Environmental Study of Some Water Characteristics at Um-Al-Naaj Marsh, South of Iraq.

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Received 25, May, 2010
Accepted 26, October, 2010

Abstract:

Um-Al-Naaj region in Al-Hawiezah Marsh, Southern Iraq was chosen to study the environmental variations of some water characteristics during 2008, seasonally. The results showed clear seasonal changes in values of some environmental variables (temperature, depth, light penetration, turbidity, total suspended solids, pH, dissolved oxygen, reactive phosphate, reactive nitrite, and reactive nitrate), while there were no clear seasonal changes in electrical conductivity and salinity values. In addition, high nutrients concentrations and light penetration were noted. Statistical analysis showed significant positive relationship between air and water temperature; electrical conductivity and salinity. Water turbidity was significantly affected by total suspended solids. On the other hand, some of the studied variables had significant negative effects (relative relationships) to each other, when water pH and dissolved oxygen were affected by temperature; total suspended solids and turbidity affected also light penetration.

Key words: Iraqi Marshes. Water Environmental Characteristics

Introduction:

The Tigris and Euphrates rivers have created about 15,000 km^2 of wetlands known as the Mesopotamian marshes. These wetlands comprise a complex of interconnected shallow freshwater lakes and marshlands and are considered the most extensive wetland ecosystem in the Middle East [1]. One of the largest Iraqi wetlands is Al-Hawizeh marsh, which is extending east from the Tigris into neighboring Iran. Um-Al-Naaj marsh is a large part from Al-Hawizeh marsh [Fig. 1].

In Mesopotamia, large numbers of waterfowl are captured and sold each year, providing a livelihood for hundreds of people [2]. One of the most serious threats to the wetlands in Iraq has been the drainage and diversion of water, as typically supply for agricultural purposes, but also in recent years, for military reasons [1].

Within the last few years, major hydrological engineering activities in and around the area of Lower Mesopotamia have resulted in the drying out of vast areas of wetlands in Al-Hawizeh marsh in Iraqi side that led to destruction and disappearance of the largest areas in this ecosystem [3]. Less than 10% of the marshlands in Iraq remain as fully functioning wetlands because of the extensive drainage and upstream agricultural irrigation programs on the Tigris and Euphrates rivers [1; 4]. Currently, restoration by re-flooding of drained marshes is proceeding in Um-Al-Naaj marsh, but the amount of water, which is reached to this marsh, is little because the dams that established on the water sources on Iran side [5].

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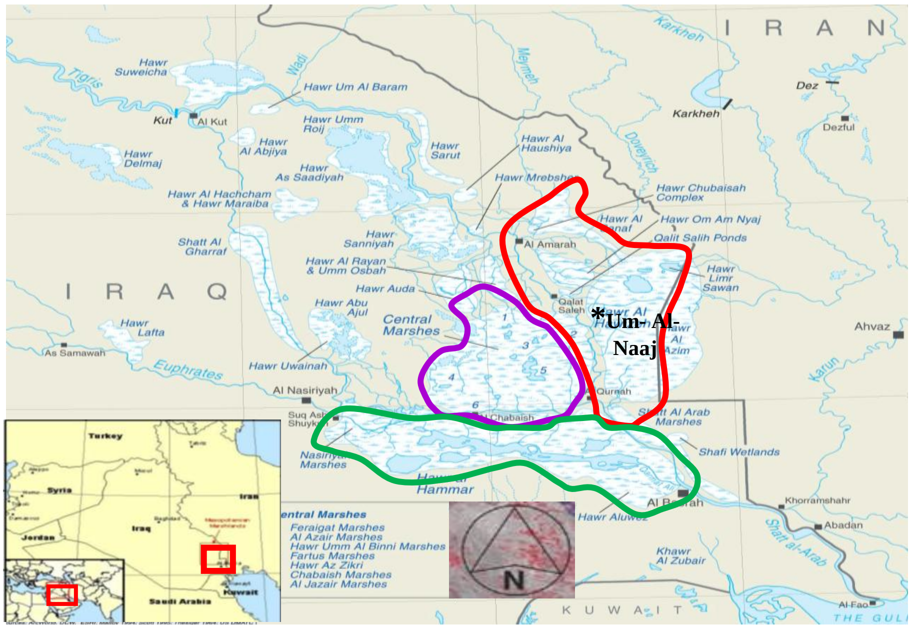

*** is the studied station.**

Fig.(1) Map Showing location of the study sites.

