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Amaricf_Basra office@yahoo.com
abdulalwan@yahoo.com
.marshbulletin@yahoo.com

Evaluation of Aquatic macrophytes vegetation after restoration in East Hammar marsh, Iraq

D.A. Hussain Al-Abbawy and A.A. Alwan
Dept. of Biology, Coll. of science, Univ. of Basra-Iraq
dunya.hussain@gmail.com

Abstract

A survey on aquatic macrophytes was done during 2006 to evaluate status of East Hammar marsh after restoration including two main stations Al-Mafrag (S1) and Al-Burgah (S2). Ninteen plant species belonging to 11 families of aquatic macrophytes were recorded in East Hammar marsh, one of them considered as an exotic species.The highest value of cover recorded for *Ceratophyllum demersum* as submerged 57.48% and *Schoenoplectus litoralis* as emerged 49.46%. The most frequent species in the Hammar marsh was *Ceratophyllum demersum* (82.5%).The value of biodiversity was 1.96 and evenness was 0.74 while richness was 2.66 in S1. *Phragmites australis* recorded the highest value of biomass in Summer for emergent aquatic macrophytes, while *Ceratophyllum demersum* recorded highest values of biomass comparing with other submerged macrophytes.

1-Introduction

A study of the diversity and distribution of aquatic plants is an essential component of understanding aquatic ecosystem due to the important ecological role of aquatic vegetation and the ability of the vegetation to characterize the water quality (Bornette *et al.* 1998). Aquatic plants are an important part of the aquatic food webs. They influence water quality by taking up nutrients, releasing dissolved organic matter, and increasing sedimentation by absorbing turbulent energy (Gross, 2003; Schallenberg and Waite, 2004).

Wetland restoration refers to the return of a wetland from a disturbed or altered condition caused by human activity to a previously existing condition. The wetland may have been degraded or hydrologically altered and restoration then may involve reestablishing hydrologic condition to re-establish previous vegetation communities (Mitsh and Jorgensen, 2004).

Wetland (as E. Hammar marsh) functions are defined as a process or series of processes that take place within a wetland. These include the storage of water, transformation of nutrients, growth of living matter, and diversity of wetland plants (Novitzki *et al*, 1997).

The term marsh means a frequently or continually inundated wetland characterized by emergent herbaceous vegetation adapted to saturated soil conditions (Mitsch and Gosselink, 2000). East hammer marsh was one of the main southern marshes in Iraq that desiccated during 1990s.

Aquatic biodiversity has enormous economic and aesthetic value and is largely responsible for maintaining and supporting overall environmental health. Aquatic organisms rely upon the great diversity of aquatic habitats and resources for food, materials, and breeding grounds (Williams et al., 2004).

Factors including overexploitation of species, the introduction of exotic species, pollution from urban, industrial, and agricultural areas, as well as habitat loss and alteration through damming and water diversion all contribute to the declining levels of aquatic biodiversity in both freshwater and marine environments. As a result, valuable aquatic resources are becoming increasingly susceptible to both natural and artificial environmental changes. Thus, conservation strategies to protect and conserve aquatic life are necessary to maintain the balance of nature and support the availability of resources for future generations (EPA, 2003).

The main objects of this work were:

1. To determine the species composition and biomass of various macrophyte species in the marsh.
2. To determine the distribution of macrophyte in East Hammar marsh.
3. Estimation of vegetation covers in East Hammar marsh after inundation in 2003.
4. To assess the marsh floristic richness, diversity and evenness.
5. To provide a base line of macrophyte data with which to compare future patterns in macrophyte species composition and distribution in the marsh.

2-Methods

The occurrence of macrophyte species presence in East Hammar marsh was surveyed and recorded during January 2006 to December 2006.

Two main stations S1 (N 30 39 996 E 74 39 65) and S2 (N 30 40 074 E 47 38 574) were chosen in the marsh (Fig. 1). Site co-ordinates were obtained using a global positioning system (GPS) unit.

