Monthly variations of some physical and chemical properties for Al-Dujaila river of Al-Kut city

Hussein Ali Awad AL-Zamili and Yaaroub FalehKhalaf AL- Fatlawy

University of Baghdad / College of Science / Biology Department

Iraq–Baghdad

Abstract

Monthly variations in physio-chemical parameters of Al-Dujaila, one of the main tributaries of the Tigris River were investigated from October 2013 to April 2014. The study location situated in the south-eastern sector of Iraq, and it was surrounded by wide and fertile agricultural lands. Three stations were selected for that. The first station is located at the beginning AL-Dujaila River after branching the Tigris river as control. The second is situated at distance 2 km away from the former represented study area. The latter station is located at 4 km apart from the second one. Samples collecting monthly, two samples were taken each month.

In the present study fourteen physical and chemical parameters were analyzed based on the importance of these parameters. These fourteen parameters are arranged as following:

- Air temperature (17 to 36 °C)
- Water temperature (10 to 24 °C)
- pH (7.02 to 8.2)
- Temperature (1.76 to 36) °C
- Water salinity (0.71 to 0.90) ppt
- DO (7.05 to 11.65) mg/L
- BOD (1.2 to 7.05) mg/L
- Turbidity (21.0 to 65) NTU
- TDS (743 to 918) mg/L
- TSS (32 to 95) mg/L
- T.H
(320 to 500) mg/L, Cl\(^{-}\) (104 to 178) mg/L, NO\(_3\) (6 to 14.53) mg/L and PO\(_4\) (0.16 to 0.60) mg/L.

**Introduction**

Rivers have always been the most important fresh water resources, and most developmental activities are still dependent upon them. Rivers are used as site for the disposal of refuse, human sewage, and waste waters from kitchens, abattoirs and industries. Streams and rivers running through areas of significant human influence such as farms, cities and industrial locations are therefore prone to pollution (1, 2).

The degree of pollution is generally assessed by studying physical and chemical characteristics of the water bodies (3).

Iraqi inland waters witness tremendous impacts through discharges of manufacturers, agricultural and domestic sewage (4, 5). Quite few studies were performed on Tigris River (6, 7, 8), but no work had considered Al-Dujaila canal in Al-Kut City. The present study has taken in consideration the investigation of abiotic conditions in this vital habitat on monthly basis.

**Materials and Methods**

**Study area**

Al-Dujaila River is one of the two branches of the Tigris River at Kut City, 225 km south of Baghdad City (Fig. 1). After branching from the Tigris, the Dujaila flows southeast toward Al-Kut City (study area) within Wasit Province, 220 km southwest of Baghdad City. The river is 57 km in length with and a cross-section is 40m.

![Figure (1): The map of sampling location in the study area](image)

**Sampling**

Samples for physical and chemical variables were performed from three sites during period extended from the October 2013 to April 2014. Water samples were collected for physiochemical analysis using pre-washed polyethylene bottle by water sample twice before filling.
The studied physio-chemical parameters include water temperature (by using precise mercury thermometer), hydrogen ion concentration (by using pH-meter), electrical conductivity (by using EC-meter), turbidity level (by using turbidity-meter), dissolved oxygen (titrimetric methods), biological oxygen demand (Winkler methods), nitrate, reactive phosphate (by using spectrophotometric methods), total hardness and chloride (by using titrimetric methods), were measured according to APHA(9,10).

Results

Table (1) and Figure (2), showed monthly changes in air temperature for the three selected stations. Values ranged between 17°C in station-1 during December (2013) to 36°C in station-2 during April (2014).

Table (1) and Figure (3), however, indicate monthly variations in water temperature. The lowest value was 10°C in station-2 during December (2013) and the highest 24°C in station-2 during April (2014).

Table (1) and Figure (4), showed monthly changes in PH. The lowest (7.02) was encountered in October (2013) from station-2 and the highest (8.2) was recorded in November (2013), but values in general were slightly alkaline direction.