The theme of most previous studies mostly on phytoplankton [6; 7], aquatic plants [8; 9], primary productivity [10; 11]. Specific water quality studies were limited, like [12; 13; 14].

Generally, several factors controlling water quality of the southern marshland, like quantity and quality of water coming from Tigris, Euphrates and Shatt Al-Arab rivers [5], evaporation rate, interaction with substratum soil, biological and human activities [15].

To monitor the water features at Um-Al-Naaj, which is included in Al-Hawizeh marsh after Iraqi marshes restoration, the objective of this study is decided. That was seasonally, during 2008

Materials and Methods:

Environmental Study:

Five samples were collected from the studied site (Um-Al-Naaj marsh) during 2008, monthly. The environmental variables, which were measured in the field, are air temperature (by mercuric thermometer which was divided until 0.1 °C), water depth (by ironic ruler, which is divided from 0- 400 cm), light penetration (by Secchi Disc, its diameter 30 cm), water temperature, water electrical conductivity, water salinity, and water pH (by digital portable multi meter; model 340i/SET). In the laboratory, total suspended solids (by filtration with filter GF 0.45), dissolved oxygen was determined using Azid modification method. Nitrate-nitrogen, Nitrite-nitrogen, and phosphate-phosphorus were measured by colorimetric methods. (All of environmental variables were determined according to [16]).

Data Analysis

CANOCO program [17] was used to apply the Canonical Correspondence Analysis (CCA) method to analyze the data that shows the relationships between environmental variables to each other.

Pearson’s Product Moment Correlation Coefficient (r) was used to determine the correlation value (r) between environmental variables. In addition, mean, standard deviation and standard error were employed.

Results:

The results of the present study showed that there are clear seasonal changes in the values of some environmental variables. The highest value for air temperature 38.5 C° was at summer, while the lowest value 11.3 C° was at winter. Water temperature was with high value 22.5 C° at summer, but the lowest value 9.5 C° was at winter. Water depth and light penetration were with the highest values 210.5 cm and 190 cm, respectively at spring, while the lowest value (for water depth and light penetration) 133 cm was at summer. The highest value for total suspended solids 4.71 mg/l was at winter, while the lowest value 1.29 mg/l was at summer. Water turbidity value was with high value 7.15 NTU at winter, while the lowest value 2.05 NTU was at summer. pH value was with high value 8.5 at winter, but the lowest value 7.3 was at summer. Winter had the highest dissolved oxygen concentration 10.3 mg/l, but summer had the lowest concentration 2.7 mg/l. In addition, there were clear seasonal changes in nutrients concentrations (NO3, NO2, and PO4), when the highest nitrite concentration 2.93 µg/l was at autumn, while the lowest concentration 0.81 µg/l was at spring. Nitrate concentration was with high value 9.51 µg/l at autumn, while the lowest value 3.07 µg/l was at spring. The highest phosphate concentration 4.53 µg/l was at autumn, but the lowest value 1.03 µg/l was at spring. On the other hand, there were no clear seasonal changes in electrical conductivity and salinity values, when their high values 2.03 mS/cm and 0.9 ‰, respectively were at summer, but the lowest values 1.49 mS/cm and 0.5 ‰, respectively were at winter. See table one.

Table -1- Mean and Standard Error for the Studied Environmental Variables, at Four Seasons during 2008.