Floristic lists were made monthly from 10 reaches containing macrophytes each 50 m long. Notes were made on the occurrence of each species qualitatively (presence/ absence) values were used in an a subsequent processing. Diversity, Richness indices were used for information analysis. Estimation of cover percent, biomass and species richness were

done using transects and quadrats methods. Twenty replicates for cover percents and ten replicates for biomass were taken in each site. Samples of biomass were taken twice a year, in mid Summer and in mid Winter. For some species sample were taken when each species has its own peak. Ten quadrats 1m*1m were taken for each site. Plants were cut at or near the ground level. The harvested plants were sorted into species, dried and weighed, weighing was carried out several times until the weight become fixed. Usual technique of preparing and mounting herbarium specimens were followed. Specimens were deposited at Basra university herbarium (BSRA).

Specimens of all plant species present were collected and saved in a cooler for later preparation of voucher specimens.

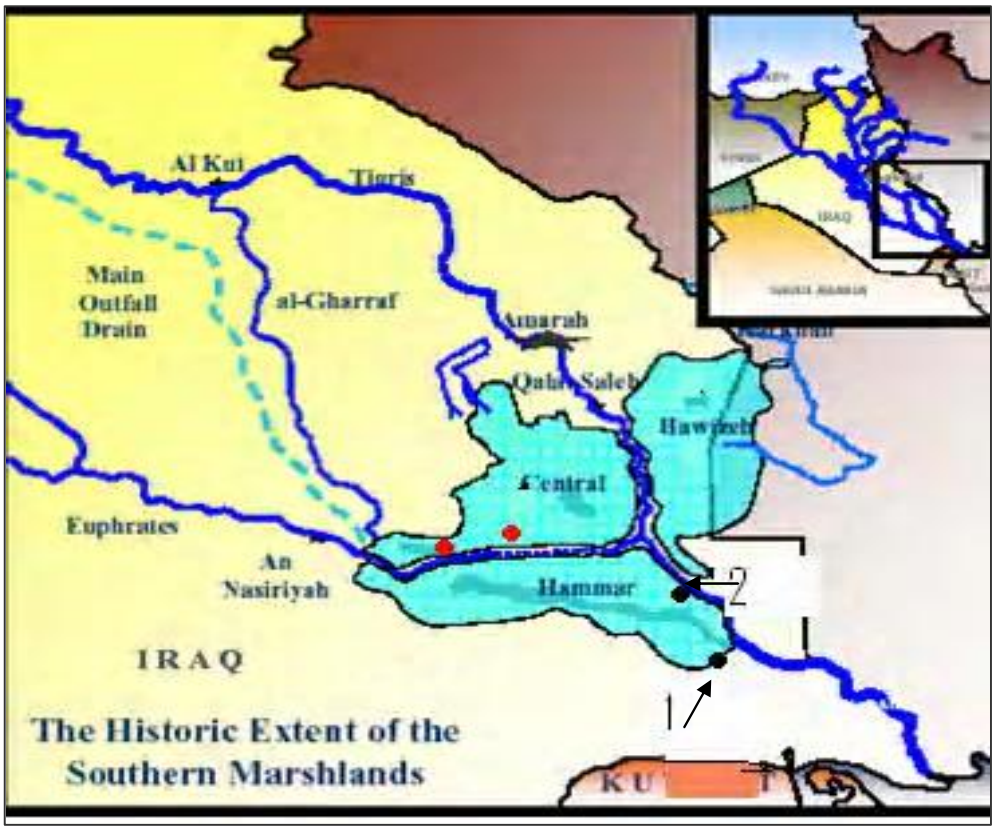

Fig. 1: Map of the study stations

S1: Al-Mafrag (Junction of Mashab and Salal)

S2: Al-Burgah

Typha domingensis

Schoenoplectus litoralis

Ceratophyllum demersum

Hydrilla verticillata

Potamogeton pectinatus

Table 1: Floristic list of aquatic plants presence in East Hammar marsh during 2006.

