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DOES IRAQI MARSHESACTAS NATURAL FILTER TO TIGRIS AND EUPHRATES RIVERS?

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ABSTRACT

To find out the role of Huawiza and Hammarmarshesas natural filter to the Tigris and Euphratesrivers. Khala & Haffarstations were selected to monitor the inlet water from Tigris and Euphrates respectively and Suwab and Nagarastations at the outlet water from the Huwaiza and Hammar marshes respectively. The water of the outlet stations became clearer, characterized by lower values of BOD, Nitrate, Reactive phosphate, total nitrogen, Ammonium, Bicarbonate and bit higher in dissolved oxygen. The out let waters were higher in concentration of TDS, Conductivity, Salinity, pH, Sodium, and Sulphate. Flow rate in marshes were higher in the open water than near the vegetation. Four water types were emerged, represented the inlet and outlet waters of Tigris and Euphrates rivers Huwaiza and Hammar marshes. These four types become closer in characters of water parameters during winter &spring and widely separated in summer & autumn. Conductivity, TDS, SO_4 and Sodium play a major role in deciding the four types of waters recognized beside the dissolved oxygen and water temperature.

INTRODUCTION

Marshes play several environmental roles. As water moves slowly through the marshes, sediments and other pollutants settle down to the bottom substrate. Marsh vegetation and microorganisms also use excess nutrients for growth that can otherwise pollute surface water such as nitrogen and phosphorus from farms fertilizer. Marshes are very important to preserving the quality of surface waters. In fact, marshes are so good at cleaning polluted waters that many countries now building replicas of this wetland type to treat wastewater from farms, towns and sewage plants. Recharge groundwater supplies and moderate stream and river flow by providing water supply to them. This is especially important functions during periods of drought at arid and semiarid regions. Wetlands were described as kidney or natural filter to adjacent rivers and trapped sediments and pollutants from riverine water received (Bush,2000,Mitsct and Gooselink, 2000,van der Valk, 2006 and Grundell*et al*, 2012), consequently many wetlands were flourish again and other were revolved to its previous status.

The marshes of southern Iraq were the largest wetlands in the Levant and South Western Asia, covered more than 15,000 km^2 representing about 44% of inland water bodies of Iraq .These marshes considered as natural refugee for many aquatic organisms, especially fish and aquatic birds. A unique ecosystem formed because of environmental, hydrological and physiographical setting, allows for high biodiversity and richness of aquatic biota.

Few articles were published concerned with the role of southern marshes as filter to Tigris and Euphrates waters. Jassim (2008) and Mohamed (2008) noted the efficiency of macrophytes absorbing and accumulation of some cations from the waters of southern marshes. Mauloodet *et al.*, (1979), Al-Zubaidi (1985), Al-Lami (1986) and Al-Aarjy (1988) proved the removal of nitrate and phosphate from marsh waters by phytoplankton and filamentous algae.

Al-Ghadban*et al*.(1999) and Al-Yammani*et al*.(2006) documented the increase of turbidity and nutrients in Kuwaiti marine water as negative result of southern marshes desiccation during the nineties. In general Iraqi marshes desiccations lead to deterioration of the marine environment and fisheries of North West Arabian Gulf (Maltby,1994). The aim of the present article to highlight the role of the restored southern marshes as filter to the materials and pollutants brought within the waters of Tigris and Euphrates rivers.

Materials and Methods

The waters of the southern marshes are a resultant of the mixing of Tigris, Euphrates and Shatt Al-Arab rivers. Huwayza marsh received its water from Tigris mainly. West Hammarmarsh gets its water from Euphrates and east Hammar from Shatt Al-Arab river and tributaries of Euphratesriver (Fig. 1).

Stations:

Four stations were selected to monitor the function of marshes as a filter, two to represent the inlet water at Tigris and Euphrates rivers and two at the outlet water from Huwaiza and Hammar marshesas in table (1).

Table 1: Locations of sampling stations (GPS) at inlet of Tigris and Euphrates rivers and outlet from the Huwaiza and east Hammar marshes.

