MARSH BULLETIN 13(2) September (2018) 74–86

MARSH BULLETIN

The impact of increase Salinity on the Aquatic Plants assemblage in Shatt Al-Arab river, Iraq

Abdulridha Alwan Al-Mayah and Widad M. Al-Asadi

Department of Ecology, College of Science, University of Basrah

A B S T R A C T

This study was carried out during the year 2018 to estimate the status of the aquatic plants in Shatt Al-Arab waterway southern Iraq. Several scientific trips to different places along the Shatt Al-Arab, for collecting aquatic plants, were achieved. Herbarium specimens were prepared and deposited in Basrah University Herbarium (BSRA). An inventory of the aquatic plants historically recorded in the Shatt Al-Arab estuary were provided. Forty two 42 species of aquatic plants and three riparian trees have been mentioned to occur in Shatt Al-Arab, but only 31 species were recorded in this study. Fourteen aquatic plant species were severely deteriorated or disappeared from the Shatt Al-Arab. Those species were four submerged species, namely *Potamogetom berchteldii*, *P. nodosus*, *P. pucillus* and *Hydrilla verticillata*, three floating species, *Lemna gibba*, *Ludwigia repens* and *Salvinia natans*, three emerged species *Persicaria lapathifolia*, *Schenoplectus triquter* and *Verbenia officinalis* were disappeared from the mainstream of Shatt Al-Arab. Four species *Persicaria salicifolia*, *Potamogeton crispus*, *P. lucens* and *Vallisnerea spiralis* were highly deteriorated. Many common species became less abundance and threatened.

Keyword: Salinity, Aquatic plants, Shatt Al-Arab River

Introduction

Shatt Al-Arab River is tidal river or a waterway located in Basrah province southern Iraq. It due to from the confluence of Tigris and Euphrates at Qurna city in the Southeastern corner of southern Iraqi marshes. Its length from its confluence at Qurna to its mouth at Ras al-Besha in the Gulf to be 204 km. (Al-Mayah *et al.*, 2016). It passes through the port of Maqil, north Basrah and the ports of Khoramshar and Abadan where reaching the Iranian border south Basrah. Karun is the only tributary coming for Zagros Mountain in Iran and pouring into Shatt Al-Arab south of Um al-Risas Island. Shatt Al-Arab receives 73% of its water from Tigris and Euphrates and 27% of its water from Karun from Iran. There are 635 secondary irrigated canals branched from both sides of the Shatt, of that 370 branches located on the western side of the Shatt south of Basrah city (Al-Faidhi, 1965).

Because of establishing, a barrage in 2009 at the Euphrates near Midaina city before its meeting Tigris, Shatt Al-Arab became an extension to the Tigris River because it is no longer receives any input from the Euphrates. The largest date palm forest in the world

occurs along banks of Shatt Al-Arab, more than 16millions of date palm trees were grown in this area but most of these trees were destroyed during the Iraq-Iran war between 1980-1988.

The Shatt is characterized by variation in depth and width from site to site and it bends and twists in many locations. Its width range between 200 to 2250m. The widest area is near in the mouth of the Shatt south of Fao near the Gulf. The depth of the Shatt Al-Arab varies between 6m in its north part near Qurna and 24m to the south of Sindabad Island near Maqil port (Al-Mayah *et al.*, 2016). The Shatt Al-Arab is characterized by numerous islands (24 Islands), the most important Islands are Al-Mohamadiya in Al-Hartha, Al-Sindabad near Garmat Ali, Al-Ejairawia opposite Abulkhasib and Um Al-Risas opposite to Karun River. Both sides of the Shatt become under erosion effect alternatively, where the erosion is on the Iraqi side the sedimentation occurs on the opposite side in Iran and a new shore build up there and vice versa, these newly formed mud shores are very productive and characterized by abundance vegetation and biodiversity.

The date palms orchards characterizes by a unique pattern of subsurface irrigation system, twice a day by tidal system, 6 hours high tide filling up all canals, branches and rivulets then 6 hours drainage through low tide and so on during the 24 hours of the day.

Studies on aquatic plants of the Shatt Al-Arab waterway are limited, However there are many studies on the aquatic plants of the southern marshes of Iraq refer sometimes to species occur in Shatt Al-Arab , among those, Al-Mayah (1978), who studied the aquatic plants of southern Iraq, Al-Saadi and Al-Mayah (1983) who studied the aquatic plants of Iraq, and they mentioned that the salinity in the middle and southern parts of the Shatt Al-Arab was ranged between 0.61 to 1.12ppt while it ranged between 0.54 to 1.69ppt in northern part of the Shatt, while pH was ranged between 7.66 to 8.02. Al-Mayah and Al-Hamim (1991) provided description for families, Genera and species of aquatic plants. Alwan (2006) presented a study on the past and present status of the aquatic plants in the marshlands of southern Iraq refering to the aquatic plants recorded in Shatt Al-Arab without mentioning their distribution. Al-Mayah *et al*. (2016) in their Ecology and Flora of Basrah mentioned brief description and general distribution of plants occur in Basrah.

The environmental impacts of salinity of the Shatt Al-Arab estuary have been studied by many authors. The relationship between salt intrusion and by different inflow conditions in Tigris and Euphrates River was espoused by Brandimarte *et al.* (2015). Yaseen *et al.* (2016) mentioned that the salinity in Shatt Al-Arab in 2008-2009 ranged between 4333mg/L in Qurna to 14735 mg/L in Fao. Abdalla (2016) provided a comprehensive study on salinity variation in highly dynamic tidal river Shatt Al-Arab saying that the monthly salinity was 1.0-2.0ppt from Qurna-Shafi, 2-5 in Maqil, 1-12 in Sehan and 8-31ppt in Fao.