Group	S1	S2	Family
	Phragmites australis	*Phragmites australis*	*Poaceae*
	Schoenoplectus litoralis	*Schoenoplectus litoralis*	*Cyperaceae*
Emergent	*Typha domingensis*	*Typha domingensis*	*Typhaceae*
	Paspalum paspaloides	—	*Poaceae*
	Panicum repens	—	*Poaceae*
	Diplachne fusca	*Diplachne fusca*	*Poaceae*
	Ceratophyllum demersum	*Ceratophyllum demersum*	*Ceratophyllaceae*
	Myriophyllum spicatum	*Myriophyllum spicatum*	*Haloragaceae*
	Najas marina	*Najas marina*	*Najadaceae*
	Najas minor	—	*Najadaceae*
Submerged	*Potamogeton crispus*	*Potamogeton crispus*	*Potamogetonaceae*
	Potamogeton lucens	*Potamogeton lucens*	*Potamogetonaceae*
	Potamogeton pectinatus	*Potamogeton pectinatus*	*Potamogetonaceae*
	Potamogeton perfoliatus	*Potamogeton perfoliatus*	*Potamogetonaceae*
	Vallisneria spiralis	*Vallisneria spiralis*	*Hydrocharitaceae*
	*Hydrilla verticillata**	—	*Hydrocharitaceae*
	Chara vulgaris	*Chara vulgaris*	*Characeae*
Floating	*Salvinia natans*	*Salvinia natans*	*Salviniaceae*
	Lemna minor	—	*Lemnaceae*
Total	**19**	**14**	**11**

— Absence * Exotic species

Table 2: Mean % cover of aquatic plants presence in East Hammar marsh during 2006

Group	Species	Station	
		S1	S2
Emergent	*Phragmites australis*	21.00	24.57
	Schoenoplectus litoralis	49.46	34.97
	Typha domingensis	37.57	34.55
Floating	*Lemna minor*	5.00	_
	Salvinia natans	6.67	5.00
Submerged	*Ceratophyllum demersum*	57.48	55.25
	Chara vulgaris	14.70	26.67
	Hydrilla verticellata	5.00	_
	Myriophyllum spicatum	15.67	18.67
	Najas marina	37.71	16.92
	Najas minor	15.00	_
	Potamogeton crispus	5.00	6.00
	Potamogeton lucens	7.00	5.50
	Potamogeton pectinatus	27.35	11.14
	Potamogeton perfoliatus	5.00	10.28
	Vallisneria spiralis	11.84	25.00

Table 3: Mean % Frequency of aquatic plants presence in East Hammar marsh during 2006.

Species	**station**	
	S1	**S2**
Phragmites australis	44.6	43.3
Schoenoplectus litoralis	60.8	24.6
Typha domingensis	32.5	51.3
Ceratophyllum demersum	77.9	82.5
Myriophyllum spicatum	6.3	36.7
Najas marina	16.3	4.2
Najas minor	2.9	-
Potamogeton crispus	0.4	4.2
Potamogeton lucens	2.1	4.2
Potamogeton pectinatus	7.1	10.0
Potamogeton perfoliatus	1.7	9.2
Salvinia natans	1.3	0.4
Vallisneria spiralis	-	5.8
Chara	-	18.3
Hydrilla	0.4	-