River	Station	Marsh	GPS	Color of water &Current
Tigris	Kahla	N.Huwaiza	N 31 40 01, E 47 17 52	Turbid, medium current
Tigris	Suwaib	S.Huwaiza	N30 58 06 ,E 47 29 46	Clear, slow current
Euphrates	Haffer	W.Hammar	N 30 53 49, E 46 28 02	Turbid, Low current
Euphrates	Nagara	E.Hammar	N 30 40 77 ,E 47 37 76	Clear tidal current

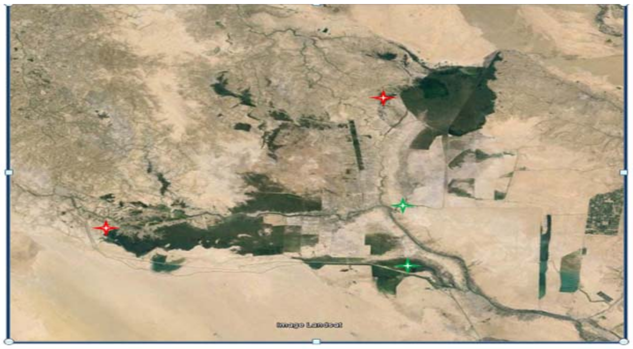


Fig (1):The southern Iraqi marshes, showing inlet and outlet stations marked by stars red and green respectively.

Field measurements and Analysis:

Sampling was doneat open water and near the vegetation of the marshes to assess their physical and chemical qualities at seasonal intervals, with five replicates were collected in thoroughly cleaned 2.5 Liter inert plastic. Few drops of alcohol were added to preserve the samples.

Air and water temperature, conductivity, salinity, pH, total dissolved solid (TDS) and dissolved oxygen (DO) determined with instrument of (YASI 556MPS). Flow rate determined by flow instrument .Transparency were determined using Secchidisc (Lind, 1979). BOD (Biological oxygen demand) determinate after 5 days with YASI 556MPS instrument. Nutrients (phosphate and nitrate) were determinate as in Parsons *et al*., (1984). Determination of Na, SO4-S,NH4-N and Total N as in standard methods (1975).

Results:

1. Air and water temperature:

Seasonal changes in, air and water, temperature showed that the minimum values were recorded in winter, where the maximum in the summer with gradual decline toward the fall for all stations in restored marshes. Spring and autumn values were comparable.

2. Salinity& conductivity (E.C):

Outlet stations (Nagara and suwaib)showed higher values in salinity & conductivity both than the inlet stations (Haffer and Kahla).Seasonal changes in conductivity and salinity showed the same trends for four monitored stations, the highest values were recorded in Summer, due to increase of evaporation rate, and the lowest were in winter.

3. Light transparency:

Seasonal changes in Transparency for the four monitored stations showed two modes the highest for Haffar and the lowest for the rest of the stations. Higher values could be as results of rain season and river current (winter and spring).

4. Total dissolved solids (TDS):

Seasonal changes in total dissolved solid showed two modes, the first mode represented by Haffar station showed higher values during monitored seasons, and the second mode represented other stations represented.

5. Dissolved Oxygen (DO)

Higher values of dissolved oxygen were recorded at outlet stations in comparison with inlet stations .High dissolved oxygen concentrations were in winter and autumn seasons and the lowest values during summer and spring seasons in relation with increase in water temperature and respiration of organsims.

6. Biological oxygen demand (BOD):

The highest values were recorded during the warm season(summer and spring) and the lowest during the colder season(winter and autumn) for all monitored stations, reflecting biological activity.

7. Nitrate (NO3):

Higher nitrate values were recorded from inlet stations and lower ones at outlets stations. Seasonal changes of showed one mode for all monitored stations, the lowest values were recorded during spring and to some extent in autumn because of hytoplanktonblooms.

8. Reactive phosphate (PO4):

Higher values were recorded from inlet (source) stations and lower ones at outlets stations .Seasonal changes of reactive phosphate showed that lower values in spring and autumn due to phytoplankton blooms in these two seasons and the higher in winter. In general the trend was the same as for the nitrate values in the monitored marshes.

9. Total nitrogen (TN):

Higher values were recorded at the inlets stations and a lower ones at the outlet stations. Nagara station had the maximum values could be affected by farms nearby and along Euphrates river.

10. Ammonium (NH_4):

The highest ammonium values were during spring and summer and the lowest during autumn and winter. Reflecting the decomposition process was high in warm seasons and lower in cold ones. Seasonal changes showed one mode for all monitored stations.

11. pH:

Outlet stations had a higher values than the inlet ones, could be as a result of increase salinity. In general the values were at the alkaline side for the outlet stations.

12. Total alkalinity (HCO_3):

Inlet stations had lower values in comparison to outlet ones. The highest values were in winter and lower ones in spring.

13. Sulphate (SO_4):

Monitored stations showed the same trends. The highest values were recorded at outlet stations during spring and the lowest during summer season could be associated with spring flood.