Materials and Methods

This work was seasonly carried out during 2018. Several trips to different places along Shatt Al-Arab from Ras el-Bisha near mouth of Shatt Al-Arab southern Fao city to the Qurna city, where Tigris meets Euphrates, including Fao, Mukhraq, Sihan, Abulkasib, Ashar, Garmat Ali, Shafi and Qurna were achieved.

Aquatic plants were collected, named, numbered, pressed, mounted, identified, and deposited in Basrah University Herbarium (BSRA).

Inventory and distribution of the previously recorded aquatic plants were presented, mainly based on all volumes (1-9) of Flora of Iraq edited by Townsend and Guest (1966-1985); Ghazanfar and Edmoson (2013, 2016); Al-Mayah (1978); Alwan (2006); Al-Mayah *et al*. (2016) and onpreserved herbarium material in the BSRA, BAG National Herbarium of Iraq and BUH Baghdad university Herbarium and our collections in 2018. Field observation concerning the present status of the aquatic plants, their abundance, rareness, distribution and deterioration were recorded. Salinity and pH were determined using multi meter apparatus.

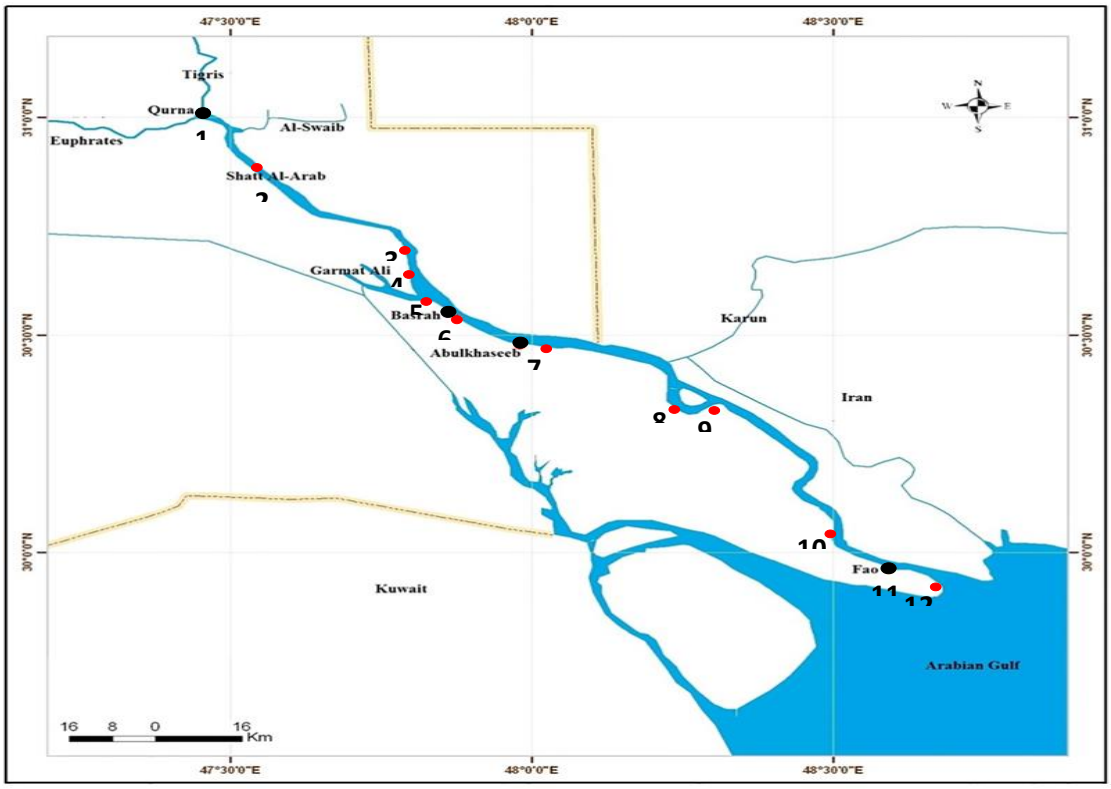

Fig. 1: Map of Shatt Al-Arab showing study stations.

1. Qurna, 2. Shafi, 3. Hartha, 4. Garmat Ali, 5. Maqil, 6. Ashar, 7.Abu Flos, 8.Sehan, 9. Seba,

10. Mukhraq, 11. Fao, 12. Ras al-Besha,

Results

Plant biodiversity of Shatt Al-Arab

A total of 45 aquatic, amphibian and riparian plant species have been recorded in Shatt Al-Arab. Table 1. (fig. 2 and 3) indicating that there were 42 species of flowering plants, one species of free floating fern *Salvinia natans* and 2 species of macroalgae, *Chara vulgaris* and *Nitella tenuissima*. More than half (26 spp) of the flowering plant were emerged, 13 were submerged and three floating species.

Table 1: Aquatic plants species number and diversity recorded in Shatt Al-Arab River before 2018.

Habit and Habitat	Plant groups					Total
	Macroalgae	Moses	Ferns	Flowering plant		
				Monocots	Dicots	
Wholly Submergents	2	0	0	3	1	6
Partly Submergents	0	0		6	1	7
Floating	0	0	1	1	1	3
Emergent	0	0	0	17	9	26
Shrub or small tree	0	0	0	0	3	3
Total	2	0	1	27	15	45

