

## The Role of Emergent Aquatic Macrophytes in Changing Water Quality at Al-Shafi Marsh, Southern Iraq

دور النباتات المائية البارزة في تغيير نوعية المياه في هور الشافي جنوب العراق

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### Abstract:

This study was done at Al-Shafi marsh, southern Iraq, to determine the role of emergent aquatic macrophytes in changing the water quality. Three dominant emergent aquatic macrophytes were identified in the marsh and the vegetation cover percentages for them were measured, which were *Phragmites australis* covers 40%, *Typha domingensis* covers 30%, and *Schoinoplectus littoralis* covers 15%, while the other 15% was open water. The water environmental variables [pre the marsh, in the marsh (distributed emergent macrophytes), and post the marsh] were measured. The statistical program t-test was applied at the significant levels ( $P$ -value  $< 0.01$ ) and ( $P$ -value  $< 0.05$ ) to know the significant differences in the environmental variables among the sites. This study showed that light penetration, total suspended solids, water turbidity, nitrate, nitrite, and phosphate concentrations differed significantly ( $P < 0.01$ ). While, Water temperature, pH, dissolved oxygen, calcium, and magnesium were differed significantly ( $P < 0.05$ ) among the sites. In addition, no significant differences in electrical conductivity, salinity, and chloride were observed by emergent macrophytes. Therefore, this study concluded that emergent macrophytes play important role in changing some water characteristics.

### المستخلص:-

تمت هذه الدراسة في هور الشافي جنوب العراق لتحديد دور النباتات المائية البارزة في تغيير نوعية المياه . حددت ثلاث أنواع من النباتات المائية البارزة في الهور وقيست النسب المئوية لغطائها الخضري ، وهي نبات القصب يغطي 40% البردي يغطي 30% والجولان يغطي 15% وان المتبقي من مساحة الهور يغطي بماء مفتوح . قيس المتغيرات البيئية للماء قبل الهور وفي الهور (حيث النباتات المائية تنتشر) وبعد الهور . وطبق النظام الاحصائي t- test عند مستويات معنوية اقل من 0.01 وأقل من 0.05 لمعرفة الاختلافات المعنوية في المتغيرات البيئية خلال تلك المواقع (قبل الهور وداخل الهور وبعد الهور) . وبينت هذه الدراسة بأن نفاذ الضوء والمواد العالقة الصلبة الكلية و عكورة الماء والنترات والنترت والفوسفات أختلفت بصورة معنوية عند مستوى اقل من 0.01 بينما درجة حرارة الماء و-pH والاكسجين المذاب والكالسيوم والمغنيسيوم أختلفت بصورة معنوية عند مستوى أقل من 0.05 . فضلاً عن التوصيل الكهربائي والملوحة وتركيز ايون الكلورايد لم تختلف بصورة معنوية لذلك أستنتجت هذه الدراسة بأن النباتات المائية البارزة لها دور مهم في تغيير بعض خواص الماء .

Keywords: Iraqi Marshes. Emergent Aquatic Macrophytes. Water Quality Changing.

### Introduction:

The Tigris and Euphrates rivers have created about 15,000 km<sup>2</sup> of wetlands known as the Mesopotamian marshes. These wetlands comprise a complex of interconnected shallow freshwater lakes and marshlands, which are considered the most extensive wetland ecosystem in the Middle East [1]. Water levels reach their maximum in early spring and then fall by as much as two meters during the hot dry summer [2].

Iraqi marshes ultimately drain southeast wards into the Gulf via the Shatt Al-Arab waterway [3]. Floodplain wetlands, riverbanks and lake shores are utilized for the cultivation of cereals, rice or vegetables, while the rivers and lakes themselves support freshwater fisheries. 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 [3]. 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 the Central Marches and Al-Hammar, and could eventually lead to the disappearance of these systems [4]. Currently, less than 10% of the marshlands in Iraq remain as fully functioning wetlands because of the extensive drainage and upstream agricultural irrigation programs on Tigris and Euphrates rivers [3]. The Marsh Arabs, or Ma'dan, who have lived in the marshes for at least 5,000 years, have been particularly affected by these actions [1]. Currently, restoration by re-flooding of drained marshes is proceeding in the Central and Al-Hammar marshlands [5].