Table (1) and Figure (6), showed monthly changes in values of water salinity. The lowest (0.71ppt) was observed in station-3 during March (2014) and the highest (0.90ppt) measured from station-2 in October (2013). Table (1) and Figure (7). Show monthly changes in values of Turbidity. The lowest (21.0 NTU) was observed in station-3 in December (2013) and the highest (65 NTU) was observed in January (2014) from station-2.

Table (1) and Figure (8), revealed monthly variations in dissolved oxygen in selected stations. Values declined during October (2013). The lowest (7.05 mg/L) was in October (2013) from station-2 and the highest (11.65 mg/L) was, in general, in January (2014) from station-1.

Table (1) and Figure (9), showed monthly variations in values of biological oxygen demands (BOD). The lowest (1.2 mg/L) was recorded in March (2014) from station-1 and the highest (7.05 mg/L) was in November (2013) from station-2.

Table (1) and Figure (10), demonstrated monthly changes in total dissolved solid. The lowest (743 mg/L) was encountered in March (2014) from station-3 and the highest (918 mg/L) was recorded in October (2013) from station-2.

Table (1) and Figure (11), showed monthly variations in total suspended solid. The lowest (32 mg/L) was observed in December (2013) from station-3 and the highest (95 mg/L) was observed in January (2014) from station-2.

Table (1) and Figure (12), revealed monthly variations in values of total hardness in the selected localities. Highest value (500 mg/L) was in November (2013) and encountered from station-2. The lowest (320 mg/L), however, was in January (2014) from station-1.
Table (1) and Figure (13), showed monthly changes in values of Chloride. The lowest (104 mg/L) was measured from station-1 in March (2014) and the highest (178 mg/L) was observed in November (2013) from station-2.

Table (1) and Figure (14), cleared monthly variations in Nitrate. The lowest (6 mg/L) was in April (2014) from station-1 and the highest (14.53 mg/L) was observed in November (2013) from station-2.

Table(1) and Figure (15), showed monthly changes in values of reactive phosphate. The lowest (0.16 mg/L) was observed in October (2013) from station-1 and the highest (0.60 mg/L) was observed in December (2013) from station-2.
Table (1): Monthly variation for Al-Dujaila River through period study 2013 – 2014