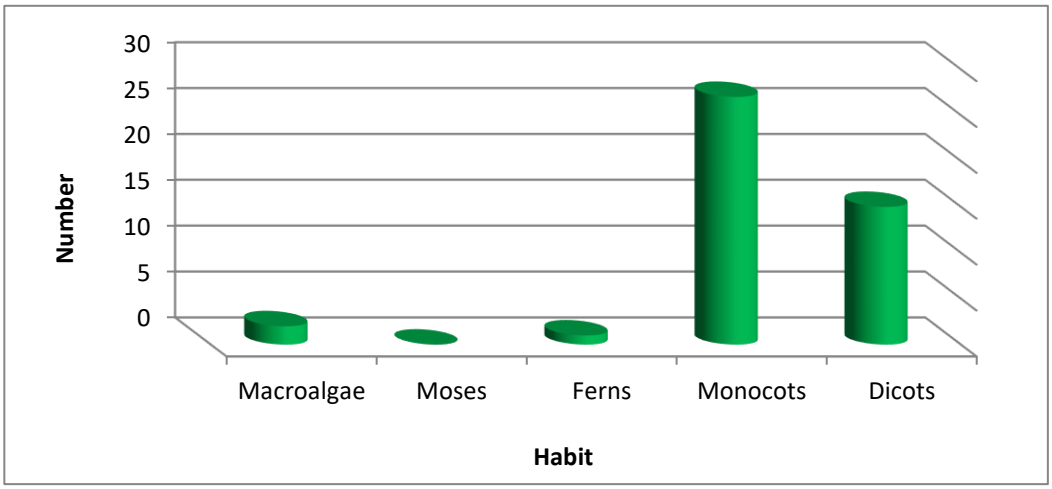

Fig. 2: Number of aquatic plants species and their plant group in Shatt al - Arab before 2018.

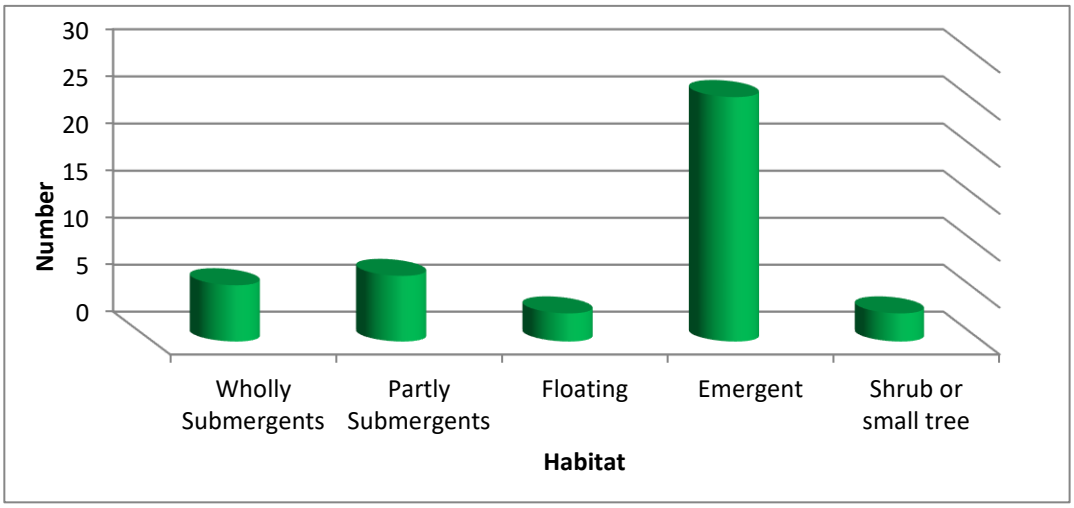

Fig. 3: Number of aquatic plants species and their habit in Shatt al - Arab before 2018 .

Table 2 and Fig. 4 show distribution and species diversity along the Shatt Al-Arab , there is clear differences in species richness among localities, the highest number of species was recorded in Qurna in the northern part of the Shatt while the lowest was in Fao in the southern part of the Shatt, in general the trends of species richness is towards the north. However there is some similarity between the localities in the middle part of the Shatt.

The most important widespread and characteristic community along the mud flat of Shatt Al-Arab was *Cyperus malaccensis*, its distribution extends from Garmat Ali in the north to Ras al-Bisha south Fao. The second characteristic species was *Cyperus triquater* which grow only in the southern part of Shatt al Arab, the third characteristic common community is *Schoenoplectus litoralis* (from same family Cyperaceae) which characterize northern part of the Shatt Al-Arab .

The first two species of *Cyperus* which called in Arabic Chulan are used as a good fodder for cow in the districts of Seba-Fao particularly in Dora, Mukhraq, Maamer and Fao. Villagers usually harvest this plant at a young stage using a special tool called masnon (Chopper) at the biging of the tide so that to be easy to cut through the water and collect while tide is rising up.

The Chaulan was also used locally by marsh people for making mats (Haser in Arabic) in the north district of Basrah.

The other characteristic and widespread community along the bank of Shatt Al-Arab is *Phragmites australis* (common reed) which usually grow adjacent to the land.

Our field observation, plant collections and distribution (table. 2) indicated that floating and submerged plants do not occur in the southern part of the Shatt Al-Arab, but they are widespread in the middle and northern part of the mainstream of the Shatt Al-Arab.