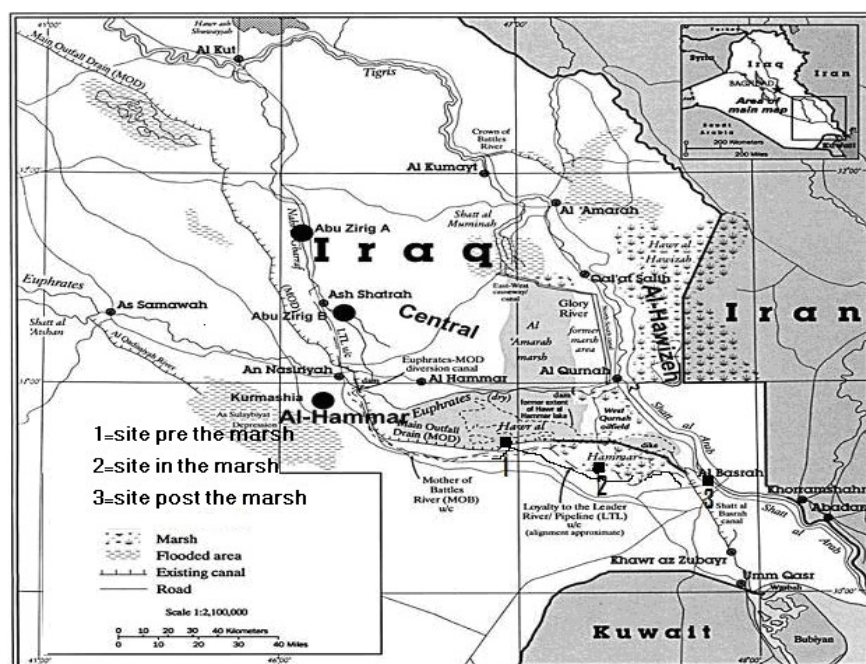


Fig (1): Southern Iraqi Marshes

Water quality improving in wetlands include surface flow marshes, vegetated subsurface flow beds (found mostly in Europe, and vegetated with *Phragmites australis*), submerged aquatic beds, and beds of floating plants such as *Eichhornia crassipes*, as well as other types [6]. Water quality treatment by aquatic plants become widespread because, in general, they have effect on the suspended solids, turbidity, calcium, magnesium, oxygen demand, nitrogen, phosphorus, and some metals [7]. The removal of excess nutrient loadings is essential to the health of aquatic ecosystem. In treatment wetlands, nutrient and solids removal is facilitated by shallow water, high primary productivity, the presence of aerobic and anaerobic sediments, and the accumulation of dead plant parts [8].

Some metals are essential micronutrients plants, but in wastewaters they may be in concentrations that are toxic to sensitive organisms. Biomagnification through the food chain occurs with a number of metals. For this reason, it is essential that removed from wastewater flows before they enter natural water [9].

The aquatic macrophytes have physical effects on the water quality, these effects including negative effect on the water velocity and allow for the filtering and settling of organic particulate matter and other suspended solids [10, 11]. Aquatic macrophytes play important role in uptake the nutrients from water [12].

The aquatic macrophyte species of all growth forms have been used in treatment of aquatic system, this treatment should not be invasive species; they should be tolerant of the local environmental conditions and of pollutants, and they should be easily established [13].

The main objectives of this study are to determine the characteristics of water, and the role of aquatic macrophyte in improving water quality in Al-Shafi Marshes-Southern Iraq.

### **Materials and Methods:**

#### **Floristic Study**

The studied macrophytes species were identification in the herbarium of College of Science in the University of Basrah according to [14].

Vegetation Cover percentage is defined as the area of ground within the quadrat, which is occupied aboveground parts of each species when viewed from above. Cover was estimated usually as a percentage. Whereas area of the quadrat is one m<sup>2</sup> [15].

#### **Environmental variables**

The environmental variables were measured according to [16]. Five water samples were taken in each site (before the marsh, in the marsh, and after the marsh) during June-2007. When the water temperature, electrical conductivity, salinity, and water pH were measured directly in the field by digital portable multi meter (model 340i/SET). While, water turbidity was measured by portable digital turbidity meter, type Hana. Light penetration was measured by Secchi disk (30 cm in diameter). TSS was measured by filtration throughout the dried and weighed filter papers (GF/C 0.45 micrometers). Dissolved oxygen was measured by Azide-modification of Winkler method. Calcium ion concentration was measured by titration against standard EDTA (0.01 M). While, the nutrients (NO<sub>3</sub>, NO<sub>2</sub>, and PO<sub>4</sub>) were measured by colometric methods.