<table>
<thead>
<tr>
<th>Time</th>
<th>Station</th>
<th>Air T. C °</th>
<th>Water T. C °</th>
<th>PH</th>
<th>E.C ms/cm</th>
<th>Salinity ppt</th>
<th>DO mg/l</th>
<th>DOB5 mg/l</th>
</tr>
</thead>
<tbody>
<tr>
<td>October 2013</td>
<td>Station1</td>
<td>33</td>
<td>21</td>
<td>7.5</td>
<td>1193</td>
<td>0.76</td>
<td>8.01</td>
<td>1.5</td>
</tr>
<tr>
<td></td>
<td>Station2</td>
<td>35</td>
<td>23</td>
<td>7.02</td>
<td>1378</td>
<td>0.90</td>
<td>7.05</td>
<td>6.56</td>
</tr>
<tr>
<td></td>
<td>Station3</td>
<td>34</td>
<td>22</td>
<td>7.4</td>
<td>1194</td>
<td>0.76</td>
<td>7.61</td>
<td>3.1</td>
</tr>
<tr>
<td>November 2013</td>
<td>Station1</td>
<td>30</td>
<td>20</td>
<td>8.0</td>
<td>1274</td>
<td>0.81</td>
<td>9.1</td>
<td>1.4</td>
</tr>
<tr>
<td></td>
<td>Station2</td>
<td>29</td>
<td>20</td>
<td>7.7</td>
<td>1358</td>
<td>0.89</td>
<td>8.02</td>
<td>7.05</td>
</tr>
<tr>
<td></td>
<td>Station3</td>
<td>30</td>
<td>19</td>
<td>8.2</td>
<td>1285</td>
<td>0.82</td>
<td>8.30</td>
<td>4.02</td>
</tr>
<tr>
<td>December 2013</td>
<td>Station1</td>
<td>17</td>
<td>10.5</td>
<td>8.1</td>
<td>1216</td>
<td>0.77</td>
<td>10.85</td>
<td>3.11</td>
</tr>
<tr>
<td></td>
<td>Station2</td>
<td>18</td>
<td>10</td>
<td>8.0</td>
<td>1299</td>
<td>0.83</td>
<td>8.42</td>
<td>5.6</td>
</tr>
<tr>
<td></td>
<td>Station3</td>
<td>20</td>
<td>11</td>
<td>8.1</td>
<td>1170</td>
<td>0.75</td>
<td>9.12</td>
<td>3.5</td>
</tr>
<tr>
<td>January 2014</td>
<td>Station1</td>
<td>20</td>
<td>15</td>
<td>7.9</td>
<td>1198</td>
<td>0.76</td>
<td>11.65</td>
<td>2.7</td>
</tr>
<tr>
<td></td>
<td>Station2</td>
<td>21</td>
<td>14</td>
<td>7.54</td>
<td>1225</td>
<td>0.78</td>
<td>9.1</td>
<td>6.3</td>
</tr>
<tr>
<td></td>
<td>Station3</td>
<td>22</td>
<td>16</td>
<td>7.7</td>
<td>1215</td>
<td>0.77</td>
<td>10.22</td>
<td>3.29</td>
</tr>
<tr>
<td>March 2014</td>
<td>Station1</td>
<td>29</td>
<td>19</td>
<td>8.1</td>
<td>1138</td>
<td>0.72</td>
<td>9.3</td>
<td>1.2</td>
</tr>
<tr>
<td></td>
<td>Station2</td>
<td>29</td>
<td>21</td>
<td>7.81</td>
<td>1259</td>
<td>0.81</td>
<td>8.1</td>
<td>4.8</td>
</tr>
<tr>
<td></td>
<td>Station3</td>
<td>30</td>
<td>20</td>
<td>8.1</td>
<td>1115</td>
<td>0.71</td>
<td>8.95</td>
<td>2.4</td>
</tr>
<tr>
<td>April 2014</td>
<td>Station1</td>
<td>32</td>
<td>22</td>
<td>7.8</td>
<td>1285</td>
<td>0.82</td>
<td>8.5</td>
<td>1.9</td>
</tr>
<tr>
<td></td>
<td>Station2</td>
<td>36</td>
<td>24</td>
<td>7.1</td>
<td>1316</td>
<td>0.84</td>
<td>7.2</td>
<td>5.7</td>
</tr>
<tr>
<td></td>
<td>Station3</td>
<td>32</td>
<td>22</td>
<td>7.4</td>
<td>1295</td>
<td>0.83</td>
<td>7.8</td>
<td>2.6</td>
</tr>
</tbody>
</table>
Appendix table-1