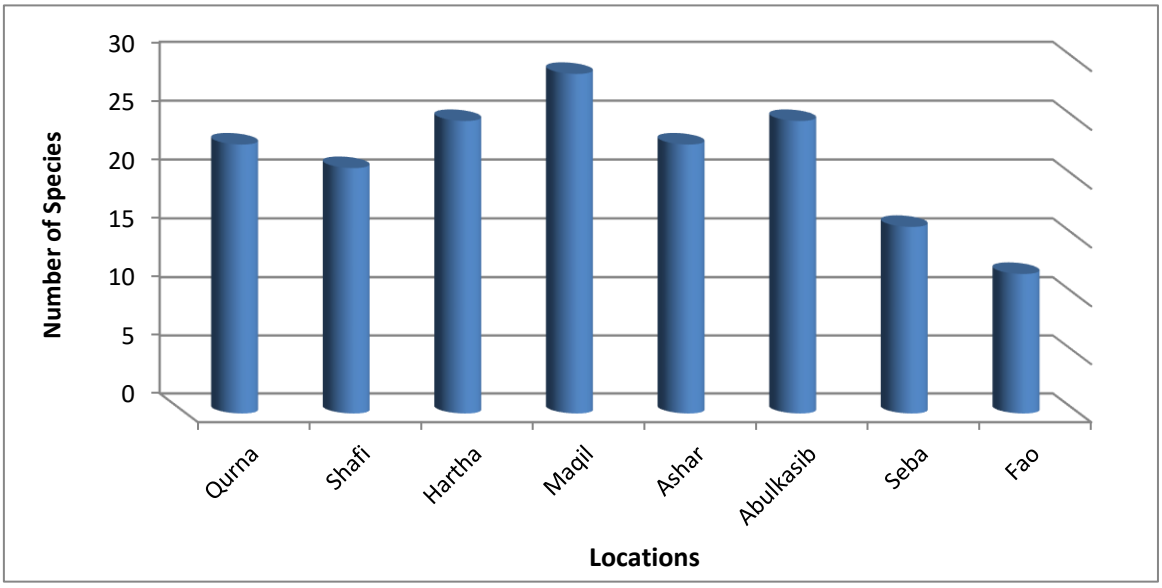

Fig. 4: Number of species in study locations.

Table (2): Checklist for aquatic and amphibian plants recorded in Shatt Al-Arab waterway and their status.

Scientific name	Common name		Distribution								Current Status
	Arabic	English	Q	Sh	Ha	Ma	As	Ab	Se	Fa	
Alternanthera sessilis	عنطران	Sessile joyweed	+			+	+	+			R
Arundo donax	قصب فارسي	Carrizo, Arundo				+	+	+		+	F
Aster tripolium	بربين سواجي	Aster							+	+	P
Bacopa monnieria	شحيمة، بربين بري	Water Hyssop	+	+	+	+	+	+			P
Ceratophyllum demersum	شمبلان	Hornwort	+	+	+	+	+	+			dr + ds
Cynanchum acutum	حبلاب	swallow-worts							+	+	P
Cyperus corymbosus	سعد	bunchy sedge			+	+					P
Cyperus difformis	تخيتة، جركت	rice sedge			+	+					P
Cyperus laevigatus	زريع	Smooth flatsedge	+	+	+	+	+	+			P
Cyperus malaccensis	جولان	short-leaved Malacca galingale		+	+	+		+	+	+	Hd
Cyperus rotundus	سعد	coco-grass, nut grass	+	+	+	+		+			P
Diplachne fusca	سبط	salt meadow grass	+		+	+					P
Eclipta alba	سنيسلة	False daisy	+	+	+					+	P
Fimbristylis bisumbellata	فليفلة	Grasslike fimbry			+	+	+				R
Hydrilla verticillata	كطل ، هيدريلا	Hydrilla	+	+	+	+	+	+			Dis
Juncus acutus	اسل ، نسل	Great sea-Rush							+	+	P
Juncus articulatus	نسل	Jointleaf rush	+			+	+	+	+	+	P
Juncus rigidus	نسل، اسل	Stiff Rush							+	+	P
Lemna gibba	عدس الماء	Duck Weed	+		+	+	+	+	+		Dis
Ludwigia repens	عرمط	creeping primrose-willow	+	+			+				Dis
Panicum repens	مران	Torpedo grass	+	+	+	+	+	+			P
Paspalum paspaloides	سلهومة	paspalum, crowngrasses				+					P
Persicaria lapithifolia	كاط	Knotweed							+		Dis
Persicaria salicifolia	حشيشة الكرعان	Ladys thum redshank				+	+	+	+	+	Ds
Phragmites australis	قصب، عنكر	Reed	+	+	+	+	+	+	+	+	C
Phyla nodiflora	بربين جداوي	Matgrass	+	+	+	+	+	+	+		F
Potamogeton berchtoldii		waterthread pondweed					+				Dis
Potamogeton crispus	حميرة، حامول	pondweed or curly-leaf	+	+	+	+	+	+	+	+	dm + ds
Potamogeton lucens	لسان الثور	shining pondweed	+	+	+						dm + ds
Potamogeton nodosus	لسان الثور	longleaf pondweed			+	+	+	+			Dis
Potamogeton pectinatus	الشتينة	Sago pondweed	+	+	+	+					dm
Potamogeton pusillus		small pondweed					+	+			Dm
Ranunculus sphaerospermus	زهير البط	Eschscholtz's buttercup		+							Dm
Ruppia maritima	لزيج، رميمنة	widgeon grass				+		+			P
Salix acmophlla	صفصاف، غرب	Oriental willow						+	+		P
Salvinia natans	غزيزة	floating fern	+	+	+	+	+	+			dim
Schoenoplectus litoralis	جولان	Bulrush	+	+	+	+					P
Schoenoplectus triqueter	جولان	Sedege, Bulrush							+		P
Tamarix sp	طرفة، اثل	Tamarisk	+	+	+	+	+	+	+	+	P
Typha domingensis	بردي	Cattail	+	+	+	+	+	+			P
Vallisneria spiralis	خويصة	Eelgrass	+	+	+	+	+	+			dm
Verbena officinalis	رجل الحمام	Common verian						+			Dis
Zannichellia palustris	حامول البحر	Horned pond weed	+	+	+	+	+	+	+		Dis

Dis: Disappeared, dm: disappeared from middle of Shatt Al-Arab , ds: disappeared from southern part of Shatt Al-Arab , p: present, hd: highly deteriorated, r: rare, f: frequent, c: common.

Q: Qurna, Sh: Shafi, Ha: Hartha, Ma: Maqil, As:Ashar, Ab: AbuFlus, Se: Seba, Fa:Fao

Table 3: aquatic plant disappeared or highly deteriorated from Shatt Al-Arab.

