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European Journal of Experimental Biology, 2014, 4(5):67-71



Determination of water quality by using WQI index and GIs in Horalazim Wetland, Iran

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ABSTRACT

Increasing water scarcity in many countries provides a strong impetus for investments in water quality remediation at the basin or sub-basin scale as a means to increase water availability. Horalazim is one of the international wetland in south west of Iran that has confines area between Iran and Iraq. to investigate polluting organic factors in Horalazim lagoon, environmental factors, dissolved oxygen, pH, salinity, temperature, the total percentage of organic substances, graining of sedimentation and quality indexes of water , BOD₅, COD, Nitrate, Phosphate, TDS, TSS by sampling over 4 seasons from fall 2011 to 2012 and measuring in 10 stations. The results showed that the quality of wetland water are in third and forth degree in WQI index and this means the Horalazim wetland is not in good condition and some pollution and human activities such as agriculture, domestic waste water discharge and oil and gas extraction effected this area.

Key words: Horalazim wetland, organic materials, WQI index.

INTRODUCTION

Unlike the degree of peoples' awareness and that of countries about the importance of natural areas specially the wetlands, there is still not much true understanding of these environmental habitats [1] The wetlands can be considered as stunt of creation. The wetlands can have a determining factor in socio-economical strategies as rich and fertile ecosystems. The wetlands are of high importance and any damage to them has a direct influence on the economy of society, recreational centers and even climatic factors [2]. The Hooralazim wetland with a varsity of over 450 hectares is of high hydrological, biological and ecological importance in the life of the area, the three forth of which is located in Iraq and the remaining one forth in Iran (about 100 hectares).The wetland reaches Hooralsanaf in Iraq from the north and the plains and low altitude deserts of Dejléh from the southern side. There are tall everglades the most variety of which is straw, Luee, Jegan, water lily, tamarisk shrub and Padeh. Many people in the area go fishing and hunting in the wetland. Hooralazim is a permanent wetland with sweet to salty water. The water comes from the Karkhah River, sub branches of Dejléh and Ferat and surface flowing waters. The wetland considerably controls the seasonal flood against cities like Susangerd, Hoveizeh, Bostan and Hamidieh. The most problematic issue in the desert is the development of salty lands. The increase of salt in water following the salt washing process required for irrigation and also the biological effects should be brought to notice.

The results from the previous studies show the pollution in Horalazim. Some pollution is from the imposed war and the Iraqi refugees and some from the agricultural slops. As this lagoon is highly important, much care needs to be exercised for its maintenance. The concerned project aims to identify the organic pollutants and helps the management of the area to control the resources. The purpose to study meteorology and climate is to recognize the climatic factors regarding the Hooralazim wetland.

MATERIALS AND METHODS

First, boundary for the study was set because of its importance. Then 10 sampling stations were selected based on the following criteria (Table, 1).

Table 1: Sampling stations in Hooralazim wetland.

Station	coordinate	Sampling site
1	38782545E 3513816N	Bostan River (Hoofel) after the bridge Bostan
2	38782869E 3513869N	Bostan River, Bridge Bostan. Hydrometer site of water organization
3	39217051E 3506566N	sableh- Bridge sableh River, Hydrometer site of water organization
4	39216608E 3494015N	Nisan River, near the bridge Nisan, village BeitKuar, on the corner of Rafi'. Hoveizeh
5	38772041E 3501038N	By the floating bridge, next to army battalion760- beginning of road Hoor
6	38764957E 3501769 N	Hooralazim- end of the road reaching the army naval base
7	38765133E 3501877N	Lake Hoor
8	38765330E 3502031N	Lake Hoor
9	38765418E 3502282N	Lake Hoor
10	38765071E 3502119N	Lake Hoor

The sampling was done seasonally for a period of year. During the project a number of 760 samples were totally transferred to the lab and put to different tests. In each sampling point in different depth, the water was sampled in a specific container. Also in each point, for the analysis of sedimentation graining, the sampling was done from the bottom and the bed using Van vien model. For the samples, first the sampling container was washed once using the water from the lagoon then it was fastened with a lead and immersed in water and after that the lead was opened in water till the container becomes full and again closed under water.

Environmental parameters like pH, conductivity, dissolved oxygen; temperature and salinity at the sampling site were measured in water using the direct electrode Huriba u 10. But COD, BOD, nitrate and phosphate were put to measurement in the lab using Moopam, 1999 method.

The standard method by [3] was used for the analysis of sedimentation graining. We calculated the weight and percentage of each of the sedimentary grains in all the sediments.