<table>
<thead>
<tr>
<th>Time</th>
<th>Station</th>
<th>Turb. NTU</th>
<th>TSS mg/l</th>
<th>TDS mg/l</th>
<th>T.H mg/l</th>
<th>Cl⁻ mg/l</th>
<th>NO₃⁻ mg/l</th>
<th>PO₄³⁻ mg/l</th>
</tr>
</thead>
<tbody>
<tr>
<td>October 2013</td>
<td>Station1</td>
<td>40</td>
<td>60</td>
<td>795</td>
<td>340</td>
<td>117.4</td>
<td>10.25</td>
<td>0.16</td>
</tr>
<tr>
<td></td>
<td>Station2</td>
<td>47</td>
<td>75</td>
<td>918</td>
<td>430</td>
<td>137.2</td>
<td>14.13</td>
<td>0.33</td>
</tr>
<tr>
<td></td>
<td>Station3</td>
<td>43</td>
<td>69</td>
<td>796</td>
<td>360</td>
<td>128.5</td>
<td>12.31</td>
<td>0.25</td>
</tr>
<tr>
<td>November 2013</td>
<td>Station1</td>
<td>36</td>
<td>46</td>
<td>848</td>
<td>372</td>
<td>127.8</td>
<td>8.93</td>
<td>0.18</td>
</tr>
<tr>
<td></td>
<td>Station2</td>
<td>42</td>
<td>50</td>
<td>915</td>
<td>500</td>
<td>178</td>
<td>14.53</td>
<td>0.29</td>
</tr>
<tr>
<td></td>
<td>Station3</td>
<td>38</td>
<td>43</td>
<td>857</td>
<td>400</td>
<td>134</td>
<td>12.35</td>
<td>0.21</td>
</tr>
<tr>
<td>December 2013</td>
<td>Station1</td>
<td>25</td>
<td>38</td>
<td>811</td>
<td>407</td>
<td>120</td>
<td>6.2</td>
<td>0.27</td>
</tr>
<tr>
<td></td>
<td>Station2</td>
<td>33</td>
<td>41</td>
<td>866</td>
<td>440</td>
<td>138</td>
<td>8.34</td>
<td>0.60</td>
</tr>
<tr>
<td></td>
<td>Station3</td>
<td>21</td>
<td>32</td>
<td>780</td>
<td>415</td>
<td>128</td>
<td>8.93</td>
<td>0.45</td>
</tr>
<tr>
<td>January 2014</td>
<td>Station1</td>
<td>47</td>
<td>73</td>
<td>799</td>
<td>320</td>
<td>117</td>
<td>9.7</td>
<td>0.24</td>
</tr>
<tr>
<td></td>
<td>Station2</td>
<td>65</td>
<td>95</td>
<td>818</td>
<td>370</td>
<td>139</td>
<td>12.8</td>
<td>0.27</td>
</tr>
<tr>
<td></td>
<td>Station3</td>
<td>52</td>
<td>76</td>
<td>810</td>
<td>350</td>
<td>115</td>
<td>10.6</td>
<td>0.25</td>
</tr>
<tr>
<td>March 2014</td>
<td>Station1</td>
<td>25</td>
<td>33</td>
<td>758</td>
<td>352</td>
<td>104</td>
<td>7</td>
<td>0.2</td>
</tr>
<tr>
<td></td>
<td>Station2</td>
<td>36</td>
<td>41</td>
<td>839</td>
<td>390</td>
<td>125</td>
<td>7.5</td>
<td>0.5</td>
</tr>
<tr>
<td></td>
<td>Station3</td>
<td>27</td>
<td>38</td>
<td>743</td>
<td>376</td>
<td>119</td>
<td>7.5</td>
<td>0.27</td>
</tr>
<tr>
<td>April 2014</td>
<td>Station1</td>
<td>22</td>
<td>35</td>
<td>857</td>
<td>366</td>
<td>120</td>
<td>6</td>
<td>0.3</td>
</tr>
<tr>
<td></td>
<td>Station2</td>
<td>30</td>
<td>41</td>
<td>875</td>
<td>428</td>
<td>138</td>
<td>7.6</td>
<td>0.55</td>
</tr>
<tr>
<td></td>
<td>Station3</td>
<td>25</td>
<td>37</td>
<td>863</td>
<td>416</td>
<td>127</td>
<td>7.3</td>
<td>0.4</td>
</tr>
</tbody>
</table>
Mean Water T.°C (Fig. 3) Monthly changes in water temperature in three selected stations

Mean Air T.°C (Fig. 2) Monthly changes in air temperature in three selected stations

Mean PH values (Fig. 4) Monthly changes in hydrogen concentrated in three selected stations
Mean EC values µS/cm
(Fig. 5) Monthly changes in electrical Conductivity in three selected stations

Mean Salinity ppt
(Fig. 6) Monthly changes in salinity concentrated in three selected stations

Mean Turbidity NTU
(Fig. 7) Monthly changes in turbidity in three selected stations
Mean DO mg/l (Fig. 8) Monthly changes in dissolved Oxygen in three selected stations

BOD5 mg/l (Fig. 9) Monthly changes in biological oxygen demand in three selected stations

Mean TDS mg/l (Fig. 10) Monthly changes in total dissolved solids in three selected stations
(Fig. 11) Monthly changes in total suspended solids in three selected stations

(Fig. 12) Monthly changes in total hardness in three selected stations

(Fig. 13) Monthly changes in Chloride in three selected stations
Discussion

Air and water temperature is an important factor in any aquatic environments affecting on biological processes, in this study it was ranged between 17 to 36 °C and 10 to 24 °C respectively. This result was similar to previous studies done by (11, 12).