Botanical name	Habit	Previous distribution	Family
Ceratophyllum demersum	S	Abualflos to Qurna	Ceratophyllaceae
Hydrilla verticillata	S	Abualflos to Qurna	Hydrocharitaceae
Ludwigia repens	F	Tanoma Abulkhasib	Onagraceae
Persicaria lapathifolia	E	Abulkhasib	Polygonaceae
Persicaria salicifolia	E	Abulkhasib	Polygonaceae
Potamogeton berchteldii	Ps	Ashar	Potamogetonaceae
P. crispus	Ps	Garma-AbualFlos	Potamogetonace
P. lucens	Ps	Garma	Potamogetonace
P. nodosus	Ps	Abulkhasib	Potamogetonace
P. pectenatus	S	Ashar, Tanoma, Maqil	Potamogetonace
P. pucellus	Ps	Abulkhasib	Potamogetonace
Salvinia natans	FF	Garam-Ashar	Salviniaceae
Schenoplectus triquter	E	Seba Along the Shatt	Cyperaceae
Vallisneria spiralis	S	Garam, Ashar, Abulkhasib	Hydrocharitaceae

S= Submerged, F=Floating , E= Emergent, Ps= Partly Submerged, FF= Free floating.

Salinity of Shatt Al-Arab

Table 4 and Fig. 5 show that the salinity in Shatt Al-Arab during the period 2002 to 2014 varied from part to part seasonally and daily. The values recorded in the northern part (from Qurna to Hartha) ranged from 0.684-2.5ppt, in the middle part (from Garmat Ali to Um al-Risas) ranged from 0.556ppt while in the southern part (from Um al-Risas to Fao) ranged from 0.627 to 31ppt.

In 2018 as indicated in table 4 the salinity in Shatt Al-Arab was highly increased. In the northern part, it ranged from 0.8 to 12.6ppt, in the middle part ranged from 11.5-27ppt and in the southern part (from Um al-Risas to Ras al Besha south Fao) ranged from 26-42ppt, during the summer.

Status of aquatic plants in Shatt Al-Arab

The number of aquatic plant species recorded in Shatt Al-Arab mainstream in 2018 is significantly reduced, table 3 showed that 14 species were disappeared from southern and middle parts of the Shatt Al-Arab River; most of these species were submerged plants. The species existed in Shatt Al-Arab until end of 2018 are listed in table 2, most of these species are emerged plants such as Reed, *Phragmites australis*, sedege (Chaulan), *Cyperus malaccensis* and Cattail, *Typha domingensis*. The floating and submerged plants become rare or frequent and localized to the northern part of the Shatt Al-Arab.

In the last years, many halophyte species invade the area along the bank of Shatt Al-Arab such as *Salicornia peremnas*, *Halocnemum strobelacium*, *Suaeda aegyptiaca*, *Suaeda vermiculata* and different species of *Juncus* and *Tamarix*, particularly in the southern part of the Shatt. Farther more a new free-floating ferns, *Azolla filiculoides* has invaded the area in northern part of the Shatt especially in Hartha and Qurna for the first time.

Table 4.: Water salinity of Shatt Al-Arab during summer 2018

Months	Locations								
	Hartha	Garma	Ashar	Abu-Flus	Sihan	Mukhraq	Fao	Ras El-Bisha	Mean
August	10.65	11.50	17.06	22.50	26.30	36.40	38.50	42.10	25.50
September	10.00	15.91	17.10	21.16	32.83	34.29	41.20	42.30	25.48
October	10.30	15.94	17.60	21.18	31.60	39.10	41.00	42.00	27.34
November	11.01	11.90	15.60	18.60	26.01	36.20	38.10	41.01	24.80
Mean	10.49	13.81	16.84	20.86	29.18	37.48	39.70	41.85	25.78

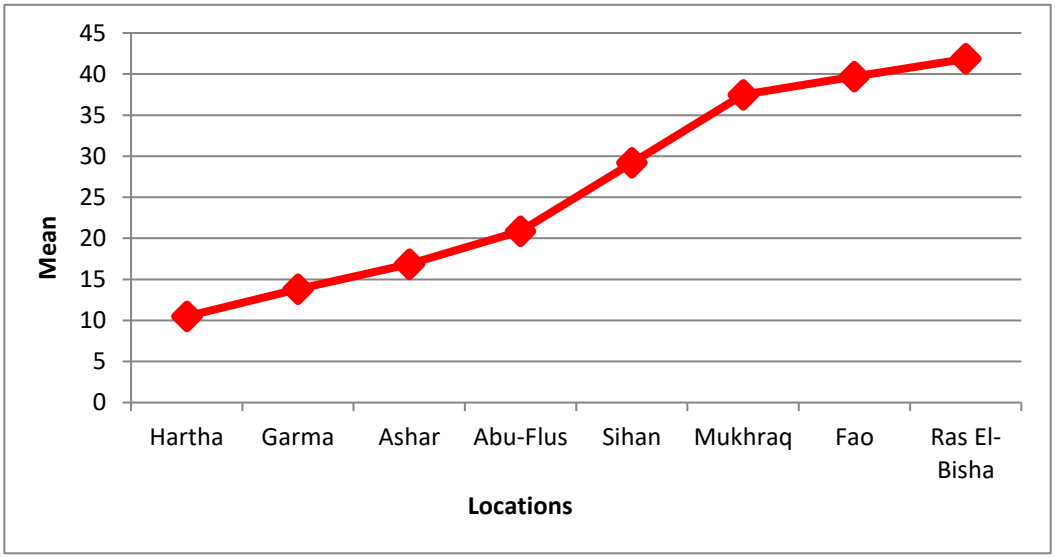

Fig. 5: Mean Water salinity of Shatt Al-Arab during summer 2018

Typology and description of Shatt Al-Arab

Based on our results of vegetation characteristics, plant biodiversity and distribution, salinity and hydrology, Shatt Al-Arab waterway can be divided into 3 distinct parts, as follow:

Part 1. The northern part of Shatt Al-Arab (NPS). It extends from Qurna southwardly to Garmat Ali, it characterized by the growing of the emerged sedge (Chaulan) *Schoenoplectus litoralis* together with the cattail (Bardi), *Typha domingensis* and dense communities of submerged *Ceratophyllum demersum* and *Potamogeton* species and the free-floating fern *Salivinia natans*. Water salinity and pollution are low; some inflow comes from Swaib River.

