Effects of Some physical and chemical factors of Lower Zab water on Tigris River

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Abstract:
Four stations were selected for water sample collections, to study the effects of some water characteristics of Lower Zab tributary on the Tigris river, during the period from November 2001 to October 2002.
Air and water temperature were (10-38)^{o}C and (10-28)^{o}C respectively. Salinity values ranged (0.25-0.33)‰ . Turbidity varied from (22) NTU at station 2 to (34.4) NTU at station 3. pH values ranged (7.5 - 8.6). Dissolved Oxygen values were higher in Lower Zab water compared to that of Tigris River. BOD were high at summer and low during winter.
Total hardness ,calcium and Alkalinity were (222-306) mg/L, (133-165) mg/L and (134-165) mg/L respectively.
Nutrition values of the water samples were low, (0.4μg/L) for nitrite, (0.27μg/L) for phosphate, and (2.1 mg/L) for silica at station 4 after the confluence. While these values were higher at station 3 before the confluence (0.6μg/L), (0.4μg/L) and (2.9mg/L) respectively. Chloride ions values ranged (33.5-38.6) mg/L .Discussion of the results of this study clarify that Lower Zab effects the environment of the Tigris river at station 4 through the values of the turbidity, total hardness and negative iones which is located in the river after the confluence, in addition to the decrease of nutritive compared to station 3 in the river. This is certainly due to the favorable conditions at station 4, which cause blooming and diversity of aquatic organisms. This was obvious from the BOD_5 values at station 4. The high BOD_5 values was proportional to organic pollutants.

Introduction:
Surface water in Iraq forms an area of (2400km^2). This forms 5% of the total Iraqi lands, which is distributed in various water systems [1].
Hydrological characteristics of Iraqi lands affected by the two rivers, Tigris and Euphrates and their related branches [2]. Lower Zab tributary forms one of the major branches of Tigris River, with a length extends 400 km and over an area of (22250 km^2) from its origin in Iran .This area is mainly located in Zakaros mountain in Iran. In Iraq, its length extends about 175km and above 200m wide [3]. Lower Zab consists of a gravel base with a mean water discharge of (233-245)m^3/sec [4].
Water characteristics of Rafidain valley like many other water areas of the world is affected by the climate, nature, soil, inner water and its bioactivities. In addition, Tigris river limnology is generally affected by it's tributaries [2].
Many studies conducted on the Iraqi surface water, but were all concentrated on limited area [5, 6, 7, 8]. Therefore, the present study aims to know the effects of some physical and chemical factors of Lower Zab water on Tigris River water.

Materials and Methods:
Four stations were selected in Tigris river (stations 3,4) and in the Lower Zab tributary (stations 1,2) (Figure -1). Monthly water samples were collected from November 2001 to October 2002.
Air and water temperatures were measured using mercury thermometer. A conductivity meter (YSI-33cc) was used to measure water conductivity (μ semins/ cm). Salinity was calculated using the following equation [9]:

Salinity (gm/L) = 0.00064 X conductivity.

Turbidity (NTU) was measured using the turbidity meter (HACH-16800cc). Water pH was measured using a pH meter (pH-EC. TDC meter /HI-9811). Winkler method [10] was used to measure dissolved oxygen (mg/L) and Biochemical Oxygen Demand (BOD). The method described in [11] was used to measure alkalinity, total hardness and calcium ions. Chloride, Nitrate, active phosphate and Silica were measured using the methods in standard methods for the examination of water method for Sea water analysis [10, 12].