### Statistical analysis

The statistical significance of difference for data among locations was assessed using t-test. *P*-value less than the point 0.01 and 0.05 level of significance were considered statistically significant [17].

### Results :

First, three dominant emergent macrophyte communities were determined in Al-Shafi Marsh, which are *Phragmites australis*, *Typha domengensis* and *Schoinoplectus litoralis*. Their vegetation cover percentages are 40%, 30%, and 15% respectively. In addition, some variations were observed in the some of environmental variables, which are including water temperature changed from 26.7 C° pre the marsh to 19.2 C° in the marsh and 23.5 C° post the marsh. Total suspended solids changed from 20.13 mg/l pre the marsh to 3.77 mg/l post the marsh. Water turbidity changed from 13.01 NTU to 1.25 NTU. Light penetration changed from 75% to 100%. Water pH increased from 7.2 to 7.4. Dissolved oxygen was declined during the study time, when its value ranged from 3.8 mg/l before the marsh to 4.6 in the marsh (where the macrophytes distribute). Calcium ion decreased from 268.4 mg/l before the marsh to 180.6 mg/l after the marsh. Magnesium ion decreased from 94.2 mg/l to 42.2 mg/l after the marsh. Nitrate concentration decreased from 2.7 µg/l to pre the marsh to 1.1 µg/l post the marsh. Nitrite concentration decreased from 0.91 µg/l pre the marsh to 0.44 µg/l post the marsh. Phosphate concentration decreased from 1.09 µg/l pre the marsh to 0.51 µg/l post the marsh. While, Chloride ion concentration, electrical conductivity, and salinity were not changed, clearly. These are clear in table (1). By t-test statistical analysis, the results of this study showed the significant effects for emergent macrophytes on the some environmental characteristics. Water temperature, pH, dissolved oxygen, calcium, and magnesium differed significantly ( $P < 0.05$ ). Light penetration, total suspended solids, water turbidity, nitrate, nitrite, and phosphate concentrations differed significantly ( $P < 0.01$ ). While, no significant differences in electrical conductivity, salinity, and chloride were observed.

**Table (1): Vegetation covers percentage and some environmental variables**

Site	Type of Macrophytes	Vegetation cover (%)	WT (C°)	TSS (mg/l)	TUR (NTU)	LP (%)	EC (mS/cm)	Sal. ppt.	pH	DO (mg/l)	Ca <sup>+2</sup> (mg/l)	Mg <sup>+2</sup> (mg/l)	Cl <sup>-1</sup> (mg/l)	NO <sub>3</sub> (µg/l)	NO <sub>2</sub> (µg/l)	PO <sub>4</sub> (µg/l)
Pre Al-Shafi Marsh			26.7	20.13	13.01	75	8.79	4.7	7.2	3.8	268.4	94.2	216.8	2.7	0.91	1.09
In Al-Shafi Marsh	<i>Phragmites australis</i>	40%	19.2	17.05	9.13	90	8.51	4.5	7.4	4.6	192.2	60.8	190.2	1.9	0.63	0.75
	<i>Typha domengensis</i>	30%														
	<i>Schoinoplectus litoralis</i>	15%														
Post Al-Shafi Marsh			23.5	3.77	1.25	100	8.33	4.5	7.4	4.2	180.6	42.2	176.4	1.1	0.44	0.51

**Discussion:**

The significant difference in water temperature may be due to the emergent aquatic macrophytes and can have a strong influence on the temperature within the aquatic environment, also plants presence decreases evaporation from the water's surface, whereas more evaporation occurs in open water, also air temperature and radiant energy from the sun have the greatest influence on water temperature [18]. As well as, the vegetation cover declines heat of sun to reach to the water surface [19] that agrees with the present study.

Light penetration is an important parameter because light affects both the biological and chemical reactions in a water-body. If a water-body is very turbid, light will not reach through the water column and many processes, especially photosynthesis, will be limited. When water is turbid, the floating particles absorb heat from the sun, raising water temperature and thus lowering dissolved oxygen levels [20]. Light Penetration in water column is affected by many factors, external factors that include climatic conditions and human activity (boat movement and grazing), and internal factors, including quantity and quality of suspended and dissolved materials, water flow and tidal situation. The aquatic macrophytes play important role in increasing the light penetration, whereas the aquatic plants act as traps and sinking the suspended materials, and the growth of aquatic plants reduce the water flow, which causes reducing of the total suspended solids value. The results of the present study showed the significant effect for emergent macrophytes on light penetration, turbidity, and total suspended solids. These agree with the previous studies about Mesopotamian marsh [20, 21].