The pH value of AL-Dujaila River in study sites during of most studied period was alkaline side above 7, and this result agreed with (13), they reported that Iraqi inland water is regarded to be on the alkaline side of neutrality, reflecting geological formations of the area and the results are agree with the finding that recorded by (14,15).

Electrical conductivity used as an indicator of water quality based on total dissolved salts (16). The increase EC values at station two reflects the strong effect of domestic sewage effluent discharge at this area. Also, EC values recorded in the present work is coincided with findings of (17,18).

The study also revealed monthly changes in salinity, with notable increase during summer months due to evaporation (19). The presence of agricultural drainage systems namely, Dibuna, Al-Numaniya, Al-Ahrar and AL-Kut may contribute in rising salinity as well.
Water turbidity is caused by suspended matter such as clay, silt and planktons also turbidity degree of River water is an approximate measure of the intensity of the pollution (20). This result was similar to previous studies done by (21, 22).

Oxygen content of water is one of the important factors, and it is very necessary for all living organisms (23). The study finding coincided with other authors (24, 25, and 26) on Iraqi inland waters mainly Tigris. Low concentration of DO recorded from station-2 may relate to organic wastes discharged from Al-Kut City. Generally, the DO at most stations of canal water was within normal guideline values cited by (27) for the protection of aquatic life.

The biological oxygen demand is defined as the quantity of DO which is able to oxidize the organic components in the water with the assistance of microorganisms under defined experimental conditions (28). Generally, results indicate increasing levels of BOD; in particular at station-2 during November and October, this may be due to decomposition of organic matters run directly to the river with domestic sewage. These results were slightly higher than that reported by (29, 30) at the same river.

Values of total hardness in the selected stations exceeded 490 mg/L as CaCO3. This indicates that waters are very hard according to (31). Increase in hardness values was found to coincide with rise in salinity (32,33). The results of total hardness were agreed with those of (34,35). Chloride is a natural substance present in all portable water as well as sewage effluents as metallic salt. Generally high concentration of chloride indicates organic pollution in the water (36). This result was similar to previous studies done by (37,38).

Total dissolved solids (TDS) is the term used to describe the inorganic salts and small amounts of organic matter present in solution in water (39). These results were slightly lower than that reported by (40, 41) at the same river. Total suspended solid reconsidered to be one of the major pollutants that contributes to the deterioration of water quality, contributing to higher costs for water treatment, decreases in fish resources, and the general aesthetics of the water (42), TSS values recorded in the present work is coincided with findings of (43,44).

Nitrate is the stable form of combined nitrogen, and it is an important factor which might limit growth of phytoplankton (45). The results of nitrate were agreed with those of (46, 47). Phosphorus is essential to the growth of algae and other biological organisms. The reactive phosphate concentration in studied river was ranged between 0.16 to 0.96 mg/l. The high concentration of phosphate may be due to sewage water effluent and fertilizer application in surrounding agricultural area. This result was close to that reported by (48).

**Conclusions**

1-The waste of factories, urban run-off, city sewage and the agricultural activities were affecting the physicochemical characteristics of Al-Dujaila River.

2-The results revealed that water parameters were most within the Iraqi standards, and WHO standards for the raw water.
References

1-Toman, M.J. (2009). Physico - chemical characteristics and seasonal changes of plankton communities in a reservoir. Lakes and reservoirs research and management. 2(1&2); 71 - 76.


8-Al-Rubaee, M. A. J. (1997).Ecological study to Ethem River and its impact on Tigris.MSc thesis; Baghdad University. (in Arabic)


