Seasonal variations in abiotic ecological conditions in Al-Garaf canal one of the main branches of Tigris river at Thi- Qar province, Iraq

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Abstract

Monthly variations in physico-chemical parameters of Al-Garaf canal, one of the main branches to the Tigris river, were monthly investigated from March 2004 to February, 2005. Sampling location situated in the south-eastern sector of Iraq and was surrounded by vast and fertile agricultural lands. Three stations were selected to implement the work. The former is located at 167 km of Kut Dam north to Shatra town and closer to water supply point to both Basrah and Thi Qar provinces. The second is situated at distance 8 km away from the former and the latter station is located at 13 km apart from the second one. Abiotic ecological conditions were regularly studied, including water and air temperatures, transparency, salinity, dissolved oxygen (D.O.), carbon dioxide (CO_2), pH, total alkalinity, total hardness and biological oxygen demand (BOD). Results reveled that water temperature ranged from 12 to 36.5 ˚C at former and latter stations respectively. Transparency ranged from 25-68 cm. The minimum salinity (1.5 ppt) recorded in May at station1and the maximum (5.71ppt) at station 3 in August. D.O. decline clearly during hotter months (July& August), the lowest (6.2 mg/L) was in August at station2. pH ranged from 6.3-8.1. The minimal alkalinity value (140 mg/L) was measured at February 2005 from station 1 and the highest in March from station 3. Maximum hardness (460 mg/L) measured in July at station 3. Minimal BOD value (1.1 mg/L) was in March, but the highest (6.1 mg/L) encountered from station 3 at July.

1-Introduction

The study of water resources and other related strategic topics gain special interest from specialists, to ensure requirements of various fields of civilization. Aquatic environments play substantial roles in human being welfare. It is therefore the deterioration in water quality, imposed by man, and due to various causes has given special interest (Odum, 1971). Iraqi inland waters witness tremendous impacts due to discharging various disposals and wastes of manufacturers, agricultural and domestic origins (Adam, 1988; Wrobel and Brebbia, 1994 and Klerks and Lentz, 1998). Quite few studies were executed on Tigris River (Al-Nimma, 1982; Al-Saadi, 1994; Al-Lami, 1998; Al-Lami, *et al.,* 1996, 1999; Hassan, 1997; Al-Saadi *et al*., 1999; Abdullah *et al*., 2001; Al-Rubaee, 1997; Sabri *et al*., 1990), but no work had considered the status of Al-Garaf canal in Thi Qar province. The present study has taken in consideration the investigation of abiotic conditions in this vital aquatic habitat.

Description of study area

A thorough description to the study area was provided in Hussein and Fahad (in press). Three stations were selected within Al-Garaf to execute the study (Fig.1). Station1 situated at 167 from Kut dam, north to Shatra. This station was selected to evaluate water quality characteristics as it receives sewage discharges. Canal width at sampling station is 52 m and depth is 8 m. Station2 is about 8 km from the previous one. It has been chosen to investigate the impact of city wastes on the canal. Station 3 is 13 km apart from the second one, where the canal is characterized by being narrow and shallow and with fast current.

2-Materials and methods

Air and water temperatures were instantaneously measured by simple thermometer. Secchi disc was used to determine light penetration. Water salinity (g/L) was calculated by conductivity meter type TOA, model CM-SET and the result was multiply with 0.64. Winkler method (Welch,1964) was adopted to measure dissolved oxygen (mg/L). pH value was determined by using pH meter type GTC, model Lesibolo. Buffer solutions (pH = 4, 7, 9) were used for calibration. Concentration of Carbon dioxide (mg/L) and total alkalinity (mg/L) were determined by methods described in APHA (1985). Total hardness was measured by method described by Lind (1979). Biochemical oxygen demands (BOD) was determined by differences in concentrations of initial oxygen and of sample kept in dark for five days under 20˚C. the result was expressed in mg/L.

3-Results

Figure (2) shows monthly changes in air temperature recorded from the three selected stations. Values ranged between 13ºC in station2 during January (2005) to 38º C in station3 during July (2004). Fig.3, however, indicates monthly variations in water temperature, where the lowest value was 12ºC monitored from station1 during January (2005) and the highest 36.5ºC in station three during June (2004). The highest values were recorded in summer months and lowest in winter.

Figure (4) reveals monthly and localized changes in light penetration. Values ranged between 25-68 cm, with relative rise during February, March, April and January. The highest (69 cm) and the lowest (25 cm) were recorded from station1 in March and November respectively.