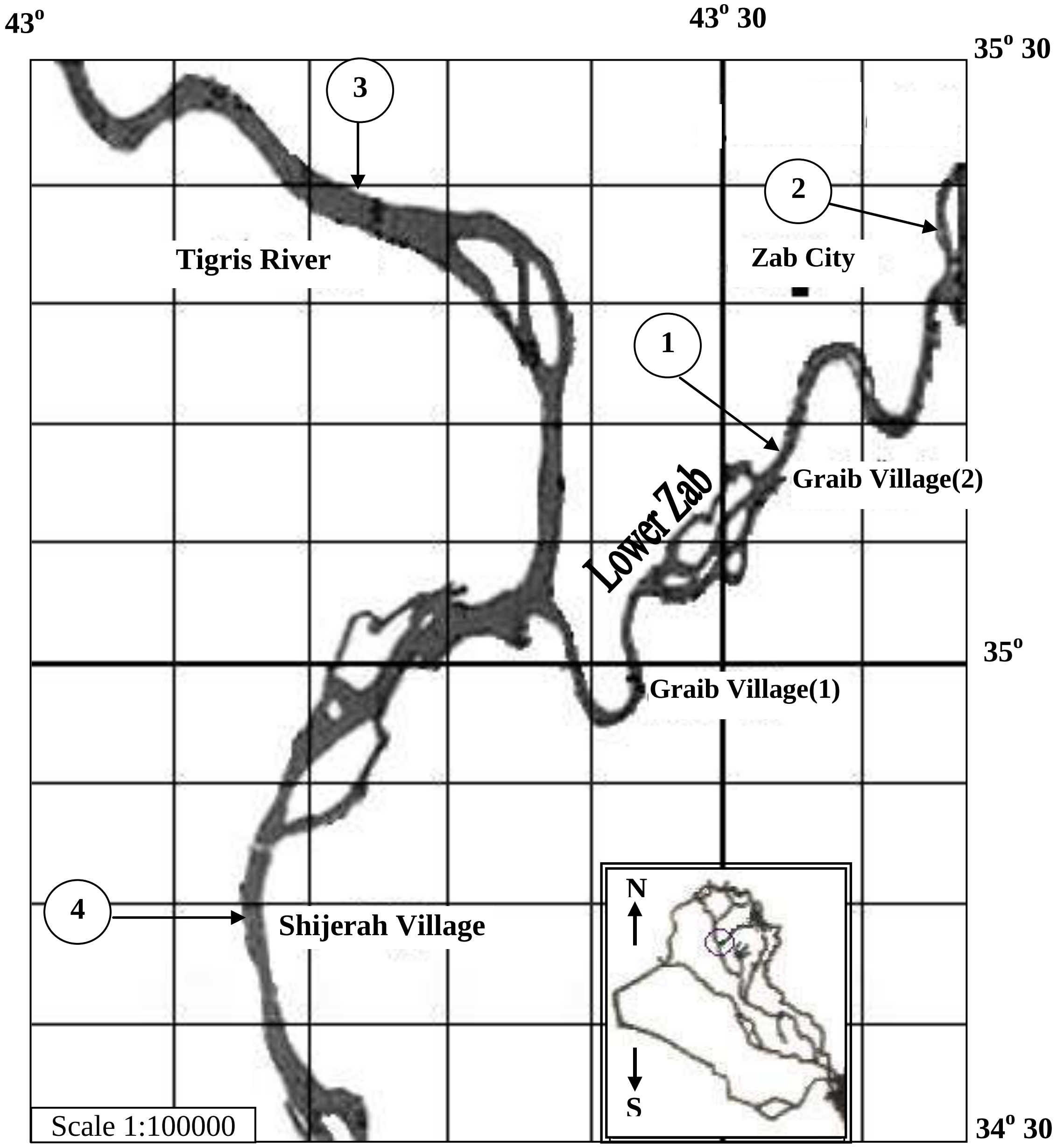


Fig. 1: Study Area; Lower Zab (stations 1, 2) & Tigris River (stations 3, 4)

Results & Discussion:

Air and water temperatures were close. In that, both air and water temperatures increased during summer and early autumn, and decreased in winter (Table-1; Figure 2). Salinity values varied at the different stations. Low values recorded at station 4 in Tigris river (0.25 gm/L), and the maximum values recorded in Lower Zab at station 2 (0.33 gm/L) (Table-1; Figure 3-a). Average turbidity values in Tigris River at station 4 and 3 were (26.5 NTU) and (34.4 NTU) respectively. While turbidity at stations 1 and 2 were in between the previous values (Table-1; Figure 3-b). Turbidity in the rivers are at the almost high during increase water level and high rapid flow, Which causes increase water suspended matter and mixing of water during rain periods(Hynes 1974) . In a study on Tigris River [2], turbidity values were related to the suspended solid substances, such as mud and silts which increased during the periods of rains and high discharge.

pH values in the present study inclined towards weak alkalinity (7.5-8.6) (Table-1; Figure 5-a). This coincides with results of previous studies [13, 14, 15], which pointed towards weak alkalinity of Iraqi water.

Dissolved oxygen values did not fall below 5.2 mg/L. High values recorded in the Lower Zab compared to Tigris River (Table-1; Figure 4-a). This was related to the fast flow and good mixing [14, 15, 16]. Biochemical Oxygen Demand (BOD_5) values were high during summer (Table-1; Figure 4-b). The real cause is the presence of organic biodegradable matter that are consumed by bacteria. Dissolved oxygen, also decreases with an increase in temperature [17].

Total hardness recorded high values at station 3 in Tigris River, compared with station 1 in Lower Zab (Table-1; Figure 6-a). AL- Lami [2] founded close values, and this was attributed as follows; Tigris river water is considered hard water, and the real causes of hardness is the nature of catchments area through which the Tigris river flows.

Also the polluted loads discharges add to this hardness. Low calcium ions values (133 mg/L) recorded at station 4 in Tigris River, and this could be due to the consumption of the ions by living organism bloomed at this station [3]. While, higher calcium ion values (165 mg/L) recorded at station 2 in Lower Zab. This is due to the surrounding soil nature (Table-1; Figure 6-b).

Table-1 and Figure 5-b, shows alkalinity values between 52 and 208 mg/L. These values were within the natural range [10]. Because most water alkalinities in Tigris River are due to bicarbonate ions. This was pointed out in many previous studies [8, 13].

Mean nitrite values recorded in the present study at all stations were close and low. A decreased value of nitrite below sensation level was recorded in station 3 in Tigris River (Table-1; Figure 7-b). Nitrite values in the unpolluted good ventilated waters are low [2]. This is true because of the values of dissolved oxygen at the same station (6.5- 9.7 mg/L).

Phosphate values at stations 3 and 4 were (0.4 µg/L) and (0.27 µg/L) respectively in Tigris River (Table-1; Figure 8-a). This is because of dilution effect after the confluence of Lower Zab into Tigris River. Also due to the consumption by living aquatic organisms. Plant nutritives considered to be very important in increasing primary productivity, which forms the principal base of food chain in aquatic environment [18].

The maximum silica value (5.7 mg/L) recorded at station 1 in Lower Zab, and the lower values recorded at station 4 in Tigris River (2.1 mg /L) (Tabe-1; Figure 8-b). Silica found naturally in water in concentrations ranged (1-10 mg/L). Silica concentration ranged (0.5-0.8) mg/L required for diatoms growth [19].

The upper chloride values recorded at all stations did not exceeded 200 mg/L ; the upper chloride ions concentration allowed and prefered in drinking water recommended by WHO (1971). And the mean values recorded in the present study were close to the preferable concentration of 25 mg/L of drinking water .The low chloride value recorded was 7.5 mg/L .This was lower than the values recorded by Saleh [20] and Al-Doori [21] in Tigris river /Salahudeen province . The upper chloride value was (38.6 mg/L) , this was also lower than the values recorded by the previous two authors .The mean chloride values were close to the preferable level (25 mg/L) allowed in the international characterization and the characterization of Iraqi waters No. 25 in 1967. Chlorides are among the important negative ions in natural waters and which give the water its salty test when it binds with sodium ions and change with concentration .One of the most special characters of Iraqi waters are the dominancy of Ca, HCO_3, Cl, SO_4 ions .This emphasize the mineral contents of the rocks in the river basin, which was also stated by Al-Lami and Al-Aubaidi [14].

Table 1: Range, Mean and standard deviations of the physical and chemical measurements for the surface water at the different stations during 2001-2002.