Water electrical conductivity is one of the important chemical properties for water, which affect the growth of plants, whereas it is considered one of the limited factors to plant growth [13]. In this study, no significant effect for aquatic macrophytes on the electrical conductivity and salinity, this result agrees with [19].

Water pH is a measure of the concentration of  $H^+$  ions in a solution. It has being known that Iraqi waters mainly tend to be alkaline, this agrees with results of [22].

In the present study, the significant effect for aquatic macrophyte on pH that may be due to degradation of the dead parts of aquatic plants, phytoplankton and organic materials, should be led to increase the production of dissolved carbon dioxide [21, 23].

There are many factors play an important role with increasing and decreasing of dissolved oxygen concentration in water. The significant difference in dissolved oxygen concentration in this study may be due to temperature; the raise of temperature leads the dissolved oxygen concentration to be declined [19]. As well as, the water flow and water depth, whereas the water was semi-stagnant and shallow during summer, this agrees with [20, 21]. In addition, the peak of growth of aquatic macrophytes was at summer, so that the exchanging gas between atmosphere and water surface should be decreased [19]. As well as, the fluctuations in the dissolved oxygen levels could be related to respiration and photosynthesis macrophytes and aquatic organisms [24].

Calcium ion is considered the main component for cell wall in aquatic plants. Generally, calcium ion was more than magnesium ion concentration, this agrees with [25].

The significant effect for aquatic macrophytes on the calcium ion that may be correlated with its importance for macrophytes growth, also calcium ion is consumed by aquatic

microbial organisms, which leave with aquatic plants in the same ecosystem [26]. As well as, these bacteriological effects may be possible that divalent cation,  $\text{Ca}^{2+}$  can act as enzyme activators or maintain the cellular structure of the bacteria which degrade the dead materials (plant and animals) and that lead to increase the nutrients which are required for macrophytes growth [8].

Magnesium ion is an essential nutrient for plants; it shares in the chlorophyll structure and is used in metabolism of plants [27]; in the same time is important for bacteria, which performs the degradation process for dead materials [28]. The significant effect for emergent macrophytes on the magnesium concentration in the present study may be because the aquatic plants uptake it to share in chloroplast structure and the metabolic processes this result agrees [19].

Availability of nutrients is considered one of the main factors affecting the abundance and composition of aquatic plant assemblages [29]. Of the many nutrients required for growth, nitrogen (N) and phosphorus (P) are the elements typically of shortest supply in aquatic ecosystems and therefore most likely to affect the growth of aquatic macrophytes species [30].

The significant effect for emergent macrophytes on the concentrations of nitrate and nitrite that may be because their importance for plant growth, whereas the nitrogen shares in protein structure, and that metabolic processes, based on protein, leading to increasing in vegetative and reproductive growth and yield is totally dependent upon the adequate supply of nitrogen, that increasing the supply of nitrogen fertilizer increases growth and photosynthesis [19]. As well as, there is strong correlation between photosynthesis and leaf nitrogen content for macrophytes, whereas 75% from amount of chloroplasts is nitrogen [31]. This agrees with [23, 32].

Phosphorus is one of the limiting nutrients for plants growth in wetlands [8]; and it is considered one of main important nutritious components to growth of aquatic plants, whereas organisms take it and then released by degradation the materials, which are present in sediment [19,33]. The significant effect for emergent macrophytes on the phosphate concentration in this study, that, may be, because the amounts of reactive phosphate which are taken by aquatic plants and phytoplankton [23, 33]. In addition, it is important for plant growth because the phosphate shares in structure of the cell wall, protein, nucleotide and ATP [34]. The result of this study agrees with many studies [19, 30, 33].

#### **Conclusion:**

This study concluded that emergent aquatic macrophytes play important role in changing some water characteristics, such as light penetration, total suspended solids, water turbidity, nitrate, nitrite, phosphate concentrations water temperature, pH, dissolved oxygen, calcium, and magnesium. On the other hand, some water characteristics are not affected emergent aquatic macrophytes, which are electrical conductivity, salinity, and chloride.

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