Figure (5) shows monthly changes in values of water salinity. The lowest was 1.53 ppt encountered in station1 during May (2004) and the highest (5.71 ppt) measured from station 3 in August (2004). The months revealed highest values in general.

Figure (6) Reveals monthly variations in dissolved oxygen in selected stations. Values sharply declined during July and August (2004). The lowest (6.2 ppm) was in August (2004) from station2 and the highest (9.5 ppm) was, in general, in February (2005).

Figure (7) shows monthly changes in pH. The lowest (6.3) was encountered in January (2005) from station3 and the highest (8.1) in August (2004), but values in general were mainly in the alkaline direction. Figure (8) reveals monthly and localized variations in free carbon dioxide. Values exhibited gradual rise from April onwards. The highest (6 ppm), however, was measured from station 2 in August (2004), then reflected gradual decline until January. Free carbon dioxide was absent in January from station1. Figure (9) Shows monthly variations in values of total alkalinity in the three selected stations. The lowest (140 mg/L) was measured from station1 in February (2005) and the highest (200 mg/L) in March (2004) from station3. Figure (10) revealed monthly variations in values of total hardness in the selected localities. Highest value (460 mg/L) was in July and encountered from station3. The lowest (180 mg/L), however, was in January (2005) from station1.

Monthly variations in values of biochemical oxygen demands (BOD) in the three stations are shown in figure (11). The lowest (1.1 mg/L) was recorded in March (2004) from station-1and the highest (6.1 mg/L) was in July (2004) from station-3.

Discussion

Water temperature is considered as one of the vital ecological factors imposing great impact on the aquatic ecosystem (Witton, 1984). It has both direct and indirect interrelated effects on occurrence and distribution of organisms (Meheseni and Stefan, 1999). It also affect growth rates and govern reproduction (Houde, 1989). The study detected monthly and localized variations in both air and water temperatures. This may be related to nature of Iraqi climate. Also temperatures in both environments were closely related to each other. However, detected localized variations might be attributed to periods of sampling. Previous works (Sabri *et al.,* 1989; Al-Rubaee, 1997; Al-Lami *et al*., 1996, 1998, 1999) implemented on Tigris were found to coincide with our finding. Light penetration was low during summer months. This may relate to water discharge and loose banks and substrates acting to rise turbidity which inversely related with transparency (Keithan and Lone, 1985). Values of light penetration agree with findings of Al-Nimma (1982); Sabri *et al.* (1989); Al-Rubaee (1997); Maulood, *et al*., (1994); Al-Lami *et al*. (1998) and Fahad (2005 a).

The study also revealed monthly changes in salinity, with notable increase during summer months. This could be due to evaporation (Afzal *et al*., 2000). The presence of agricultural drainage networks namely, Al-Shatra, Dawaya, Badaa and Garaf may contribute in rising salinity as well. The study deduced that values of dissolved oxygen (D.O.) exhibited notable rise in winter months as they inversely correlated with water temperature (Lind, 1979). Statistical analysis indicates that the correlation between the two factors is R= -0.554. The study finding coincided with other authors (Sabri *et al*., 1989; Saadalla and Maulood, 1993; Al-Rubaee, 1997; Al-Saadi Hassan, 1997; Al-Lami,*et al*., 1998; Attee, 2004) on Iraqi inland waters mainly Tigris. Low concentration of D.O. recorded from station 3 may relate to organic wastes discharged from Shatra and Garaf. Tayel (1996) achieved similar conclusion on Alexandria waters. Results indicate that pH values were rarely fluctuated. This probably attributed to buffering ability of carbon dioxide. Also, values were mainly within alkaline state that coincided with vast majority of Iraq inland water bodies (Mohamed and Barak, 1988; Hussein *et al*., 1991; Al-Rudane *et al*., 2001 and Attee, 2004). On the other hand, values of carbon dioxide varied among stations and seasons. This due to several causes mainly decomposition of organic matters, photosynthesis activities, respiration and water temperature (Brown, 1980; Goldman and Horn, 1983; Tietjen *et al.,* 1999; Ferrie, *et al.,* 2001). Higher concentrations in July is related to the increasing levels of decomposition imposed by the activity of microorganisms stimulated by rise in water temperature, whereas winter months exhibited notable decline in carbon dioxide or it was totally absent. This is in agreement with Al-Saadi *et al.* (1993) and Hussein, *et al.* (2002).