Station / ***Factors***	***Lower Zab***		***Tigris river***	
	1	***2***	***3***	***4***
Air Temperature (^oC)	12 - 36	12 -34	13.5-38	10-31
Water Temperature (^oC)	11 - 27	10 – 27	10-28	10-24
Salinity (%o)	0.19 - 0.46 (0.31) ± 0.1	0.2 – 0.59 (0.33) ± 0.1	0.22-0.46 (0.28) ±0.1	0.16-0.35 (0.25) ±0.04
Turbidity (NTU)	0.73 -111 (27.1) ± 30	ND – 109 (22) ± 30.7	0.24-185 (34.4) ±54.8	2.57-72 (26.5) ±23
pH	7.9 - 8.3 (8.12) ± 0.1	7.7 – 8.4 (8.1) ± 0.1	7.8-8.3 (8.1) ±0.1	7.5-8.6 (8.1) ±0.3
Dissolved Oxygen (mg/l)	5.2 – 10 (7.9) ± 1.2	6.3 – 10.4 (7.9) ± 1.2	6.5-9.7 (7.6) ±0.9	6.1-10 (7.7) ±1.1
BOD (mg/l)	0.4 – 4.6 (2.5) ± 1.6	0.7 – 4.6 (2.3) ± 1.5	0.7-3.8 (2) ± 1.1	1.3-4.5 (2.7) ±1.2
Total Hardness (mg/l)	65 – 540 (281) ± 114	175-510 (293) ±80	120-635 (306) ±135	110-475 (222) ±94
Calcium (mg/l)	50 – 260 (154) ± 68	60-280 (165) ±64	50-245 (141) ±54	50-225 (133) ±56
Alkalinity (mg/l)	104 – 208 (152) ± 0.6	52 – 208 (135) ± 49	104 – 208 (165) ± 41.6	104 – 208 (134) ± 33
Nitrite (µg/l)	0.016 -1.534 (0.7) ± 0.6	0.008-2.6 (0.5) ± 0.7	N.D-2.04 (0.6) ±0.8	0.07-2.12 (0.4) ±0.5
Phosphate (µg/l)	0.012 – 1.23 (0.33) ± 0.3	0.03-1.24 (0.33) ±0.4	0.06-1.5 (0.4) ±0.3	0.029-1.368 (0.27) ±0.3
Silica (mg/l)	1.98 -18.5 (5.7) ± 4.9	0.06-6.6 (3.8) ±1.5	0.2-10.9 (92.9) ±3.2	0.06-3.97 (2.1) ±1.1
Chloride (mg/l)	23.1 – 45.3 (33.8) ± 7.5	26.6 – 65.7 (38.6) ± 11.8	22.8 – 52.4 (34) ± 8	26.3 – 58.6 (33.5) ± 8.5

N.D = Not detected .

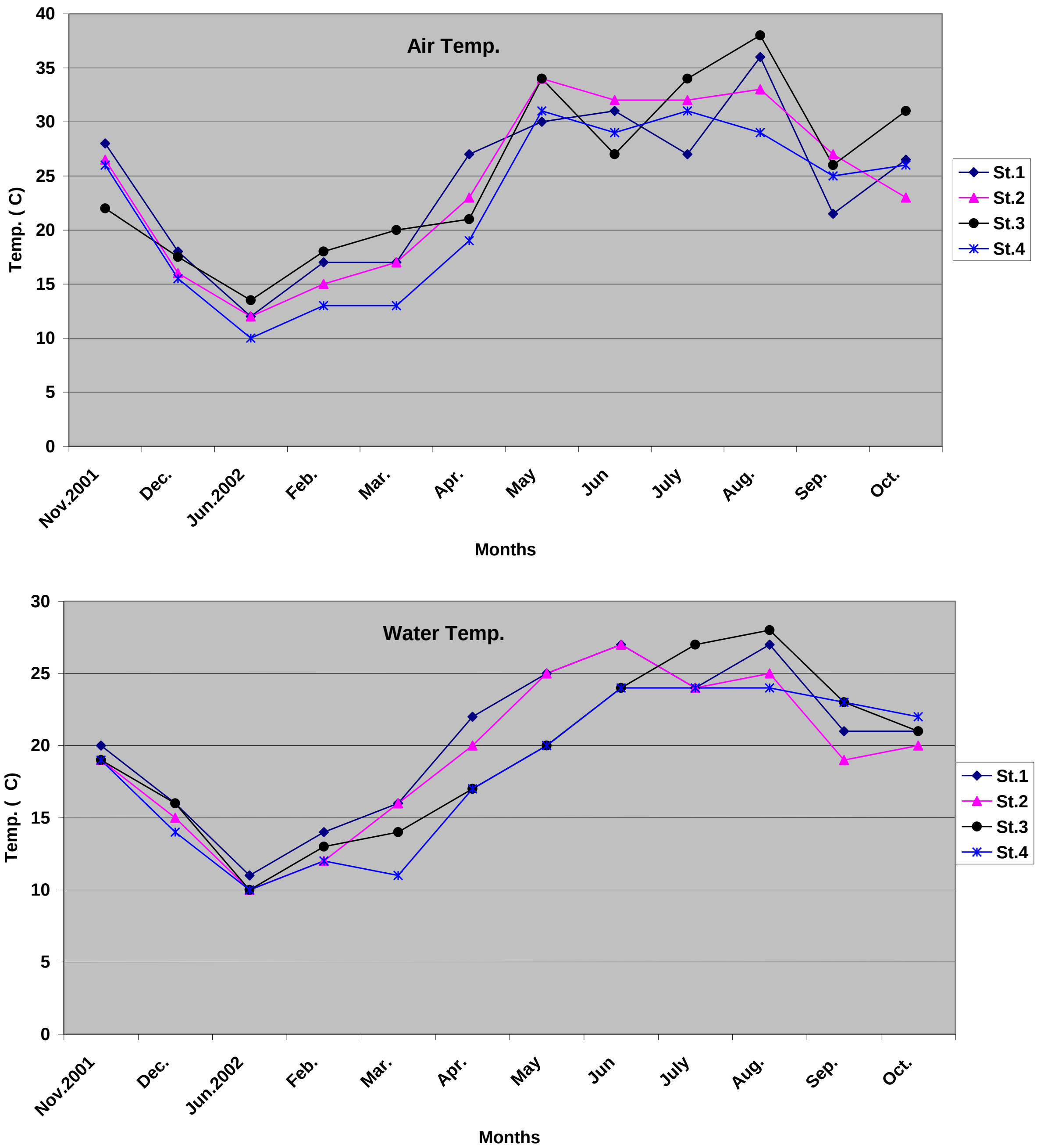
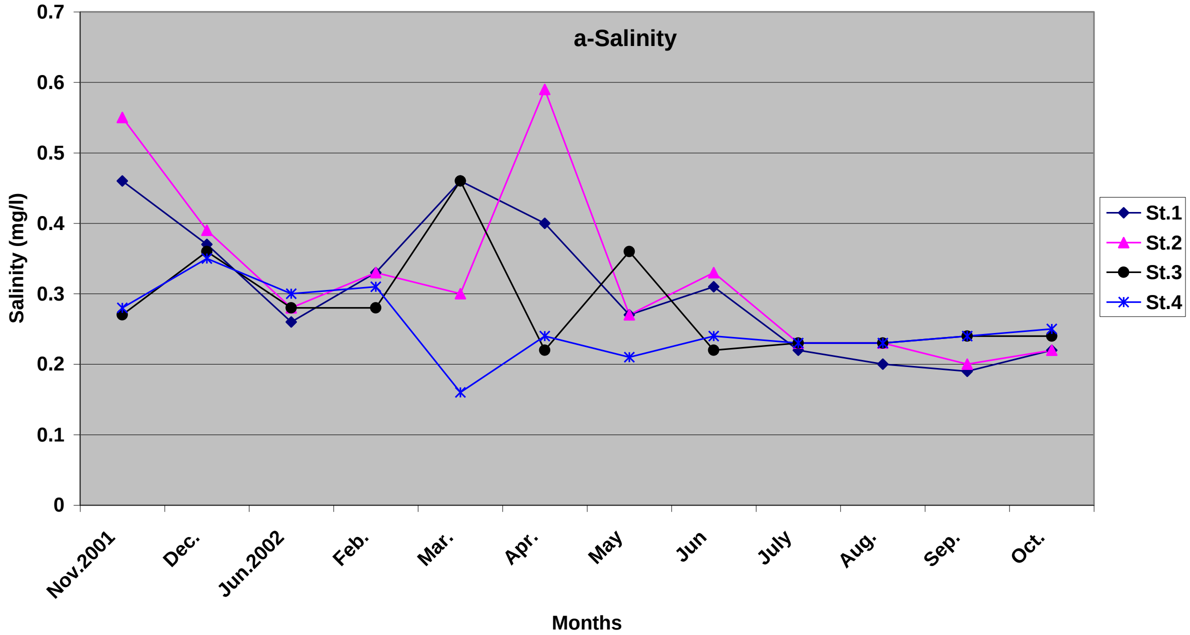