14. Sodium (Na):

All monitored stations showed lower values during autumn season and higher ones in summer, Nagara station recorded the highest values during summer could be due to stagnation and evaporation.

15. Mean of flow rate (cm/sec.):

The flow rate in Huwiaza marsh was different, low near the aquatic plants 0.2 – 0.5 cm /sec. and higher in the open water 1.9-2.5 cm/sec. The same was recorded in west Hammar marsh from 0.3 – 0.6 cm/sec. near aquatic plants and higher in the open water 2.5 -4.0 cm/sec. In general the flow rate was higher in east Hammar marsh due to strong tidal effect.

Discussion:

Four major factors play a decisive role in determine the water quality of the southern marshes, first increase rate of evaporation ,slow current or water stagnation , percentage of aquatic macrophytes cover or density and the amount of pollutants /sewage carried by Tigris and Euphrates waters (Al-Saboochi*et al*.,2011, DouAble *et al*.,2011 and Hussain*et al*.,2011).

Richardson *et al.,* (2005),Richardson and Hussain (2006) demonstrated that the water salinity of southern marshes were higher than that of Tigris and Euphrates rivers before desiccation and even after inundation in 2003.The same was concluded by the present work. The increased values of salinity and conductivity at the outlet stations could be due to high evaporation rate >2m/yr, (Yaqub and Salman1992), beside the water of Euphrates at Haffer station was more saline than that of Tigris at Kahla station. Richardson and Hussain (2006) pointed out that the high evaporating rates have resulted in extremely high ions concentration, pH and TDS.

Long resident time and stagnation allow the muddy substratum of the marshes to leach salts to the above water layers including Sodium, Potassium, Calcium, and Bicarbonate as experienced at the outlet water from the marshes, the same was pointed out by Richardson and Hussain (2006). Hassan (2007) showed the importance of muddy sediments at Shatt al Arab River to captures and release of few heavy metals. Hanaf (2009) illustrated the ability of three species of macrophytes (*Phragmites australis, Ceratophyllumdemersium* and *Potamegatomspiralis*) in Shatt Al-Arab river to absorb and accumulated Lead and copper, these three species were the most dominant aquatic plants in the marshes. The same role of macrophyte (*Typhalatifolia*, *Certophyllumdemersum* and *Potamageton*spp.*)* was found by Gessner*et al*.(2005)It was well known that the riverine waters and southern marshes of Iraq characterized by their hardness and alkalinity i.e. richness in CO_3, $HCO_3$and SO_4(Al-saad, *et al*.,2010 &Hussain,2014).

The reduction of Nitrate and Phosphate concentrations in the water outlet station indicated that these nutrients were used by aquatic plants, filamentous algae and phytoplankton for growth. Seasonal changes of N- NO_3 concentration ,the lowest values were recorded during spring and autumn because of phytoplankton blooms, the same was recorded after inundation in 2003 by Hammadi*et al*. (2007)and before massive desiccation by Al-Zubaidi (1985), Al-Lami (1986); Al-Aarjy(1988).

There was a clear inverse relationship existed between dissolved oxygen (DO)and biological oxygen demand(BOD)expressing that the marsh environment tend to reduce pollution and produce balanced one ,also inverse relationship was recognized between dissolved oxygen and NH4 ,could led that an inverse relation between primary production seasons and decomposition season (Summer) ,noting the increase of decomposition of detritus during summer; autumn and due to the activity of microorganism (Al-Dosari,2008 and Al-Nashi,1990).

The increase in pH value at the outlet water reflects the increase in salinity and respiration of dense aquatic plants canopy. Hussain and Grab (2009) indicated that the pH values of marshes ranged between 7-8, which again reflected the increase of CO_2 in marsh water due to respiration of dense aquatic plants canopy especially during summer and autumn

The reduction of water flow near the dense aquatic plants in comparison to open marsh water, allow the suspended particles to settle down leading to increase of transparency of the water at outlet station supporting the idea that marshes play a major role as sedimentation bed for the suspended particles brought by Tigris and Euphrates. Malt by (1994),Al-Ghadban*et al*.(1999) and Par tow (2001) postulated that the southern marshes served as a natural filter for sediments and pollutants of Tigris and Euphrates rivers through sedimentations process ,protecting other downstream rivers environments.