It has been indicated that water alkalinity is affected by several factors, namely concentration of carbon dioxide, activity of microorganisms and primary productivity (Reid, 1961). It has been found that total alkalinity in the study area is mainly attributed to bicarbonate. This reflects the trend of Iraqi inland waters, in general. Also, alkalinity values encountered in the present work is coincided with findings of several workers including Al-Nimma (1982); Sabri, *et al.* (1989); Al-Saadi,*et al.*(1989); Al-Rubaee, (1997) and Hassan,(1997). However, low values recorded in the warmer periods may attribute to higher consumption of carbon dioxide leading to dissociation of bicarbonates (Hussein and Attee, 2000). Values of total hardness in the selected stations exceeded 400 mg/L as $CaCO_3$. This indicates that waters are very hard according to Lind (1979) and APHA (1985). Although higher values encountered, in general, in summer months is related to decline in water level and evaporation rate (Bhuvanoswarn, *et al.*, 1999). Increase in hardness values was found to coincide with rise in salinity (Hassan, 1988; Al-Gaffily, 1992). On the other hand, the study revealed that values of total hardness exceeded those of total alkalinity. This indicates that hardness is caused by other ions rather than Ca^{+2} and Mg^{+2} ions that participate in formation of not carbonic hardness (Lind, 1979). Other inland localities showed even higher values of hardness (Al-Saadi, *et al.,* 1996; Hassan, 1997; Fahad, 2001). Several factors impose effects on monthly variations in hardness for instance, rain, evaporation and discharges (Al-Lami, *et al.*1998). Results indicate increasing levels of BOD, in particular at station 2 and3, during summer months. This may be due to decomposition of organic matters run directly to the river with domestic sewage. This coincides with Hussein *et al.* (2002) findings in their study on Kora canal in Basrah. Best and Ross (1977) declared that BOD is measurement to determine amounts of oxidized and decomposed organics by microorganisms. However, results of the present work revealed that encountered BOD values never attending levels (> 10 mg/L) reflecting deteriorating water quality (Hynes, 1972). This could be attributed to continuous movements of water masses.

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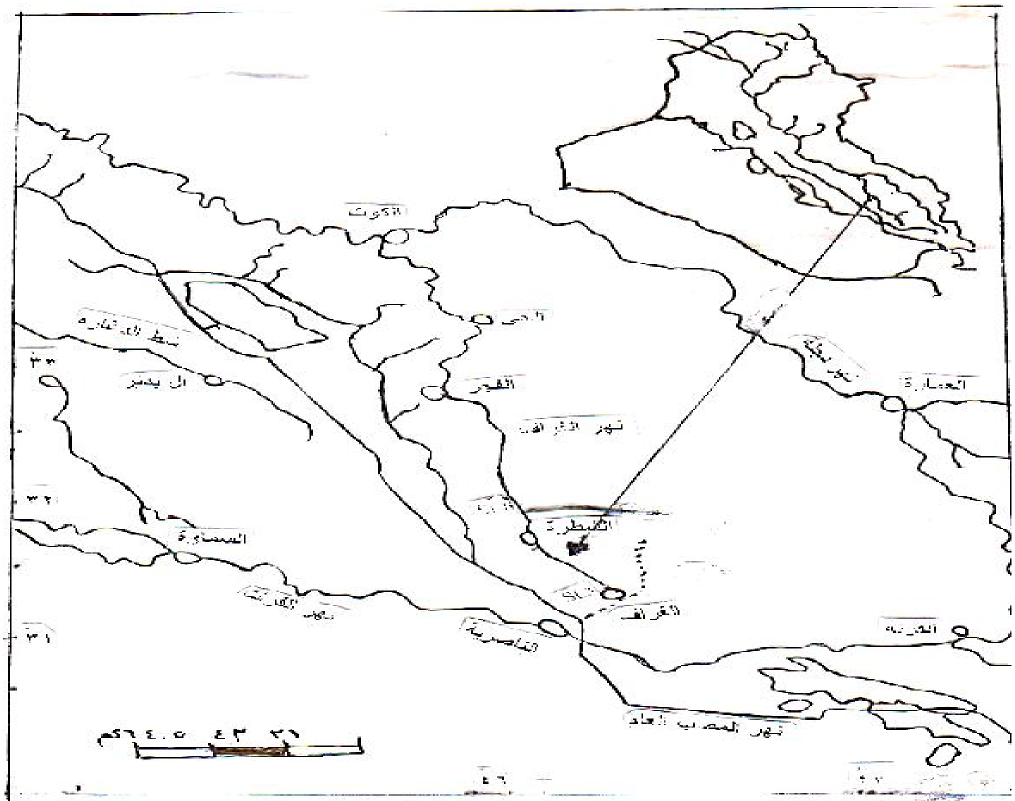
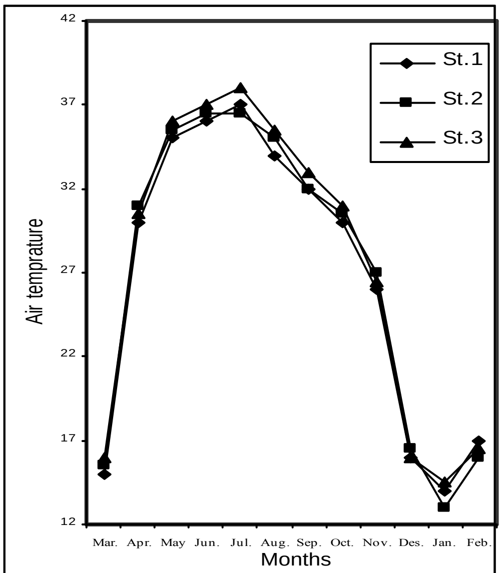
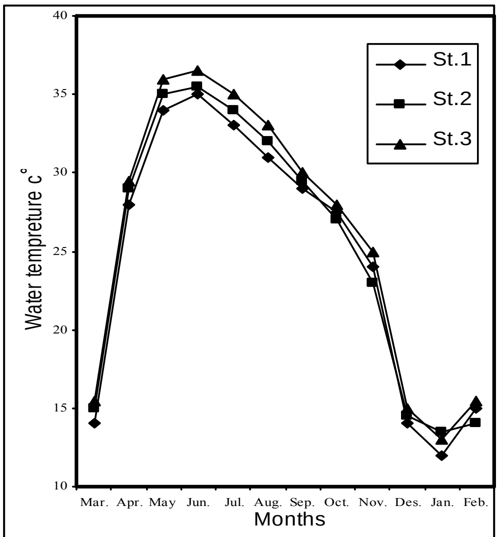