Fig. (2): Air & Water Temperature at the study area from Nov. 2001 to Oct. 2002



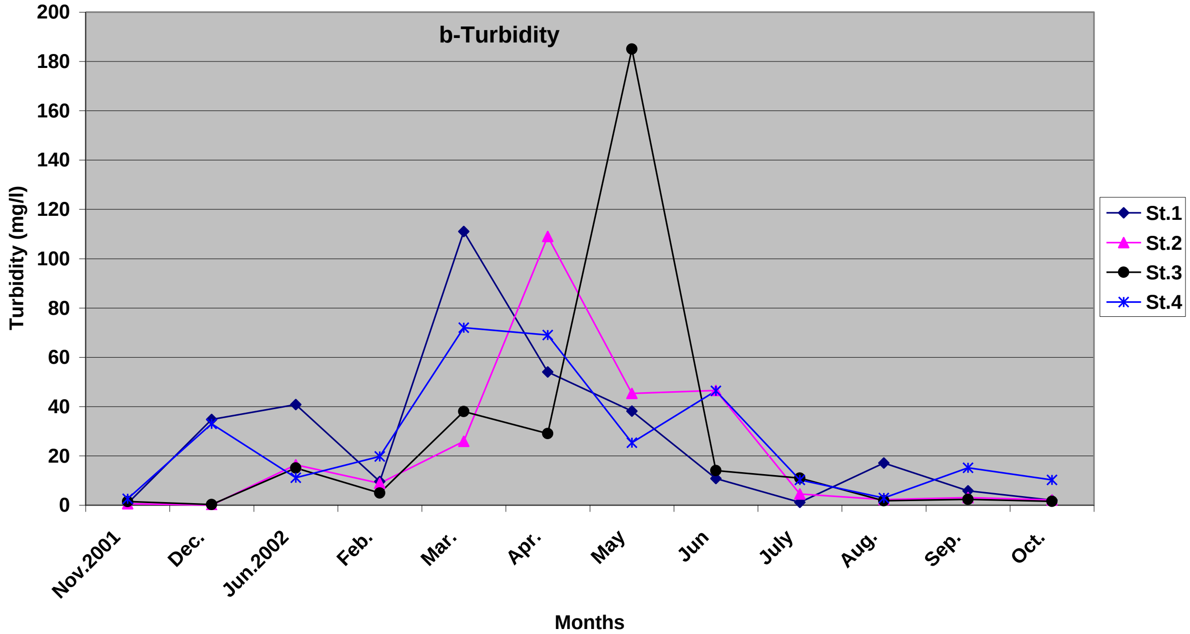
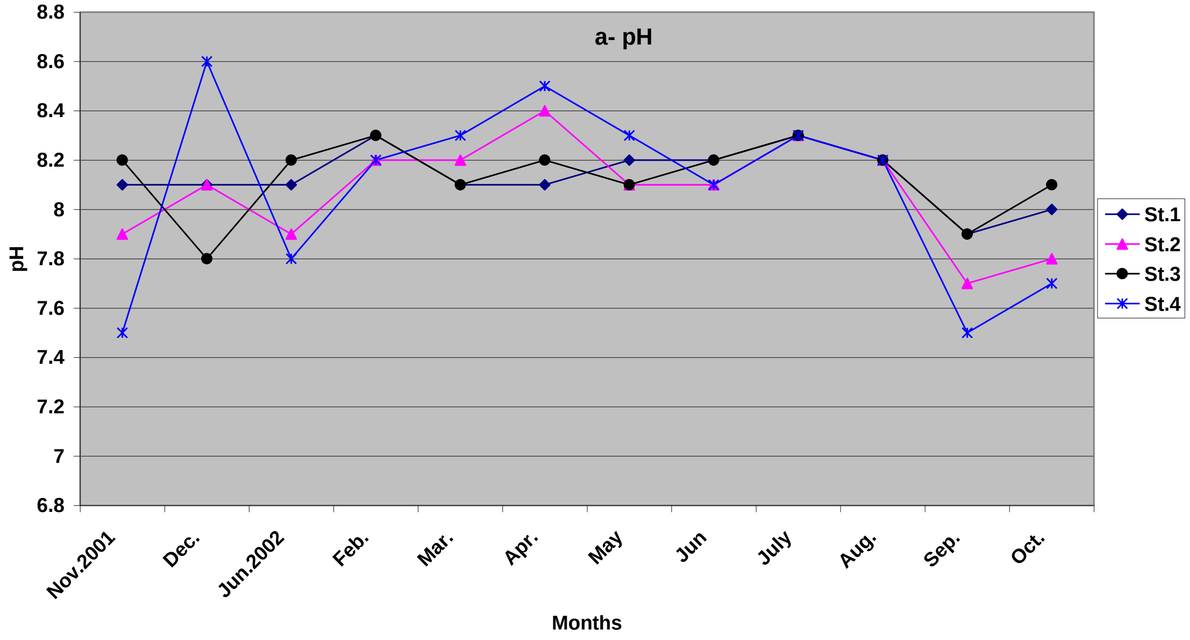