The percentage of graining = $M \cdot 100 / 25$

M= the weight for the remaining sediment in sieve.

To find out the total percentage of the sediments organic materials in each point, we used the standard method by [4]. The base of this method is on the basis of sediments burning. Then using the following formula, the percentage of the organic materials in each point was calculated.

0/0 TOM= $A - B / A - C \cdot 100$

A= weight of Kruze and dry sediment for 8 hours with 70 degrees of centigrade

B= weight of Kruze and burned sediment for 8 hours with 550 degrees of centigrade

C= weight of empty Kruze

Data analysis and statistical calculation

In this study, we used Excel for all needed calculations and the drawings and we used windows based SPSS for the statistical analysis on the obtained results. For the calculation of water quality index, special curves are used. The following formula is used for calculating water quality index [5].

$\sum WQI = \sum WiQi$

WQI= water quality index which varies from 0 to 100

Wi= Weight or the degree of factor priority from 0 to 1

Qi= parameter quality from 0 to 100

RESULTS

One way ANOVAs conclusions are shown in tables 2 to 5. In the columns of the table, you will find the different parameters and in the cells the mean \pm and standard deviation of the means for the different seasons indicating the mean changes process for the parameter in different seasons of the year.

Table 2 – Mean comparison for parameters DO, BOD and COD (Mean \pm SD) in different seasons

Seasonal Parameter	DO	BOD	COD
Fall 2004	9.02 \pm 0.26	2.93 \pm 0.36	20.2 \pm 1.58
Winter 2004	10.03 \pm 0.3	4.19 \pm 0.26	18.8 \pm 0.95
Spring 2005	6.4 \pm 0.33	2.38 \pm 0.76	1.7 \pm 2.38
Summer 2005	4.7 \pm 0.15	1.59 \pm 0.07	24.6 \pm 0.73

Table 3- Mean comparison for parameters EC, TDS and temperature (Mean \pm SD) in different seasons

Seasonal Parameter	EC	TDS	Temperature
Fall 2004	1531 \pm 22.1	990 \pm 15.29	13.3 \pm 0.26
Winter 2004	1742.5 \pm 20.55	1115.4 \pm 13.21	17.5 \pm 0.22
Spring 2005	1215 \pm 4.6	79.8 \pm 3.42	27.2 \pm 0.25
Summer 2005	1455.4 \pm 35.9	839.2 \pm 42.3	27.6 \pm 0.8

Table 4 – Mean comparison for parameters NO₃, PO₄ and salinity (Mean \pm SD) in different seasons

Seasonal Parameter	NO ₃	PO ₄	Salinity
Fall 2004	4.84 \pm 0.2	.0012 \pm 0.0126 0	0.072 \pm 0.001
Winter 2004	8.21 \pm 0.38	.0008 \pm .0141	0.82 \pm 0.002
Spring 2005	8.99 \pm 0.37	.0004 \pm .0087	0.615 \pm 0.0007
Summer 2005	7.5 \pm 0.71	.0113 \pm .0882	0.8 \pm 0.003

Table 5- Mean comparison for parameters NH₃ and PH, (Mean \pm SD) opaqueness in different seasons

Seasonal parameter	NH ₃	pH	Dirtyness
Fall 2004	0.75 \pm 0.03	825 \pm 0.03	20.8 \pm 1.26
Winter 2004	1.09 \pm 0.38	8.22 \pm 0.13	24.6 \pm 0.67
Spring 2005	0.99 \pm 0.05	8.26 \pm 0.12	34 \pm 1.6
Summer 2005	1.02 \pm 0.07	0.26 \pm 0.13	24.4 \pm 1.63

Table 6 – Classification of water quality index in different sampling points

Station	Fall	Winter	Spring	Summer	Yearly Index
1	53.8	61.99	45.98	51.98	641.25
2	50.93	60.77	48.35	41.72	605.31
3	53.47	62.8	45.52	42.35	612.42
4	54.56	53	43.67	53.35	613.74
5	53.44	51.46	43.65	51.22	599.31
6	55.43	63.33	40.22	51.79	632.31
7	55.53	63.31	40.68	45.28	614.14
8	56.26	61.76	52.58	53.91	673.53
9	53.33	63.88	56.72	53.2	681.39
10	53.77	62.38	54.11	53.51	671.31

Table 7- Sediment graining analysis in different seasons. (GSA)

(<.0.63) GS ₃		(0.063 -0.125)GS ₂		(>0.125) GS ₁		Season of year
Min	Max	Min	Max	Min	Max	
17.72	44.44	25.16	57.56	17.12	46.2	Fall 2004
6.12	47.54	24.04	48.96	17.69	44.92	Winter 2004
17.6	48.84	24.92	46.88	19.68	46.4	Spring 2005
29.2	44.64	27.96	43.36	18.48	38.48	Summer 2005

The studies of sediments graining at sampling points show that the main combination of sediments is of Cilty- Clay particles. In order to show the changes of graining, we put the dominant sedimentary particles in three sized spans.