شكل (1) يوضح منطقة جمع العينات لنهر الغراف

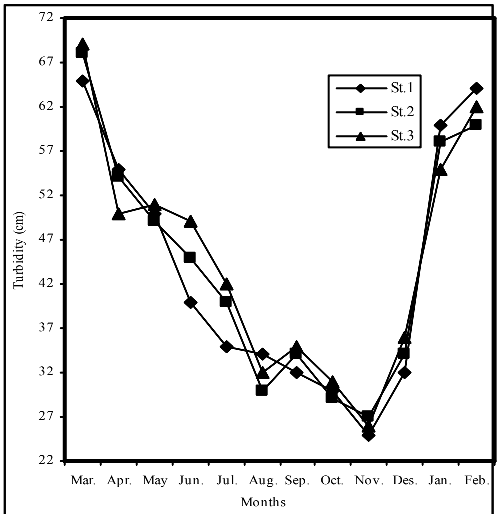
Figure (1) showing the sampling location in Garaf canal



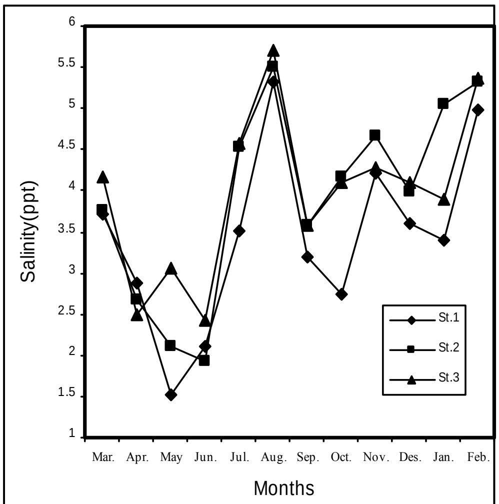
(fig.2)Monthly changes in air tempreture in three selected stations



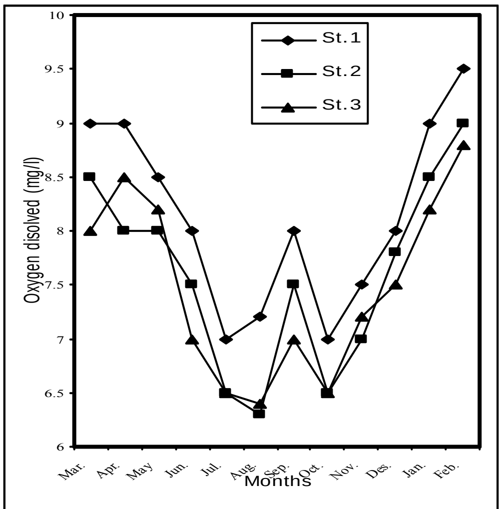
(fig.3)Monthly changes in water tempreture in three selected stations