Part 2, the middle part of Shatt Al-Arab (MPS) it extends from Garmat Ali to Karun River confluence near Um al-Risas. It characterized by the growing of the emerged sedge (Chaulan) *Cyperus malaccensis* and the submerged *Ceratophyllum demersum*, *Vallisneria spiralis* and *Potamogeton* species, higher water Salinity and pollution, usually under the effect of marshes and agricultural drainage.

Part 3, the southern part of Shatt Al-Arab (SPS). It extended from Um al-Risas to Ras al-Bisha at the Gulf. It characterized

by the existence of two species of sedge (Chaulan) *Cyperus malaccensis* and *Schoenoplectus triqueter* and the absence of the submerged and floating plants, water salinity is very high, pollution is low, often becomes under the effect of Karun river. (Fig. 6 & 7).

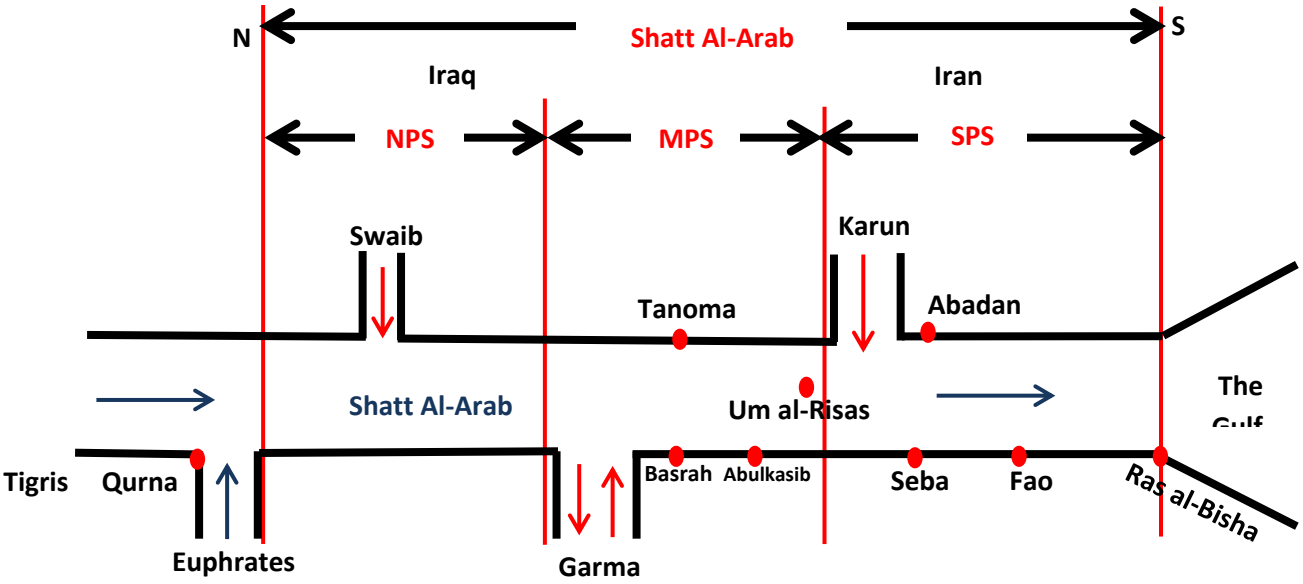

Fig. 6: Schematic diagram for Shatt Al-Arab waterway showing its classification into 3 parts based on aquatic plant biodiversity, water quality and inflow.

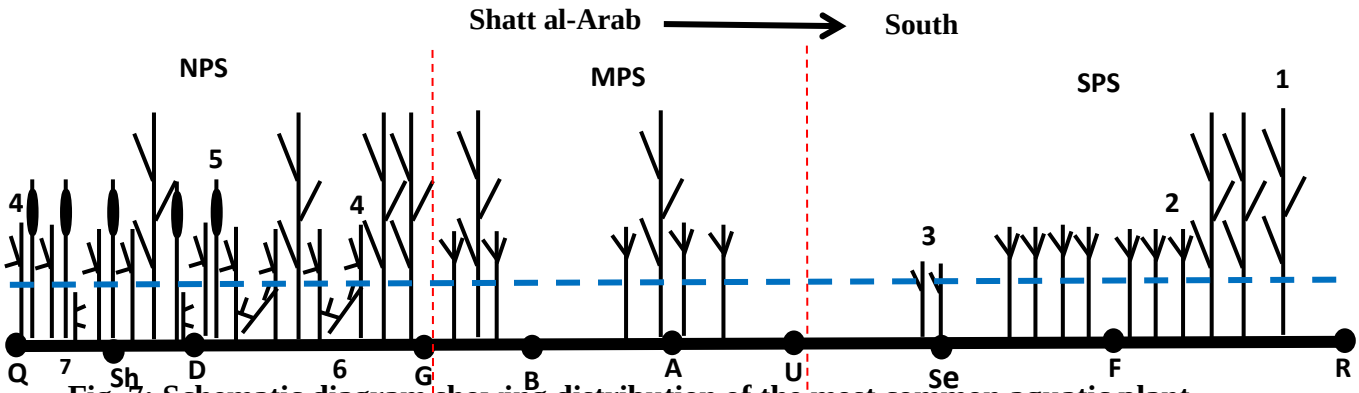

Fig. 7: Schematic diagram showing distribution of the most common aquatic plant communities along Shatt Al-Arab Estuary.