Fig. (3-a&b): Salinity & Turbidity at the study area from Nov. 2001 to Oct. 2002



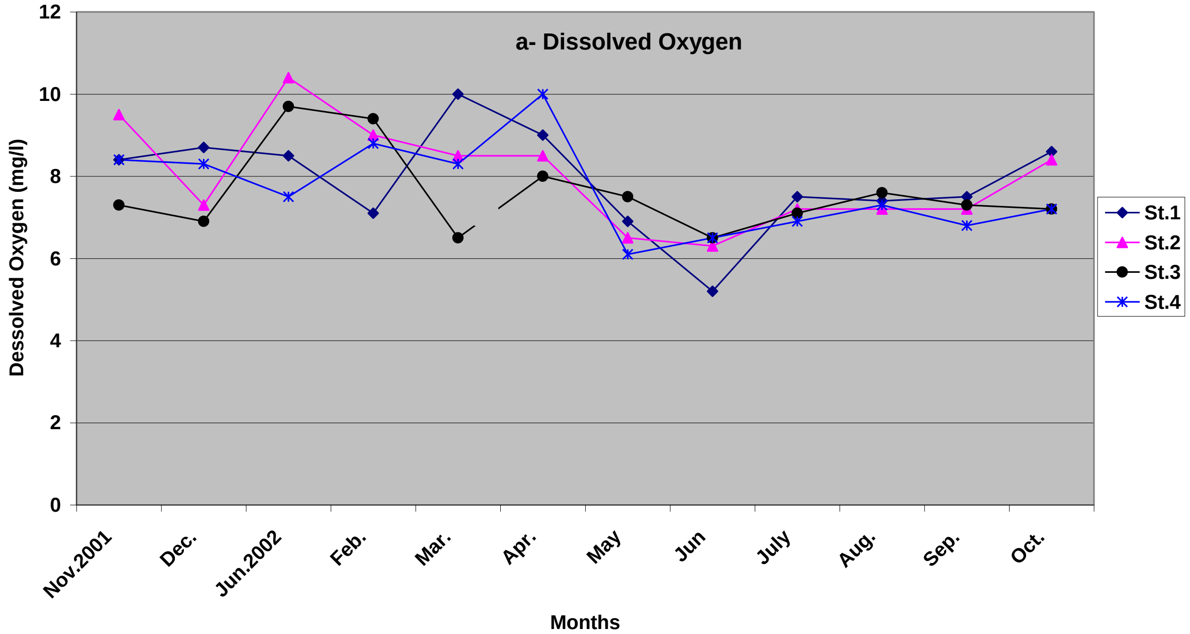
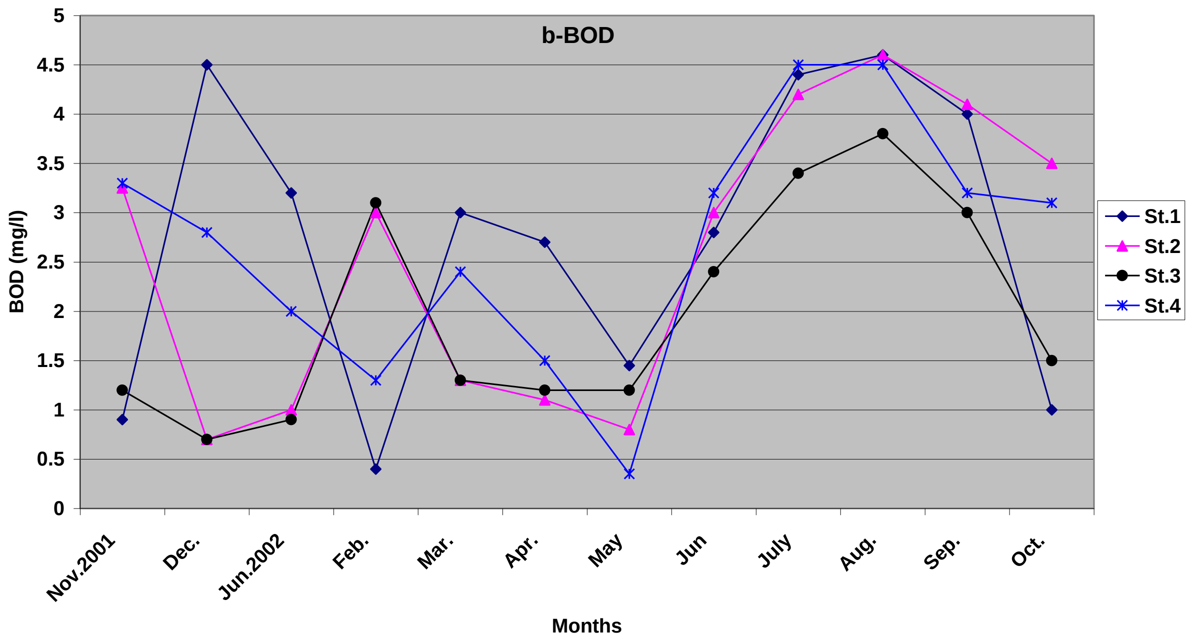