By applying Principal Coordinates Analysis (PCoA, = Multidimensional scaling, MDS) to determine the similarity and dissimilarity between the data matrix obtained from the inlet and outlet stations, four types of waters were emerged identified by their salinity , dissolved oxygen concentration, water temperature and pH. These four waters types became more similar during spring and summer and widely separated in winter. The most different were between Khala inlet station (Tigrisriver) and out let station Nagara (East Hammar marsh),the other two stations two Haffer and Suwab were in between.

Data obtained by application of canoncial correspondence analysis (CCA) revel that the four stations were differently affected by environmental parameters, Haffer and Suweb stations showed strong relation with dissolved oxygen in winter and decrease in autumn ,we conclude that dissolved oxygen play a major role in deciding the type and quality of water at different stations. Nagara and Khala stations had two different water qualities during winter. Khala water in winter had positive correlation with alkalinity and pH while Nagara in winter got positive relation with nitrate & phosphate, therefore the high concentration of nutrients was the reason make Nagara water different from the other three stations during all four seasons. Overall picture indicated conductivity and TDS coming in first rank followed bysulphate, salinity and sodium.

Untreated domestic swage discharge tends to increase the BOD and reduced the dissolved oxygen, in southern marshes as indicated by (Imarah*et al*., 2006a &Imarah *et al*.(2007). Inverse situation was noticed were the outlet water were a bit higher in DO and low in BOD.

Awad *et al*.(2008)found the concentrations of Cd, Pb, Cu, Mn and Fe were higher in the sediments in comparison with aquatic plants species common in marshes *Certophyllum demersium*. Al-Yaseri (2011) indicated the same in Nagara at outlet station of east Hammar.

Lindsay (1797) postulated that increase in pH reduced the dissolvability of Cd,Pb, Cu, Mn and Fe by hundred time. Bush (2000) said that the concentration of Pb and Fereduced with increase salinity and highlighted the role of electrical charge and size of mud particles in attracting the cations and bond them in unviable complex in marshes. Al-Haidaery &Hassan (2010)by applying Geochemical index showed the ability of Hawaiza sediments to accumulated of heavy metals boosting its role in reducing heavy metals pollution .Al-Khateb (2008) showed that n-alkanse compounds were higher in sediments than in water in Hawaiza marsh. The same was concluded for total aliphatic hydrocarbons by Talal *et al*. (2010) in east Hammar and chibiesh marshes. Ji *et al*.(2004) indicated the importance of aquatic plants especially reeds in removal of crude oil.

Differences in filtrationability was found between Huwaiza and Hammar marshes(Figs 4&5). Hammar seem to utilized more nitrogen compounds than Huwaiza, seemed as result of dense macrophytes cover existed as exhibited by Al-Abbawy and Al-Mayah(2010).

We concluded that the southern marshes do play an important environmental role through their functions as major producers of dissolved oxygen, settle down the suspended particles of Tigris and Euphrates rivers, adsorbing several cations and reducing the amount of loaded nutrients, lowering BOD and returning back more oxygenated water to the rivers.

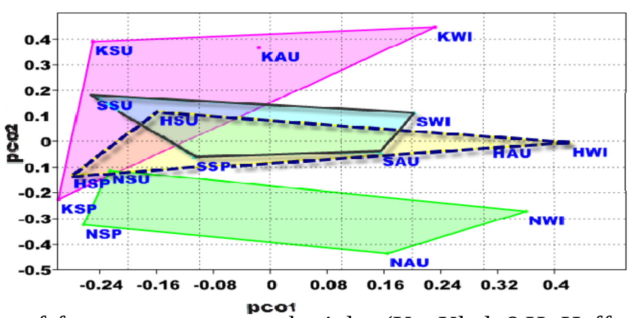


Figure (2) The formation of four water types at the inlet (K= Khala&H=Haffar) and outlet stations (S=Sweb N=Nagara during summer =su, Au= Autumn Wi=Winter and Sp=Spring . by using principle coordinates (PCo).

