g/L)</th>
<th>pH</th>
<th>BOD</th>
<th>COD</th>
<th>NH3-N</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>24.44</td>
<td>6.81</td>
<td>423</td>
<td>0.033</td>
<td>10.27</td>
<td>0.021</td>
<td>0</td>
<td>0.04</td>
<td>3.0</td>
<td>0.04</td>
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<tr>
<td>2</td>
<td>25.84</td>
<td>7.47</td>
<td>97</td>
<td>0.003</td>
<td>14.11</td>
<td>1.75</td>
<td>0</td>
<td>0.06</td>
<td>2.8</td>
<td>0</td>
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<tr>
<td>3</td>
<td>21.76</td>
<td>6.61</td>
<td>357</td>
<td>0.02</td>
<td>9.16</td>
<td>0.012</td>
<td>0</td>
<td>0.06</td>
<td>2.3</td>
<td>0.03</td>
</tr>
<tr>
<td>4</td>
<td>21.58</td>
<td>6.34</td>
<td>367</td>
<td>0.025</td>
<td>8.97</td>
<td>0.016</td>
<td>0</td>
<td>0.03</td>
<td>1.7</td>
<td>0.02</td>
</tr>
<tr>
<td>5</td>
<td>21.65</td>
<td>6.14</td>
<td>306</td>
<td>0.023</td>
<td>14.23</td>
<td>0.015</td>
<td>0</td>
<td>0.04</td>
<td>1.6</td>
<td>0.09</td>
</tr>
<tr>
<td>6</td>
<td>21.58</td>
<td>6.02</td>
<td>330</td>
<td>0.022</td>
<td>11.95</td>
<td>0.015</td>
<td>0</td>
<td>0.13</td>
<td>2.8</td>
<td>0.03</td>
</tr>
<tr>
<td>7</td>
<td>21.69</td>
<td>6.11</td>
<td>338</td>
<td>0.009</td>
<td>10.98</td>
<td>0.005</td>
<td>0</td>
<td>0.04</td>
<td>1.6</td>
<td>0.09</td>
</tr>
<tr>
<td>8</td>
<td>21.7</td>
<td>6.11</td>
<td>346</td>
<td>0.012</td>
<td>10.21</td>
<td>0.007</td>
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<td>0.04</td>
<td>1.6</td>
<td>0.09</td>
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<tr>
<td>9</td>
<td>22.28</td>
<td>6.78</td>
<td>355</td>
<td>0.019</td>
<td>16.22</td>
<td>0.011</td>
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<td>0.1</td>
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<td>10</td>
<td>21.78</td>
<td>5.91</td>
<td>371</td>
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<td>0</td>
<td>0.97</td>
<td>10.2</td>
<td>0.24</td>
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<tr>
<td>11</td>
<td>21.21</td>
<td>5.45</td>
<td>385</td>
<td>0.018</td>
<td>10.23</td>
<td>0.011</td>
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<td>0.14</td>
<td>2.8</td>
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</tr>
<tr>
<td>12</td>
<td>22.02</td>
<td>5.16</td>
<td>320</td>
<td>0.01</td>
<td>16.75</td>
<td>0.006</td>
<td>0</td>
<td>0.05</td>
<td>3.1</td>
<td>0.03</td>
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<tr>
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<td>21.92</td>
<td>3.93</td>
<td>373</td>
<td>0</td>
<td>9.83</td>
<td>0</td>
<td>0</td>
<td>2.22</td>
<td>7.2</td>
<td>0.03</td>
</tr>
<tr>
<td>14</td>
<td>22.01</td>
<td>3.66</td>
<td>369</td>
<td>0.01</td>
<td>9.6</td>
<td>0.006</td>
<td>0</td>
<td>2.07</td>
<td>6</td>
<td>0.05</td>
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</tbody>
</table>

Overall, based on the Harkin’s Index, the river water quality status within the study area is considered high where 94% of the sampling locations fall under Class I and there are plenty of Gyrinidae and Dytiscidae presence in those sites and only 6% fall under Class II. The number of Gyrinidae family collected is 25 and Dytiscidae family is 5. In conclusion, based on the water quality parameters and the presence of these two water beetle species have confirmed that, the water quality at measured sites is very clean.

CONCLUSION

In summary, the study area can be classified as having a very stable environment as far as land disturbance is concerned where the suspended solid concentration were relatively low. For beneficial use, the water source within the study area can be utilized for domestic use and aquaculture for exotic species.

REFERENCES