Fig. (4-a&b): PH &Dissolved Oxygen at the study area from Nov. 2001 to Oct. 2002



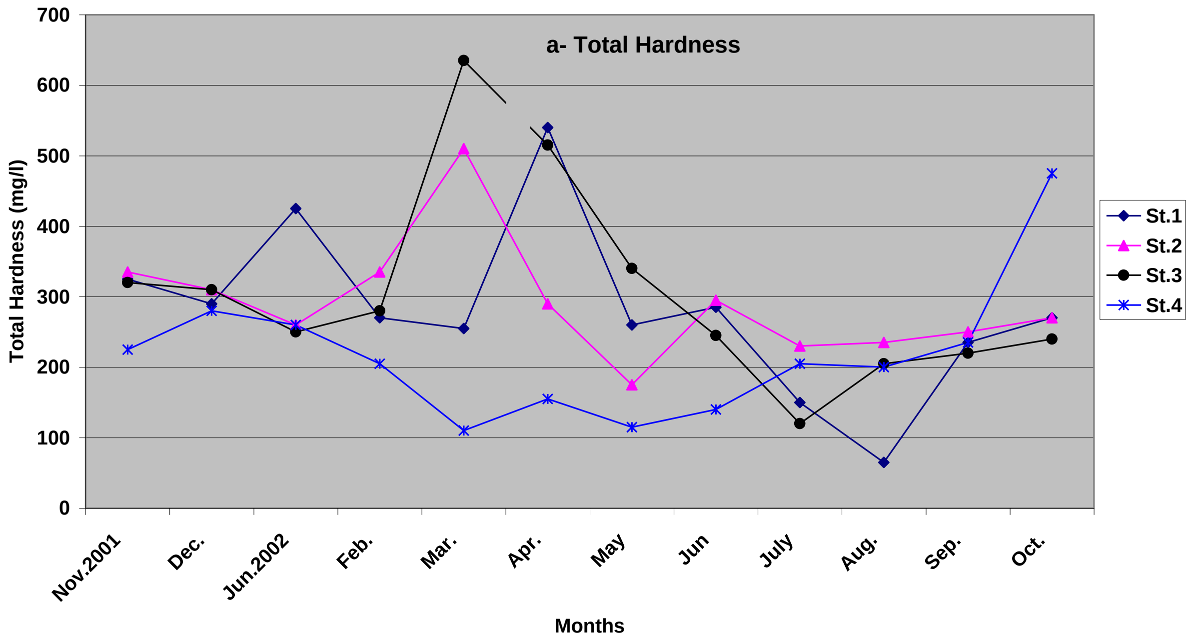
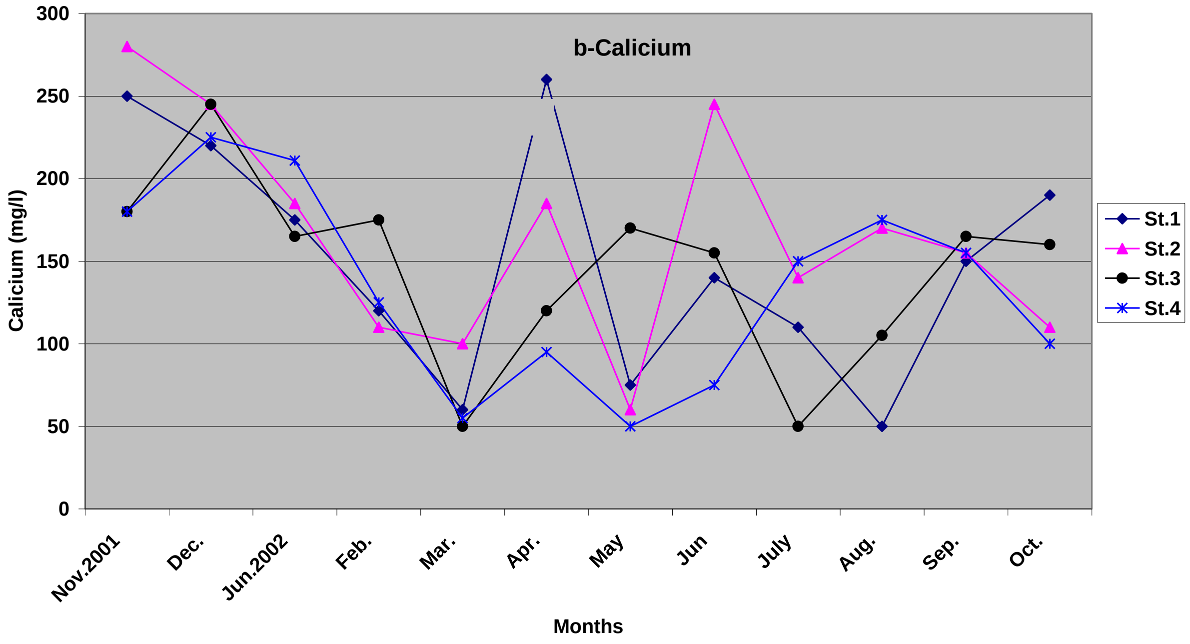