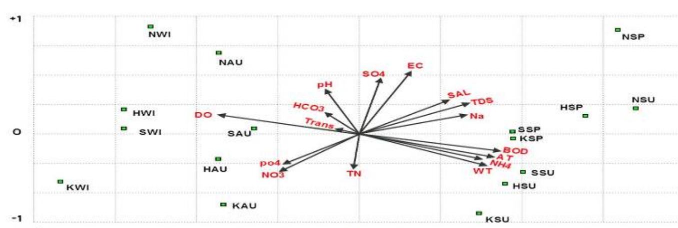
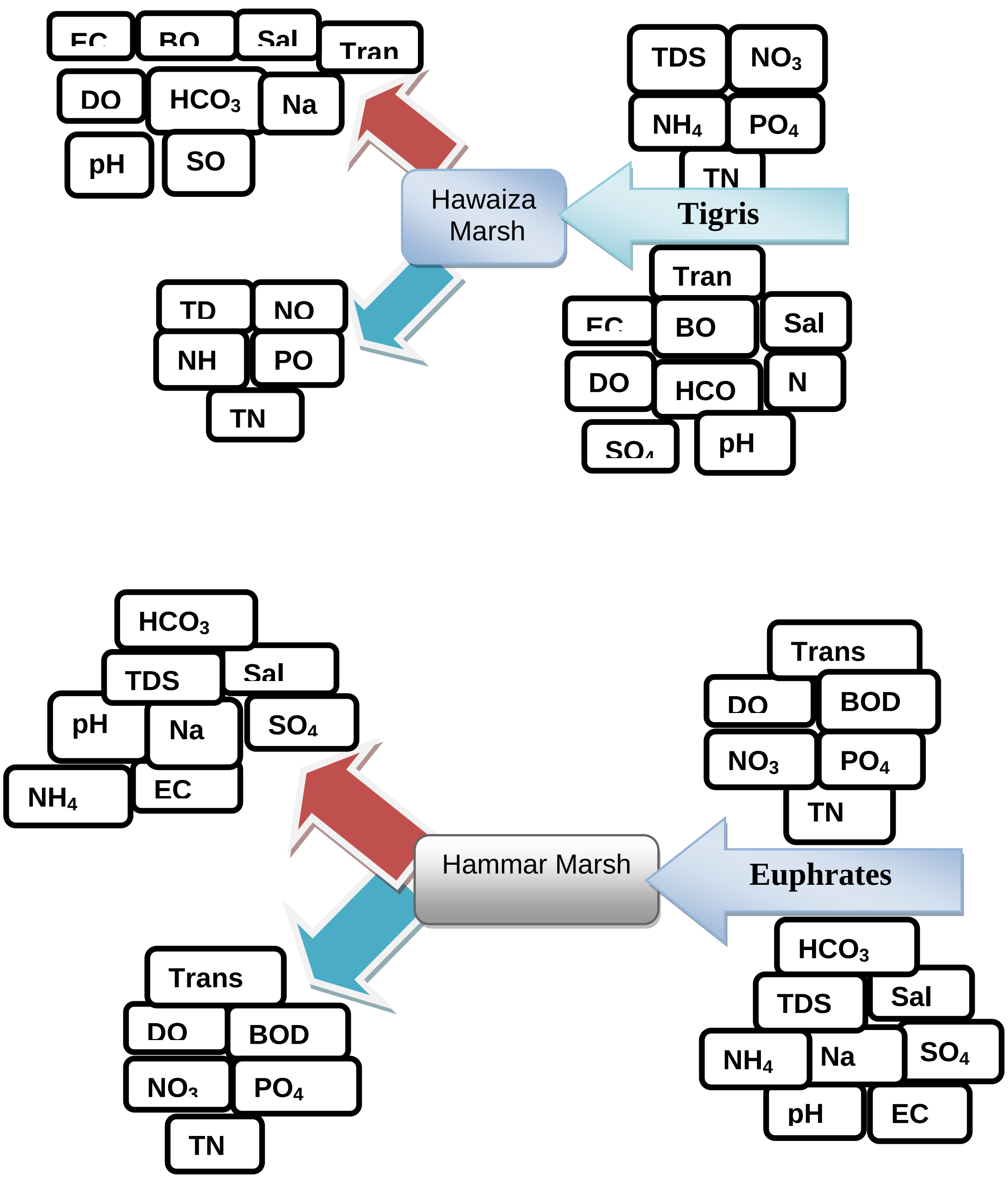


Fig.(3): Application of canonical correspondence analysis (CCA), illustrated the influence of measured water parameters (AT=Air Temperature, WT=Water Temperature, Sal=Salinity, EC=Electrical Conductivity, Na=Sodium, BOD=Biological oxygen demand, NH_4=Ammonium, TN=Total Nitrogen, NO_3=Nitrate, PO_4=Phosphate, DO=Dissolved Oxygen, Trans=Transparence, HCO_3=Bicarbonate, pH=Hydrogen potential.SO_4=Sulphate inlet stations Khala & Haffar and outlet stations Sweb & Nagara in Summer =su, Au= Autumn, Wi=Winter and Sp=Spring.



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