The tinier particles range from 0.063 millimeter (GS3), particles 125, 0-0.063 millimeter (GS2) and the bigger particles range from 125, 0 millimeter (GS1). The results of the maximum and minimum sediments grainings in different sampling seasons of the year are shown in table 3.

DISCUSSION

The process of BOD₅ changes at different sampling stations show that the degree of BOD in selected stations in Lake Hoor (6, 7, 8, 9, 10) is more than the degree of BOD in sampling points of the input branches of the lagoon (Hoofel, sabileh, nisan). Generally, the sixth point in Lake Hoor has the highest degree of BOD 3.3 milligram per liter and the least mean degree of BOD is 3.02 out of 2.49 milligram per liter in station 3. The highest degree of BOD in winter was observable and measured with the highest degree in most stations and the least degree was obtained in summer. Then in fall time the degree goes up and it is even more in spring than that of summer. The mean of COD over four sampling seasons show that the degree is higher than that of the world health standard. The highest mean of COD during the whole sampling period with 24.5 milligram per liter is for the station 6 and the least mean with 17.75 milligram per liter is for the first station. The statistical analysis shows that there is not any significant difference among the different stations ($P < 0.05$). Also in terms of season, summer has the highest degree of COD with 24.6 milligram per liter. The least degree with 18.7 milligram per liter was observed in spring time. According to the statistical analysis, there is a significant difference among the degree of means for COD in summer and fall, summer and spring, summer and winter but no difference is observed between the mean of this parameter and other seasons ($P > 0.05$). The mean of the Nitrate degree from the selected stations over the four sampling seasons shows that the degree of this parameter is 4.84 in fall and 8.21 in winter 8.99 in spring and 7.5 milligram per liter in summer. Also the highest mean of NO₃ is for the first point with 8.87 milligram per liter and the least is 5.77 milligram per liter for the ninth point. The degree of Nitrate for the stations 1, 2,3,4,5 is more than the degree in stations 6, 7, 8,9,10.

The investigation shows that there is a significant difference in the mean of NO₃ in different seasons but no significant difference among the different stations. The mean of phosphate degree over the four sampling seasons from the selected stations shows that the degree of this parameter is lower than standard in all the sampled stations. The highest mean of PO₄ with 0.051 milligram per liter is for station 5 and the least mean of PO₄ with 0.024 milligram per liter is for station 6. Based on the statistical data, there is not any significant difference among the mean of phosphate parameter in the 10 stations ($P > 0.05$). Also the seasonal comparison of the results shows that the highest degree of phosphate was observed in summer, less in spring and the least in fall time. Results show that the presence of Silty and Clay particles was of the highest percentage in all the stations. So the maximum amount of sediment with grains less than 0.063 millimeter was registered %6, 12 in winter in the third point.

So according to the results, there have been lots of changes in the total amount of the organic materials over the different seasons. A way that the highest percentage of organic materials in sediments was observed in summer in station 8 (%42) and the least percentage was in fall time in station 5 (%2, 71). The analysis of the results shows that in all seasons, the station 8 had the highest percentage of the organic materials in sediments and the least one was for station 5 except for the summer. The results of water quality index show that the lagoon ranks the third and fourth according to the system of water quality index and it has no good quality in terms of pollution. The highest quality goes for station 9 in Lake Hoor and the least goes for the fifth stations in span between the wetland and its input branches. Also the physicochemical factor results and the index of water quality show that in winter because of much rain and the increase of water inputs, water of wetland has the highest quality and in warm dry seasons like spring and summer because of less rain and the decrease of water inputs, the water has the least quality. The highest amount of organic materials in sediments of the bed goes for station 8 in all seasons. In summer, because of less water flow and as a result of low water inputs, auto filtration comes down and causes the organic materials to go up. However, in fall and winter, because of good conditions for the producers of raw materials and consumption of nutrients, the filtration goes up and the organic materials come down [6]. The study of the lagoon bed shows the domination of Clay and Silty particles in the lagoon. The general results obtained from the study show that there is pollution in all selected sampled stations and the degree of pollution is different in different parts of the wetland. The main cause of wetland pollution is from the agricultural slopes created as a result of agricultural activities in the margin of the wetland and later we can add humane wastes in terms of importance.

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