1- *Phragmites australis* 2. *Cyperus malaccensis* 3. *Schoenoplactus triqueter*
4. *Schoenoplactus litoralis* 5. *Typha domingensis* 6. *Ceratophyllum demersum*
7. *Potamogeton* sp.

A. Abulkasib, B. Basrah, D. Dear, F. Fao, G. Garmat Ali, Q. Qurna, R. Ras al-Besha, Se. Seba, Sh. Shafi, U. Um al-Risas.

Table 5: Water salinity of Shatt Al-Arab River from 2002-2018.

Location		Previous studies							
	Al-Essa 2004	Mahmood, 2008	Al-Saadi, 2009	Al-Hejuje, 2014	Abdullah, 2016	Yaseen, *et al.*, 2016	Al-Hammadi, 2017	Basrah water directorate 2018	Present study, 2018
Qurna			0.684-1.9712		1.0-2.0	1020-1658 (1325)		0.8-1.5	
Shafi	1.16-2.26				1.0-2.0				
Hartha (Kitaiban)				0.8-2.5				8.2-12.6	10-11.1
Garma (Maaqal)	0.89-1.76 1.28	0.556-2.04	1.5-3 1.7	0.9-4.9	2.0-5.0	1273-6131 (2589.2)	5-7.2	15.4-17.5	11.5-15.9
Ashar (Bradhaya)	1.35-2.31 1.71			1.2-6.1	2.0-5.0			19.7-21.2	15.6-18
AbuFlus	1.30-2.7 1.69			1.7-45	2.0-5.0		4.2-6.4	24.3-27	19-23
Sehan		0.627-3.456			10-12.0	1685-12559 (42297)		30.0-33.0	26-33
Mukhraq									35.4-39.2
Fao					8.0-31.0	3254-35663 (17871)			38.1-41.2
Ras el-Bisha		0.883-5.408							41-42.3

Discussion

The salinity problem in Shatt Al-Arab started in 1990 as Turkey built several dams on the Euphrates river as part of its GAP project. Recently Turkey has finished the construction of the Illisu dam on the Tigris River, and started to filling it in June 2018, this resulted in increasing salinity more than six-fold during the summer 2018 particularly in the southern part of the Shatt al Arab. Also the Iranian diversion of the Karun and Karkha river paths, the two rivers that feed the Shatt Al-Arab to pass through Iran have also made the crisis more worse, Iran blocked that water flow to Iraq by closing the Karun river and diversion its course. Furthermore cutting the Euphrates inflow to Shatt Al-Arab by building a barrage on Euphrates near Medaina before its Junction with Tigris affect negatively the level of water in Shatt Al-Arab and increased its salinity and pollution.

The reason for disappearing many species of submerged aquatic plants particularly during the last two years are correlated to the significantly increased salinity in these years. Salinity has a great effect on what species can exist in aquatic habitat. Salinity has many impacts on wild life in aquatic environment (Brandimarte *et al.*, 2015). Some aquatic plant species can adapt their bodies accommodate the salinity variation such as the emerged plants ex. *Cyperus malaccensis, Phragmites australis* and *Typha domingensis* while other aquatic plant species cannot tolerate a high concentration of salts ex. the submerged *Hydrilla verticillata, Myriophyllum spicatum* and *Vallisneria spiralis*. The amount of salts in plant body and in water Shatt be naturally balanced.

If the amount of salts in water is much higher than the aquatic plant body, submerged aquatic plants have to uptake salts from water. This may be destroy the plant body tissue and finally killing the plants. Salinity was found to cause reduction in species richness and abundance of aquatic plants at salinity between 1000 and 5000mg/L (Nielsen *et al.*, 2003).

The salinity in the southern and middle parts of Shatt Al-Arab ranged between 8-41ppt in 2018 the lowest value (8ppt) which recorded in Shatt Al-Arab is above the tolerance of most submerged plants living in water of estuary environment therefore most of untolerent plants in Shatt Al-Arab were disappeared in summer 2018. In addition, the cover, density and distribution of most common and widespread emerged species or communities along mud flat shore of Shatt Al-Arab were reduced and became localized to some places or became very rare or even disappeared. Water pollution and high salinity are the most important factors affect aquatic plants biodiversity. In the middle part of Shatt Al-Arab in which the Basrah city center lie on, the aquatic plants specially the submerged became under strong stress of pollution such as junk and plastic, debris, chemicals, oil industry, agriculture discharge, this may cause damage to the aquatic life and was killing the aquatic plants and animals (Schmutzer, 2017; Hiscoe, 2015).

If we compare between the three distinct portions of Shatt Al-Arab mainstream NPS, MPS and SPS shown in the figure 6 we find that the MPS has similarity with the other two parts, it is similar to NPS by the existence of same submerged and floating plants and to the SPS by the dominance of the emerged *Cyperus malaccensis*, this is may be due to having similar level of nutrification with NPS and similar substrate and water depth with the SPS. This combinations of characters make the MPS a distinct part.

Salinity alone is not a sufficient and constant character to base on to classify the Shatt Al-Arab into 4 reaches as mentioned by Abdulla (2016).

References

Abdullah, A.D. (2016). Modelling approaches to understand salinity variations in a highly dynamic tidal river the case of the Shatt Al-Arab River dissertation. Submitted in fulfilment of the requirements of the Board for Doctorates of Delft University of Technology. P.186.