Fig. (5-a&b): BOD& Total Hardness at the study area from Nov. 2001 to Oct. 2002



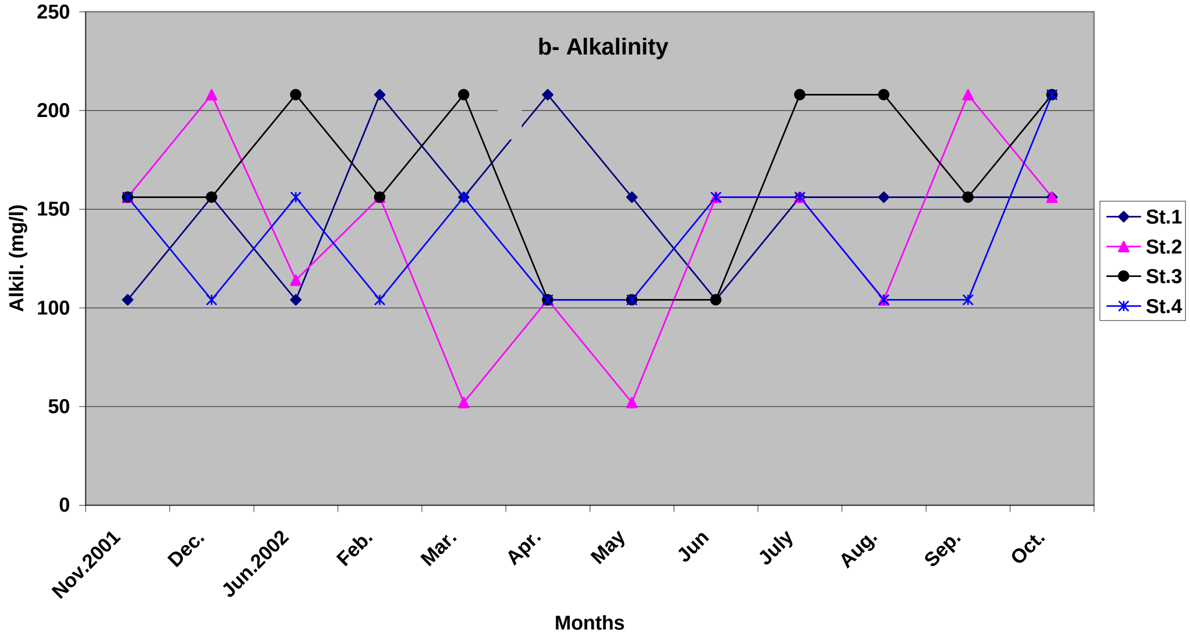


Fig. (6-a&b): Calcium & Alkalinity at the study area from Nov. 2001 to Oct. 2002

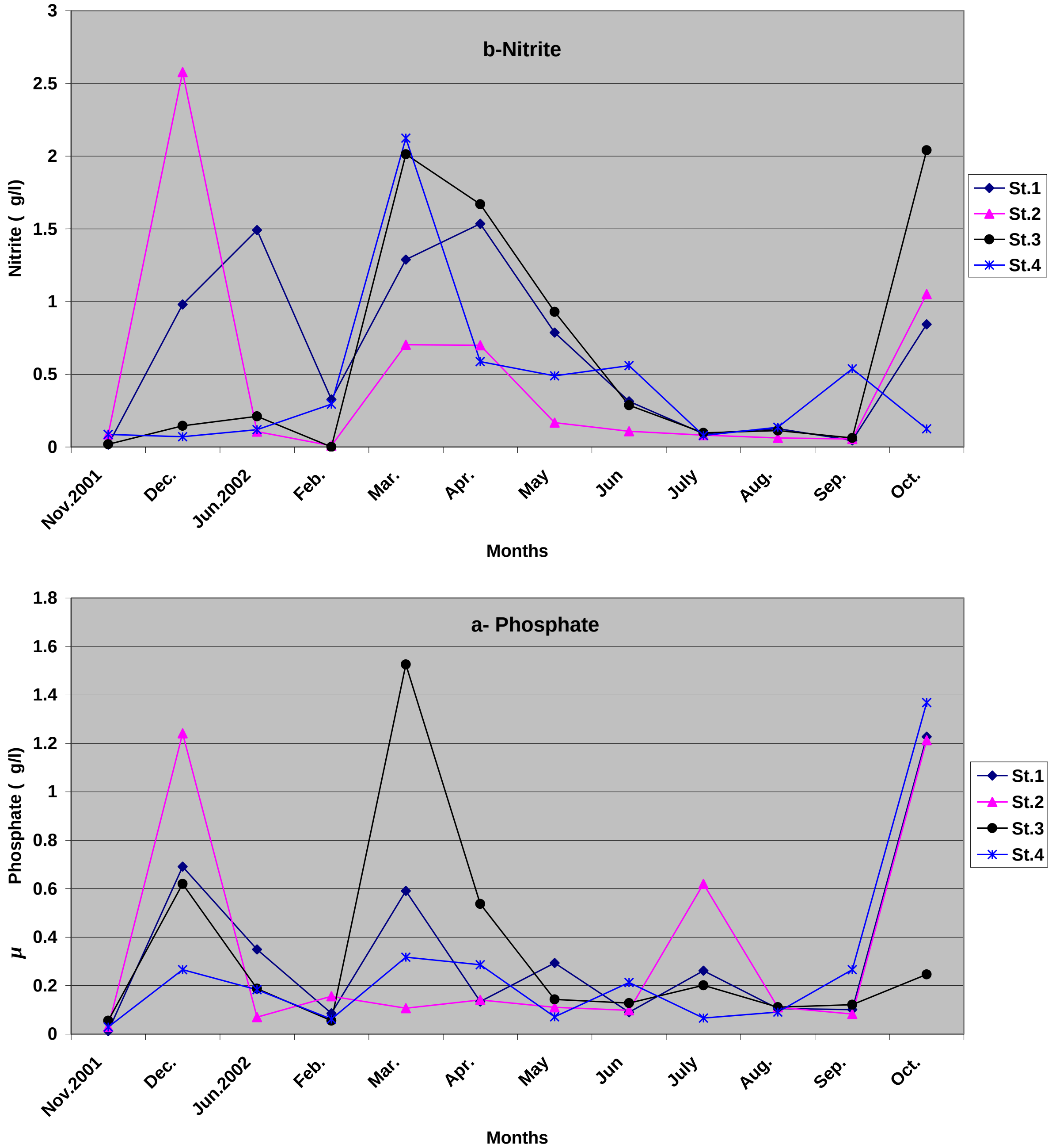
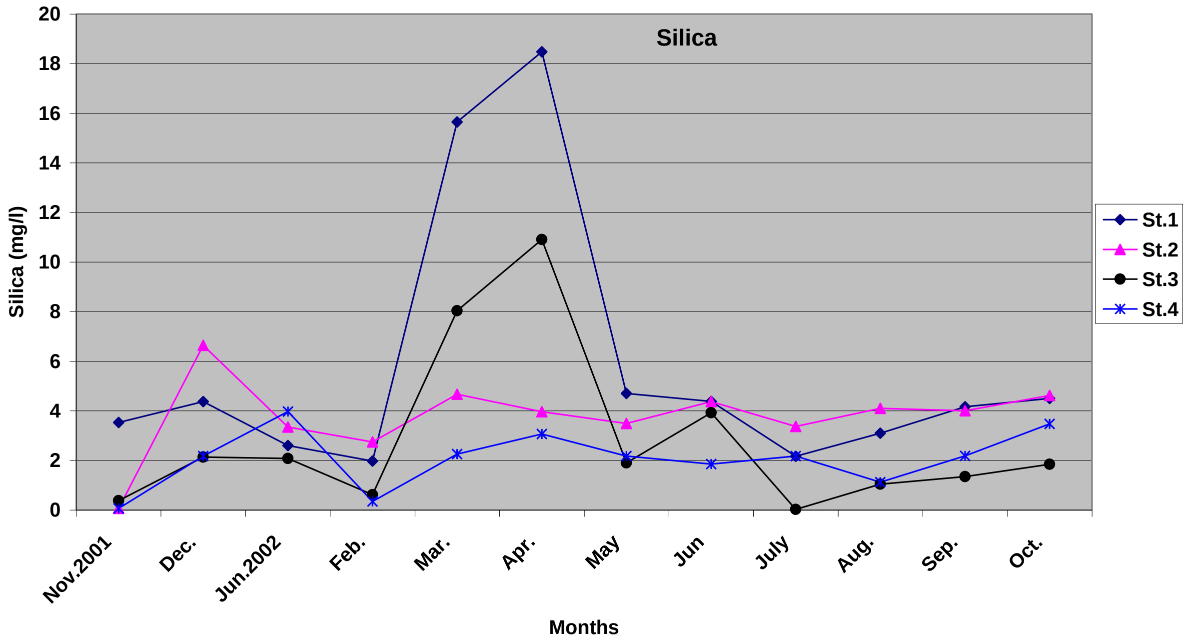