Station and Season	Mean and Standard Error for Environmental Variables												
	AT±SE (C°)	WT±SE (C°)	WD±SE (cm)	LP±SE (cm)	TSS±SE (mg/l)	Tur.±SE (NTU)	EC±SE (mS/cm)	Sal.±SE (‰)	pH±SE	DO±SE (mg/l)	NO2±SE (µg/l)	NO3±SE (µg/l)	PO4±SE (µg/l)
Um-Naaj-Winter	11.3±0.23	9.5±0.31	190.3±9.3	165±0	4.71±0.09	7.15±0.39	1.49±0.05	0.5±0	8.5±0.03	10.3±0.3	2.37±0.13	8.59±0.17	3.09±0.22
Um-Naaj-Spring	15.1±0.41	11.3±0.15	210.5±7.5	190±0	2.85±0.31	4.01±0.22	1.61±0.03	0.7±0	7.9±0.05	7.3±0.5	0.81±0.11	3.07±0.21	1.03±0.05
Um-Naaj-Summer	38.5±0.29	22.5±0.22	133±5.13	133±0	1.29±0.15	2.05±0.19	2.03±0.19	0.9±0	7.3±0.2	4.9±0.15	1.55±0.07	6.41±0.25	1.93±0.09
Um-Naaj-Autumn	30.25±0.11	20.03±0.13	161±3.93	161±0	3.9±0.27	5.71±0.08	1.71±0.11	0.8±0	8.1±0.3	2.7±0.21	2.93±0.27	9.51±1.73	4.53±0.08

Canonical Correspondence Analysis (CCA) figure 2 and Pearson's Product Moment Correlation Coefficient (r) table 2 showed the relationships among some environmental variables to each other. Air temperature affects water temperature, positively. Thus, there is positive relationship between total suspended solids and turbidity. In addition, there is positive relationship between electrical conductivity and salinity. On the other hand, turbidity and total suspended solids affect light penetration, negatively. As well as, water temperature affects dissolved oxygen and pH, negatively.

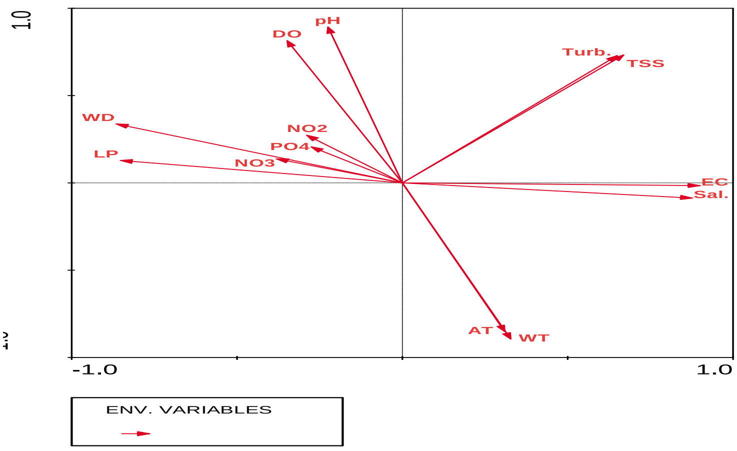

Fig.(2) CCA-ordination diagram shows the effects and the relationships of 13 environmental factors to each other, arrows represent them.

(WD= Water Depth; LP= Light Penetration; DO= Dissolved Oxygen Concentration; pH= Hydrogen Ion Concentration; Turb.= Turbidity; TSS= Total Suspended Solid; EC= Electrical Conductivity; Sal.= Salinity; NO3= Nitrate Concentration; NO2= Nitrite; PO4= Phosphate concentration)

Table (2)The Correlation (r) Values between Environmental Variables to Each Other.