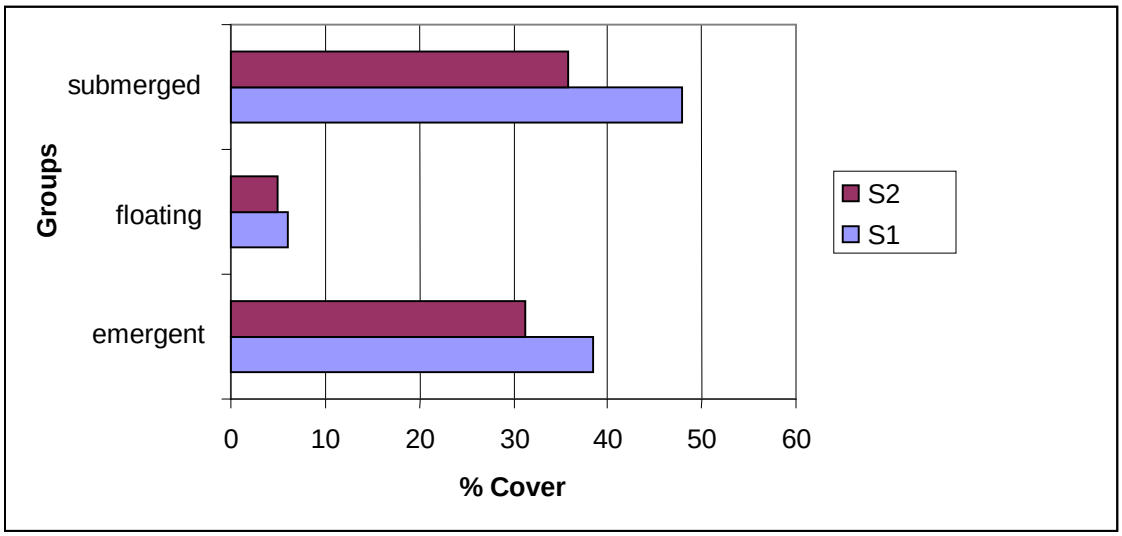

Fig. 2: Mean % cover of aquatic plants group from East Hammar marsh during 2006.

Table 4: Biological indices (Diversity, Richness and Evenness) of East Hammar marsh during 2006.

STATION	Diversity	Richness	Evenness
S1	1.96	2.66	0.74
S2	1.67	2.52	0.65

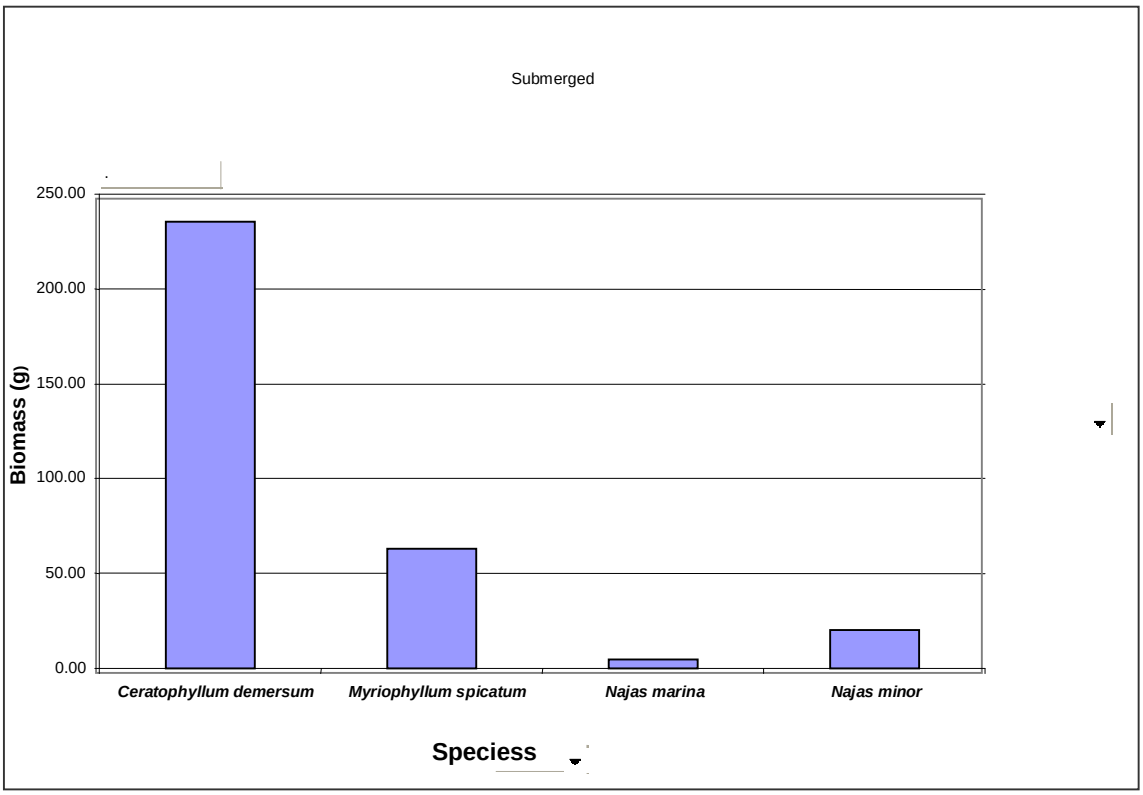

Fig. 3a: Biomass of Submerged plants collected from E. Hammar marsh during 2006.