Al – Mayah, A.A. (1978). Common water and marsh angiosperms of Southern Iraq. J. Bangladesh Academy of Science. 2(2): 47 – 54.

Al-Essa, S.S. (2004). Ecological study of the aquatic plants and Epiphytic Algae in Shatt Al-Arab River. PhD. Thesis, University Basrah.

Al-Hammadi, N.S.A. (2017). Comparative ecological study of two species of invertebrates *Amphibalanus Amphitrite* (Darwin, 1854) and *Namalycastis indica* (outhern, 1921) in two station of Shatt Al-Arab River. Ms. Thesis, university Basrah, 114pp.

Al-Hejuje, M.M.K. (2014). Application of Water Quality and Pollution Indices to Evaluate the Water and Sediment Status in the Middle Part of Shatt Al-Arab River. Ph.D. thesis, university Basrah, pp.

Al-Mayah, A. A., & Al- Hamim, F. I. (1991). Aquatic plant and the Algae (pp. 699-701). Univ. Basrah (in Arabic)

Al-Mayah, A. Alwan (1978). Common water and marsh Angiosperms of southern Iraq. J. Bong. Aca. Sci. 2(2): 47-54.

Al-Mayah, A.A., Al-Edani, T,Y., & Al-Asadi, W.M.(2016). Ecology and Flora of Basrah. 686 pp.

Al-Saadi, H.A and Al-Mayah, A.Alwan (1983). Aquatic plant of Iraq. Cent. Arab. Gulf. Univ. Basr.

Al-Saadi, S.M. (2009). Taxonomical and Ecological study of the wetland plants of southern Iraq. Ph.D. Thesis, University Basrah.

Alwan, A. A. (2006). Past and present status of the aquatic plants of the marshland of Iraq. Marsh Bulletin, 1(2): 160-172.

Brandimarte, L., Popescu I., Neamah N.K., 2015. Analysis of fresh-saline water interface at the Shatt Al-Arab estuary, International Journal of River Basin Management, 13 (1): 17-25.

Ghazanfar, S. A. and Edmondson, J. R. (2013). Flora of Iraq. Vol. 5. Ministry of Agriculture, Baghdad. 349 pp.

Ghazanfar, S. A. and Edmondson, J. R. (2016). Flora of Iraq. Vol. 5. Part 1. 285pp.

Hiscose, R. (2015). Does salt have any impact of the aquatic life. University of Leeds, https://www.researchgate.net.

Mahmood, A. A. (2008). Concentration of pollutants in water, sediments and aquatic plant in some wetlands in south of Iraq. Ph.D. thesis, University Basrah, 244pp.

Nicholson E. and Clark, 2003. The Iraqi marshlands: A Human and Environmental study London.

Nielsen, D.L., Brock M.A., Ress G.N., and Baldwin D.S., 2003.Effects of Increasing Salinity on Freshwater Ecosystems in Australia. Australian J. of Botany, 51: 655-665.

Schmutzer, M. (2017). What are the effect of water pollution on aquatic life. https://www.quora.com.

Townsend, C. C. and Guest, E. (1966). Flora of Iraq. Vol.2. Ministry of Agriculture Baghdad. 184 pp.

Townsend, C. C. and Guest, E. (1968). Flora of Iraq. Vol.9. Ministry of Agriculture Baghdad. 588 pp.

Townsend, C. C. and Guest, E. (1974). Flora of Iraq. Vol.3. Ministry of Agriculture Baghdad. 662 pp.

Townsend, C. C. and Guest, E. (1980). Flora of Iraq. Vol.4. Ministry of Agriculture Baghdad. 1199 pp.

Townsend, C. C. and Guest, E. (1985). Flora of Iraq. Vol.8. Ministry of Agriculture Baghdad. 440 pp.

Yaseen, B.R.; Al-Asaady, K.A.; Kazem, A.A. and Chaichan, M.T. (2016). Environmental Impacts of Salt Tide in Shatt Al-Arab -Basra/Iraq. J. Envir. Sci., Toxicol. and Food Tech., 10(1): 35-43.

تأثير زيادة الملوحة على تجمع النباتات المائية في شط العرب ، العراق

عبد الرضا علوان المياح وداد مزبان الأسدي
قسم البيئة ، كلية العلوم ، جامعة البصرة

المستخلص

أجريت هذه الدراسة خلال عام 2018 لتقدير حالة النباتات المائية في شط العرب جنوب العراق. تم إجراء العديد من الرحلات العلمية إلى أماكن مختلفة على طول شط العرب لجمع النباتات المائية. تم جمع العينات واودعت في معشب جامعة البصرة (BSRA). تم تقديم قائمة جرد للنباتات المائية المسجلة تاريخياً في مصب شط العرب. تم ذكر 42 نوعًا من النباتات المائية وثلاثة أشجار على ضفاف النهر في شط العرب ، ولكن لم يتم تسجيل سوى 31 نوعًا في هذه الدراسة. أربعة عشر نوعا من النباتات المائية تدهورت بشدة أو اختفت من شط العرب. كانت هذه الأنواع أربعة غاطسة ، وهي *Potamogetom berchteldi* و *P. nodosus* و *P. pucillus* و *Hydrilla verticillata* ، وثلاثة أنواع طافية ، *Lemna gibba* ، و *Ludwigia repens* و *Salvinia natans* ، و 3 أنواع بارزة *Persicaria lapathifolia* ، و *Schenoplectus triquter* و *Verbenia officinalis*. تدهورت بشدة أربعة أنواع *Potamogeton crispus*, و *Persicaria salicifolia* و *P. lucens* و *Vallisnerea spiralis* . أصبحت الأنواع الشائعة أقل وفرة ومهددة.

كلمات مفتاحية: ملوحة، نباتات مائية ، شط العرب