	AT	**WT**	**WD**	**LP**	**EC**	**Sal.**	**pH**	**Turb.**	**TSS**	**DO**	**NO_3**	**NO_2**	**PO_4**
AT	1.0000												
WT	0.9805	1.0000											
WD	-0.6053	-0.5540	1.0000										
LP	-0.2901	-0.4049	0.9601	1.0000									
EC	0.2019	0.1901	-0.6903	-0.7011	1.0000								
Sal.	0.2173	0.3005	-0.7011	-0.6529	0.9992	1.0000							
pH	-0.8000	-0.7950	0.5097	0.3025	-0.3059	-0.3001	1.0000						
Turb.	-0.3909	-0.3919	-0.4001	-0.6802	0.5701	0.4599	0.5205	1.0000					
TSS	-0.3502	-0.4114	-0.3194	-0.6264	0.5118	0.4501	0.5299	0.9899	1.0000				
DO	-0.8819	-0.9217	0.6106	0.4105	-0.3001	-0.3297	0.7095	0.3517	0.4019	1.0000			
NO_3	-0.7525	-0.7522	0.3557	0.3511	-0.4879	-0.4915	0.4713	-0.0785	-0.0301	0.3009	1.0000		
NO_2	-0.7092	-0.6941	0.2951	0.2269	-0.4299	-0.4503	0.5499	0.0709	0.1195	0.3517	0.9801	1.0000	
PO_4	-0.7002	-0.7003	0.2311	0.1489	-0.4602	-0.4401	0.5083	0.0291	0.0802	0.3014	0.9295	0.9612	1.0000

Discussion:

Water temperature follows air temperature clearly; table 1, which were shown by Canonical Correspondence Analysis (CCA) figure 2 and correlation (r), table 2. This phenomenon was confirmed by many researchers in many lakes and water bodies [9; 14; 18].

Water depth is one of the important factors, which has effect on the aquatic ecosystem [19]. This study showed that the water depth was at the highest value in winter and spring seasons that because precipitation in winter and melt of ice in the north regions, then bring big amount of water by Tigris River to this marsh. On the other hand, the water depth was at lesser value at summer that because no precipitation in this season. Also, rise of the sun radiation, so that the evaporation and evapotranspiration should be increased, that led the water level to be lesser at this season, this agrees with many studies [9; 18; 20].

Light penetration is an important parameter because light affects both the biological and chemical reactions in a water-body. Light Penetration in water column is affected by many factors, external factors that include climatic conditions, and internal factors, including quantity and quality of suspended and dissolved materials, water flow and tidal situation. The results of the present study showed that the light penetration was at the highest value in spring season, while the lowest value was in summer. See table one, that may be because the spring season has blooming , increasing the cover, distribution and diversity of aquatic macrophytes, so that the vegetation cover acts as traps to hold the suspended materials and filter the water, so that the water should be clear, this agrees with [5; 9; 21].

Total suspended solids and turbidity values were with the highest value at winter. See table one that may be because rainfall and increasing the amount of water, which reached the marsh and that causes erosion for edges of the rivers and marsh. In addition, the vegetation cover was at the lowest growth in winter, so that the total suspended solids should be increased, that lead to increase the turbidity value. The positive relationship between turbidity and TSS was shown by Canonical Correspondence Analysis (CCA) figure 2 and correlation (r), see table 2. This agrees with many studies [5; 14; 18].

Water salinity is one of the important chemical properties for water, which affect the organisms in the aquatic ecosystem. Salinity value depends on total dissolved ions, by table one there are no clear seasonal changes in the salinity and electrical conductivity, but there is little increasing in summer season that was caused by decreasing of the water levels and increasing of the evaporation ratio, so that the dissolved ions should be more concentrated, that leads to increase the electrical conductivity and salinity, this positive relationship between electrical conductivity and salinity was shown by Canonical Correspondence Analysis (CCA) figure 2 and correlation (r), see table 2. This result agrees with many studies [9; 20; 22].

The results of the present study show no clear differences in pH values (alkaline level) See table one, but it has being known such as all Iraqi waters mainly tend to be alkaline that due to the ability of water to be as buffer solution to regulate pH values [18], this agrees with many studies [5; 6; 9; 23]. Canonical Correspondence Analysis (CCA) figure 2 and correlation (r) in the table 2 showed negative relationship between pH value and temperature, when the high pH values are during winter, while the low values are at summer that related to phytoplankton productivity [20; 22]. While, the low pH values were in summer during the study period that may be because degradation of the aquatic plants, phytoplankton and organic materials, also production of dissolved carbon dioxide [6; 18; 9], While the high pH values were at winter, this agrees with many studies [6; 20; 21] that was because declining of carbon dioxide concentration and increasing the alkaline ions [24].