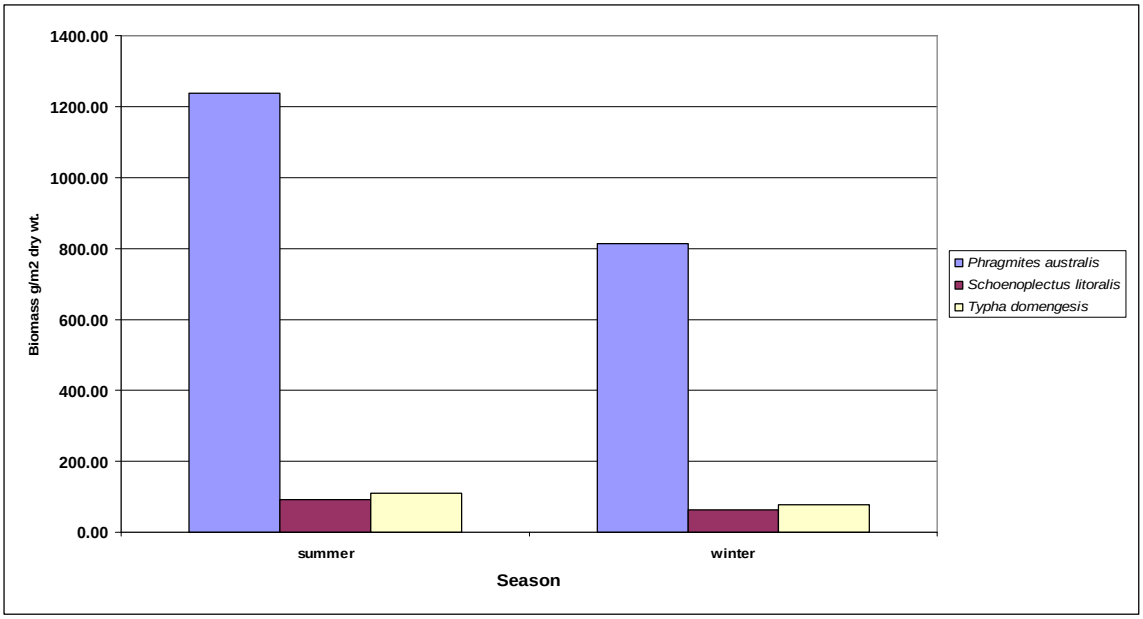

Fig. 3b: Biomass of Emerged plants collected from East Hammar marsh during SummerandWinter2006.

3-Results and Discussion

East Hammar marsh was exposed to a period of desiccation happened during 1990s to March 2003 , but in 2004 onward different activities were done aiming to restore the marsh . The results showed that East Hammar marsh had a diverse native aquatic macrophyte community at the time of sampling Jan.06 to Dec. 06, comprising 18 native and 1 exotic species (table 1). Some species were shown in site S1 like *Hydrilla verticillata*, *Najas minor* , *Lemna minor* , *Paspalum paspaloides* and *Panicum repens* .

It seems to be that we recorded less number of species than that by Alwan (2006) about historical data of aquatic plants species in East Hammar marsh before desiccation.

Restoration of a disturbed ecosystem to a former steady state can be monitored by censuses of species richness (van Andel, 1998).The definition of disturbance as "a change in conditions which interferes with the normal functioning of a biological system " (van Andel *et al*.1987).

Many ecosystems are likely to exist in alternatives stable, depending on their history; this phenomenon is also relevant to setting the restoration goals (Hobbs and Norton, 1996).

The highest values of cover percent were for submerged macrophytes followed by Emerged and floating macrophytes (Fig. 2). From tables 2and3 it seems to be that the most abundant submerged species was *Ceratophyllum demersum* (57.48% cover with 82.5% frequency), which is a common in Iraqi rivers and marshes. It has some salinity tolerance as indicated by its presence in Shatt Al-arab River (Salinity about 3ppt), and it is considered to be of ecological value as habitat for different organisms with its biomass about 235.7 g/m2 (Fig. 3a) and as stabilizer of marsh sediments, while *Schoenoplectus litoralis* had the highest percent of cover for Emerged plants (49.46% cover with 60.8% frequency), and its biomass reached 91.06 g/m2 in Summer because of its full growth (Fig. 3b). While *Phragmites australis* recorded the lowest value of cover. This results deals with that of Alwan, 2006 on his survey during 2004 to 2005.