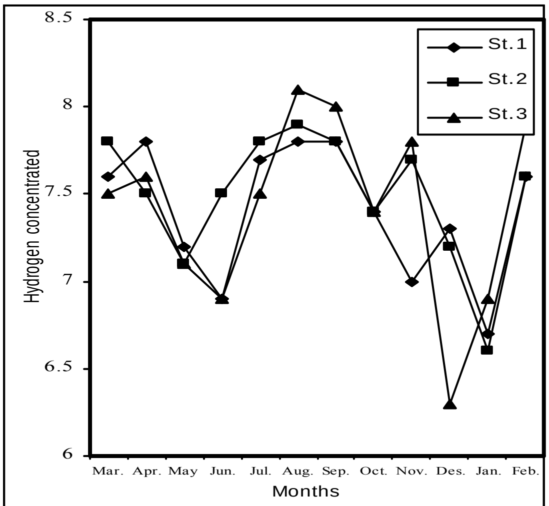
(fig.4)Monthly changes in terbidity in three selected stations



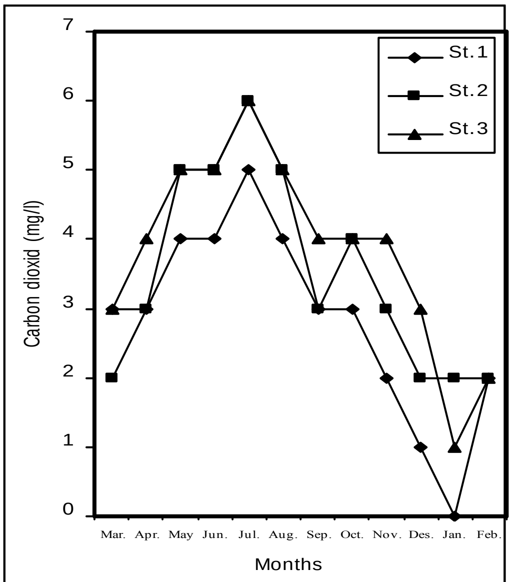
(fig.5)Monthly changes in salinity in three selected stations



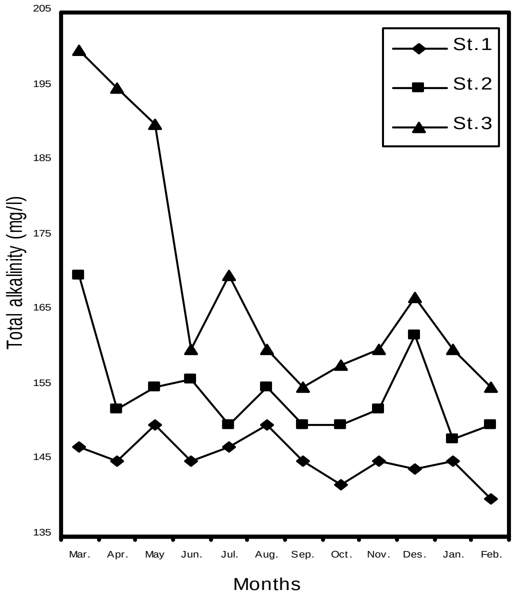
(fig.6)Monthly changes in oxigen desolved in three selected stations



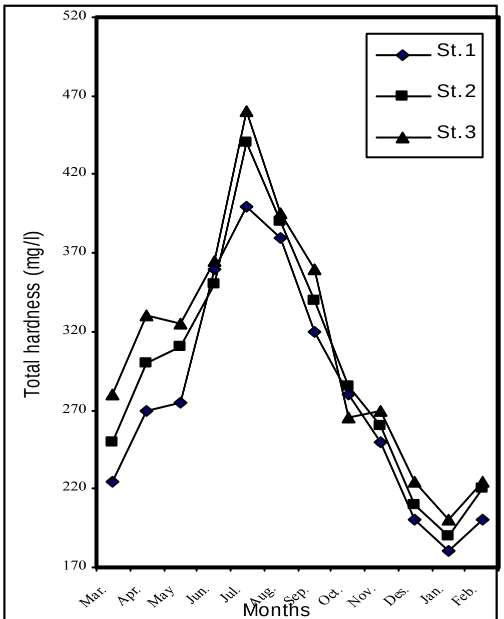
(fig.7)Monthly changes in hydrogen concentrated in three selected stations