The results of the present study show that the highest dissolved oxygen concentrations are at during winter, but the lowest values are during summer and autumn. In addition, Canonical Correspondence Analysis (CCA) figure 2 and correlation (r) in the table 2 showed negative relationship between dissolved oxygen concentration and temperature. In addition, there are clear seasonal changes in dissolved oxygen concentration, see table one. At winter season, there is no more vegetation cover on the water surface and increasing the wind velocity that increases gas exchange between the atmosphere and surface water, thus there is more amount from water because rainfall and increasing the water flow all of these reasons lead to increase the dissolved oxygen concentration in water. At spring, there was beginning for blooming of many species of aquatic plants and increasing the growth of vegetation cover that leads to increase the photosynthesis process, so that the levels of dissolved oxygen concentration in water should be increased [9; 14].

While, during summer, the dissolved oxygen concentration is in the lowest values that may be because gas exchange between the atmosphere and surface water is controlled primarily by the boundary layer thickness [25]. The increasing of temperature leads to decline the dissolved oxygen concentration in water that may be the decomposed organisms use the dissolved oxygen to degradation of the organic matter by self-purification [26]. In addition, the salinity values were high at summer that should be led for decreasing the solubility of oxygen gas in water [6; 9].

The increasing in concentrations of nitrite, nitrate and phosphorus were during winter that may be due to erosion of some amounts from these concentrations by rainfall water from the edges of the rivers and the marshes, also in this season the uptake of these nutrients by the aquatic plants and phytoplankton is little because their growth at winter are stagnant [9; 20; 23]. While the increasing of these nutrients during autumn that may be because the amounts of the nutrients, which are taken by the aquatic plants and phytoplankton, do not affect their concentrations clearly. Thus, the released amounts of nutrients from the bottom sediments to water and degradation of aquatic plants, phytoplankton and others organic matter. In addition, the decreasing of water levels led these nutrients in water to be more concentrated during this period, these results agree with many studies [6; 9; 22].

While the low nutrients concentration was during spring and summer. This decreasing may be returned for increasing the diversity, distribution, and growth of aquatic plants, in addition phytoplankton, so that the most amounts from nutrients should be up taken by these organisms [9; 20; 23].

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دراسة بيئية لبعض خصائص مياه هور أم النعاج, جنوب العراق.

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الخلاصة:

أختيرت منطقة أم النعاج في هور الحويزة, جنوب العراق لدراسة التغيرات البيئية لبعض مواصفات المياه بصورة موسمية ولتوضيح التأثيرات المتداخلة فيم بينها, خلال سنة 2008. هذه الدراسة لاحظت تغيرات موسمية في قيم بعض المتغيرات البيئية (درجة حرارة الماء, عمق الماء, نفاذ الضوء، عكورة الماء, العوالق الصلبة الكلية, الأس الهيدروجيني للماء, الأوكسجين المذاب, الفوسفيت الفعال, النتريت الفعال والنترات الفعال). بينما لا توجد تغيرات موسمية واضحة في قيمة التوصيل الكهربائي والملوحة. أضافة الى ان قيم تراكيز المغذيات وعمق الماء ونفاذ الضوء في هذا الهور كانت عالية. النظام الأحصائي الكونوكي (CCA) وقيمة معامل الأرتباط (r) طبقا لتحليل البيانات. هذه التحاليل الأحصائية بينت بأن هناك علاقة معنوية موجبة بين درجة حرارة الهواء ودرجة حرارة الماء وكذلك بين التوصيل الكهربائي والملوحة بالأضافة الى ان عكورة الماء تتأثر معنويا وبصورة أيجابية بالمواد العالقة الصلبة. من جانب اخر هناك تأثيرات عكسية معنوية بين درجة حرارة الماء والأس الهيدروجيني للماء وأيضا مع تركيز الأوكسجين المذاب, وكذلك المواد العالقة الصلبة وعكورة الماء يؤثران سلبيا وبصورة معنوية على نفاذ الضوء.