P. australis is one of the most widely distributed wetland plant species on earth. In the tidal environment it is typically a freshwater species, but its salt tolerance allows it to invade brackish and even marine environments (Soetaert *et al*., 2004).

Struyf *et al.* 2007 mentioned that *P. australis* is highly competitive and produces aboveground biomass typically a round 1000 g dry weight/ m2. But from Figure 2 *P. australis* in East Hammar marsh in present study recorded about 1238.32 g dry weight/ m2 in Summer .This value was less than 7700 g dry weight/ m2 that reported by Soetaert *et al*.(2004) and the values reported by Al-Hilli (1977). *Typha domingesis* was moderate in biomass reached 111.32 g dry weight/ m2 in Summer, while *Schoenoplectus litoralis* recorded the lowest values comparison with the other emerged plants.

Occurrence of Some aquatic plants like *Potamogrton lucens* and *P. crispus* were recorded in the marsh .There abundance was very low . *Najas* spp. are common aquatic plant throughout Iraq .It constituted almost 5 and 20 g/m2 for *N. marina* and *N. minor* respectively of the biomass collected from East Hammar marsh . These species are natives that are tolerant of brackish waters and have high value as habitat for biota (Schallenberg and Waite ,2004) .

Myriophyllum spicatum is a native water milfoil distributed in Iraq. It was found in low abundance (about 15.67% cover with 6.3% frequency) at site S1 throughout E. Hammar marsh with a bout 18.67% in site S2.

H. verticellata was the only exotic species found in this aquatic macrophytes survey (Alwan, 2006). It was found only at low abundance 5% cover with 0.4% frequency and mainly in the S1 site of E. Hammar marsh. *Hydrilla* typically forms high density canopies . Therefore, it is considered noxious plant (Alwan, 2006) .Its distribution in E. Hammar marsh depending on present survey confirms that it is not yet be aggressively invasive and can co-exist with native aquatic macrophytes in mixed stands.

The species diversity, richness and evenness are shown in table 4. The values of diversity, richness and evenness were higher in S1 than S2 because of difference composition between two sites.

4-Conclusions

- Station S1 contains more species of aquatic Macrophytes than station S2.
- The highest value of diversity and evenness were in station S1.
- *Ceratophyllum demersum* recorded the highest value of cover percent for both stations.
- *Ceratophyllum demersum* recorded the highest value of biomass for the submerged and *Phragmites australis* for the emergent.
- Depending on present available data, it seems to be that restoration in E. Hammar marsh will go on and success with time.

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تقييم حالة الغطاء النباتي بعد عملية الاسترجاع في هور شرق الحمار، العراق

دنيا علي حسين وعبدالرضا أكبر علوان
قسم علوم الحياة - كلية العلوم –جامعة البصرة

الملخص

أجري مسحا للنباتات المائية خلال عام 2006بهدف تقييم حالة هور شرق الحمار بعد عملية الاسترجاع في 2003 واختير لذلك محطتين رئيسيتين هما المفرق والثانية البركة. سجل تسعة عشر نوعا من النباتات المائية تعود إلى 11 عائلة في هور شرق الحمار أحدها يعتبر نباتا دخيلا لمياه هور الحمار. سجلت أعلى القيم للغطاء النباتي لكل من نباتي الشمبلان 57.48% و الجولان 49.46%. كان نبات الشمبلان من أكثر الأنواع النباتية تكرارا (82.5%) في الهور. بلغت قيم التنوع الحياتي 1.96 وقيمة التكافؤ 0.74 اما الغزارة كانت 2.66 في المحطة الاولى و اقل منها في المحطة الثانية. أظهر نبات القصب أعلى القيم للكتلة الحية في فصل الصيف مقارنة مع بقية النباتات المائية الموجودة في هور الحمار، أما الشمبلان فكان له أعلى القيم من الكتلة الحية مقارنة مع بقية النباتات الغاطسة.