Fig. (7-a&b): Nitrite & Phosphate at the study area from Nov. 2001 to Oct. 2002



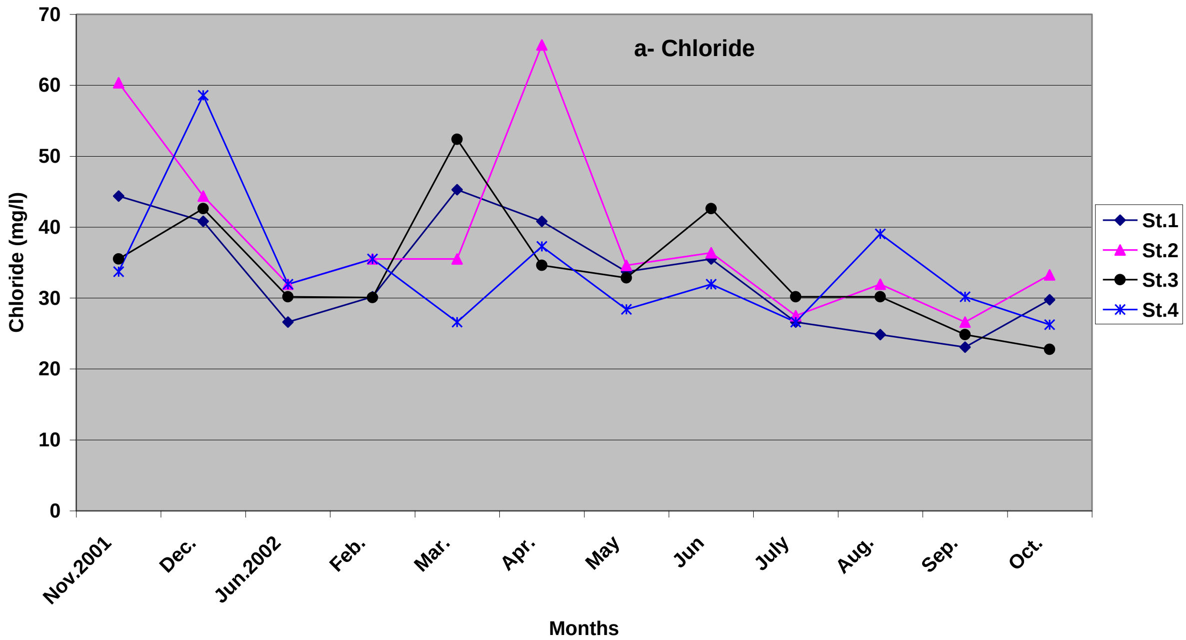


Fig. (7-a&b): Silica & Chloride at the study area from Nov. 2001 to Oct. 2002

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تأثير بعض العوامل الفيزيائية والكيميائية لمياه الزاب الأسفل في نهر دجلة

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الملخص:

اختيرت أربعة محطات لجمع عينات المياه لدراسة تأثيرات بعض خصائص مياه رافد الزاب الأسفل على مياه نهر دجلة من تشرين الثاني ٢٠٠١ ولغاية تشرين الأول ٢٠٠٢ .تراوحت درجات حرارة الهواء والماء (١٠-٣٨)°م و(١٠-٢٨)°م على التوالي. في حين كانت قيم الملوحة بين (٠,٢٥-٠,٣٣) جزء بالألف. كانت كدرة المياه(٢٢ وحدة كدرة نفثالية) في المحطة ٢ و(٣٤,٤ وحدة كدرة نفثالية) في المحطة ٣. تراوحت درجة الأس الهيدروجيني في جميع المحطات بين(٧,٥-٨,٦). قيم الأوكسجين المذاب كانت عالية في مياه الزاب الأسفل مقارنة بمياه نهر دجلة ، في حين كانت قيم المتطلب الحيوي للأوكسجين عالية خلال الصيف ومنخفضة خلال الشتاء . سجلت العسرة الكلية وايونات الكالسيوم والقاعدية قيماً تراوحت بين (٢٢٢-٣٠٦)ملغم/لتر،(١٣٣-١٦٥) ملغم/لتر و(١٣٤-١٦٥)ملغم/ لتر على التوالي .

قيم المغذيات لعينات المياه كانت واطئة لحد ما، وبلغت (٠,٤مايكروغرام / لتر) للنترنيت و(٠,٢٧ مايكرو غرام/لتر) للفوسفات و (٢,١ ملغم/لتر) للسليكا في المحطة الرابعة بعد مصب الرافد في نهر دجلة. بينما كانت قيم المغذيات أعلاه في المحطة الثالثة في نهر دجلة مرتفعة، حيث سجلت (٠,٦ مايكرو غرام / لتر) و(٠,٤ مايكرو غرام/ لتر) و(٢,٩ ملغم/لتر) على التوالي .

أما قيم الكلوريد فقد تراوحت (٣٣,٥-٣٨,٦) ملغم/ لتر. نوقشت النتائج على أساس التغيرات البيئية في مياه المحطات ١و٢و٣ و بالتالي تأثيرها على مياه المحطة الرابعة.وقد تبين من النتائج إن الزاب الأسفل يؤثر على بيئة نهر دجلة في المحطة الرابعة من خلال قيم العكورة، والعسرة الكلية والايونات السالبة والواقعة في نهر دجلة بعد نقطة اتصاله بالنهر، إضافة إلى انخفاض قيم المغذيات مقارنة بالمحطة الثالثة. وهذا بالتأكيد يعود إلى الظروف الملائمة في المحطة الرابعة والتي تسبب الازدهار والتنوع الحياتي للأحياء المائية. وهذا كان واضحاً من قيم المتطلب الحياتي للأوكسجين في المحطة الرابعة. القيم العالية للمتطلب الحياتي للأوكسجين كانت ذات علاقة بالتلوث العضوي الحاصل.