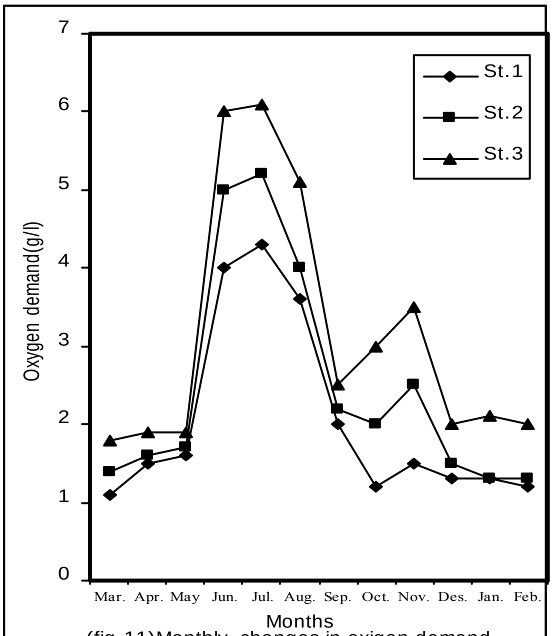
(fig.8)Monthly changes in carbon dioxid in three selected stations



(fig.9)Monthly changes intotal alkalinity in three selected station



(fig.10)Monthly changes in total hardness in three selected stations



(fig.11)Monthly changes in oxigen demand in three selected stations

الاختلافات الفصلية في الخصائص البيئية اللاحياتية في نهر الغراف احد الأفرع الرئيسة لنهر دجلة ،عند مدينة الناصرية.

صادق علي حسين و كامل كاظم فهد

الخلاصة

درست التغيرات الشهرية في الخصائص الفيزيائية والكيميائية للمياه لتقييم حالة نهر الغراف البيئية للمدة من آذار 2004 إلى شباط 2005 . يقع نهر الغراف في الجزء الجنوبي الشرقي من العراق و تحيط فيه مساحات شاسعة وخصبة من الأراضي الزراعية. اختيرت ثلاثة محطات للدراسة ، تقع المحطة الأولى على بعد 167 كم من سدة الكوت شمال مدينة الشطرة حيث موقع تجهيز الماء إلى مدينتي البصرة والناصرية ، . وتقع المحطة الثانية على بعد ثمانية كيلو مترات من المحطة الأولى بعد اجتياز النهر لمدينة الشطرة..أما المحطة الثالثة فتقع على بعد 13 كم من المحطة الثانية بعد اجتياز النهر لمدينة الغراف ، قيست الخصائص البيئية اللاحياتية كدرجة حرارة الهواء والماء والنفاذية والملوحة [redacted] والأوكسجين الذائب وثنائي أوكسيد الكربون والأس الهيدروجيني والقاعدية والعسرة الكلية والمتطلب الحيوي للأوكسجين بشكل منتظم ولمدة عام كامل. تراوح قيم درجة حرارة الماء بين 12 و36.5° م في المحطتين الأولى والثالثة على التوالي. وتراوحت نفاذية الضوء بين 25-68 سم. سجلت أدنى القيم للملوحة (1.5 جزء بالألف) خلال أيار في المحطة الأولى ، وأعلاها(5.71 جزء بالألف) في المحطة الثالثة في آب. أظهرت قيم الأوكسجين الذائب انخفاضاً خلال الأشهر الحارة (تموز وآب) ، وسجلت أدنى القيم (6.2 ملغم/ لتر) خلال آب في المحطة الثانية. تراوح مدى الأس الهيدروجيني بين 6.3 و8.1. و سجلت أوطأ قيم القاعدية (140 ملغم / لتر) في المحطة الأولى في شباط 2005 ، بينما سجلت أعلاها في آذار في المحطة الثالثة. سجلت العسرة اعلي التراكيز في تموز(460 ملغم/ لتر) في المحطة الثالثة. وكانت أدنى القيم للمتطلب الحيوي للأوكسجين(1.1 **ملغم/لتر) في آذار المحطة الأولى** وأعلاها في تموز (6.1 **ملغم/ لتر) في المحطة الثالثة**.