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Status of Aquatic Macrophytes in Saffia Nature Reserve, South of Huwaiza Marsh, Iraq

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Abstract

Aquatic macrophyte species in the Saffia Nature Reserve (SNR) were studied between December 2008 and November 2009 to find out the status of the communities, and also establish a database. Monthly samples were taken for quantitative and qualitative analysis. A total of 33 plant species were recorded twelve (belonging to nine families) were hydrophytes. *Phragmites australis* appeared as the most dominant community in all the Reserve whereas *Typha domingensis* and *Schoenoplectus litoralis* were only found in certain areas as small patches. Variations in the species components and a decrease in vegetation cover (as percentage) were observed. During the last three months(September, October and November) of the study most hydrophytes (except for two species *P. australis* and *T. domingensis*) disappeared, instead salt tolerant species like *Tamarix ramosissima* became dominant as the SNR suffered from desertification due to reduce water inflows from the rivers Tigris and Al-Kargha. Recently, the situation has worsen due to the closing of a crucial stream from Iran into the Reserve. The disappearance of many important aquatic native species of Southern Iraq in the SNR is ongoing with enormous negative effects for biodiversity as a whole.

Keywords: ***Iraq, macrophytes, marshlands, Saffia Nature Reserve***

1- Introduction

Aquatic macrophytes constitute a major component of freshwater wetland communities in term of biomass, ecosystem functioning and species richness (Hutchinson, 1975; Wetzel, 2001) hence changes in freshwater macrophyte diversity also affect associated organisms as well the single macrophyte species (Heino and Toivonen, 2008). Aside of changes in plant biodiversity due to direct human disturbances water quality degradation also heavily impacts on plant populations. Aquatic macrophytes are most important in marshes and freshwater bodies in general due to their role in providing habitat, food and oxygen for organisms like fish and invertebrates. Furthermore, their role in maintaining water quality by increasing sedimentation, containment of toxic substances and nutrient balance is enormous protecting biodiversity. Due to these reasons aquatic macrophytes are considered to be keystone elements in freshwater ecosystems (UNEP, 2001; Tews *et al.*, 2004; Abdulhasan, 2009).

Although wetlands are naturally subjected to seasonal variations in water flows level severe water shortages heavily impinge on biodiversity and macrophyte communities since large alterations in water quality, oxygen concentration, sediment accumulation, salinity and nutrient availability and balance. To the point that if the flows are not restored the wetland and its associated species may disappear.

In situ preservation through the establishment of a natural reserve as a conservation mechanism has shown to be one of the most effective and least expensive means to protect biodiversity (Rae D. in Bowes, 1999). Conservation in marshes and freshwater bodies include the keeping in so much as possible of the natural environment in its original conditions including aquatic plants and their respective associated populations. To attain it proper habitat management should be done limiting also encroachment and overgrazing as well as controlling water drainage amongst others aspects. It is understood that Nature Reserves are the most important means to protect plant species and their natural interactions. This can also be done by growing the plants in botanical gardens (exsitum) but in this case the complex intra and interspecies interactions occurring in natural systems are largely reduced.

During the past three decades the unprotected Southern marshes of Iraq have been under severe damage due to the policy of the past regime under Sadam Hussein aiming at diverting rivers and canals in order to desiccate them. As a result most of the existing aquatic species and populations as well as habitats suffered enormously to the point of many having become scarce or highly degraded if not disappearing. To revert the situation and preserve some of the remaining natural plant population and aquatic habitats restoration efforts have been undertaken in some of the marshland areas (UNEP, 2000). In terms of protection some important ones are on-going like in the

Huwaiza marsh (about 150 km northeast of Basrah City), where the Ministry of Agriculture established the Saffia Nature Reserve (SNR) in 2006, although efforts to restore the original plant population are still required. The SNR, which is a part of Hor Al-Saffia marsh south of Huwaiza marsh has a rectangular shape with a total area of $44km^2$, 11 km long and 4 km wide (Fig.1).

Based on the fact that the ecological status of marshlands biota is determined by both the physiochemical properties of the water body and the communities wellbeing (Hrivnak *et al.*, 2006) studies on the composition and structure of plant communities and biodiversity are crucial. Following this principle and in order to find the wellbeing of the species the present study of aquatic plants in the SNR was undertaken through a number of surveys with the objectives to a) collect and identify aquatic and upland plants species in the Reserve, b) estimate the plants cover percentage monthly, c) estimate the aboveground biomass and d) assess the water quality.

2- Materials and Methods

Study sites

Two sampling sites were chosen from SNR in order to have a good picture of the qualitative and quantitative composition and characteristics of the aquatic plants in the SNR two, Station 1 near Sabla stream, and station 2 near Al-Khabtta marsh (Fig.1). It is important to highlight that the SNR receives water from the Sabla stream in the south and from the Al-Kahla, Al-Kargha, and Al-Mashrah rivers from the north which are also part of the hydrology in Iran.

Figure 1: Geographical location of the Saffia Nature Reserve (SNR) in Southern Iraq and sampling locations Stations 1 and 2 (in black pins).

Sampling and data analysis

Water

Chemical and physicochemical water parameters such as pH, electrical(EC-mS/cm), dissolved oxygen (DO-mg/l) and temperature(C°) was measured at 10 cm depth using a calibrated Horiba portable multimeter analyzer. Data were further analyzed to establish a relationship with the presence and growth of macrophytes in the SNR.

Vegetation

Floristic lists were made monthly for the aquatic macrophytes species recording the presence or absence during study period. Estimations of vegetation cover and aboveground biomass in each site were undertaken using the quadrate method (1mx1m) separated by 10 m described by Willis (1973). Percentages of vegetation cover were calculated according to the Braun-Blanquet scale described in Kent and Coker (1992). Ten replicates for vegetation cover were randomly chosen each month and samples for biomass analysis (five replicates for aboveground parts) were undertaken twice a year in mid winter (beginning of the study) and in midsummer. The harvested plants were air dried and weighed several times until the weigh become fixed (Lind, 1979). Samples were taken to the laboratory for confirmative identification and deposited in Basra University Herbarium BSRA. The plants were identified based on Bor in Townsend and Guset (1968), Townsend and Guest (1974), Townsend *et al*. (1985) and Al-Mayah and Al-Hemeim (1991).

3- Results

A total of 33 species were recorded in the SNR during the study. Twelve species were hydrophytes while twenty one species were in upland habitats. Table 1 shows that during the six months of the survey when the water depth was in its optimum level (2.9 m) the number of hydrophytes species was twelve of which nine were submerged; thereafter in June 2009 the submerged number of species declined to two only i.e. *Ceratophyllum demersum* and *Potamogeton perfoliatus* which finally disappeared as from July. During the later month only three emergent species remain alive, but in September *Schoenoplectus litoralis* also disappeared leaving only two species with very low vegetation cover and distinct distribution. The variety of terrestrial species in the SNR range from herbs, to shrubs and only one tree species was found i.e. *Z. spina-christii* (Table 2).

During the study time a decrease in submerged species was noticed due to their high sensitivity to water quantity and quality. Figure 2 presents the variations of some water parameters in the study area during the period showing a similar pattern along the year with the exception of pH which started to vary from around mid summer through the autumn of 2009. This was due to the decreasing amount of water in the marsh resulting in higher concentration of salts and increased alkalinity.

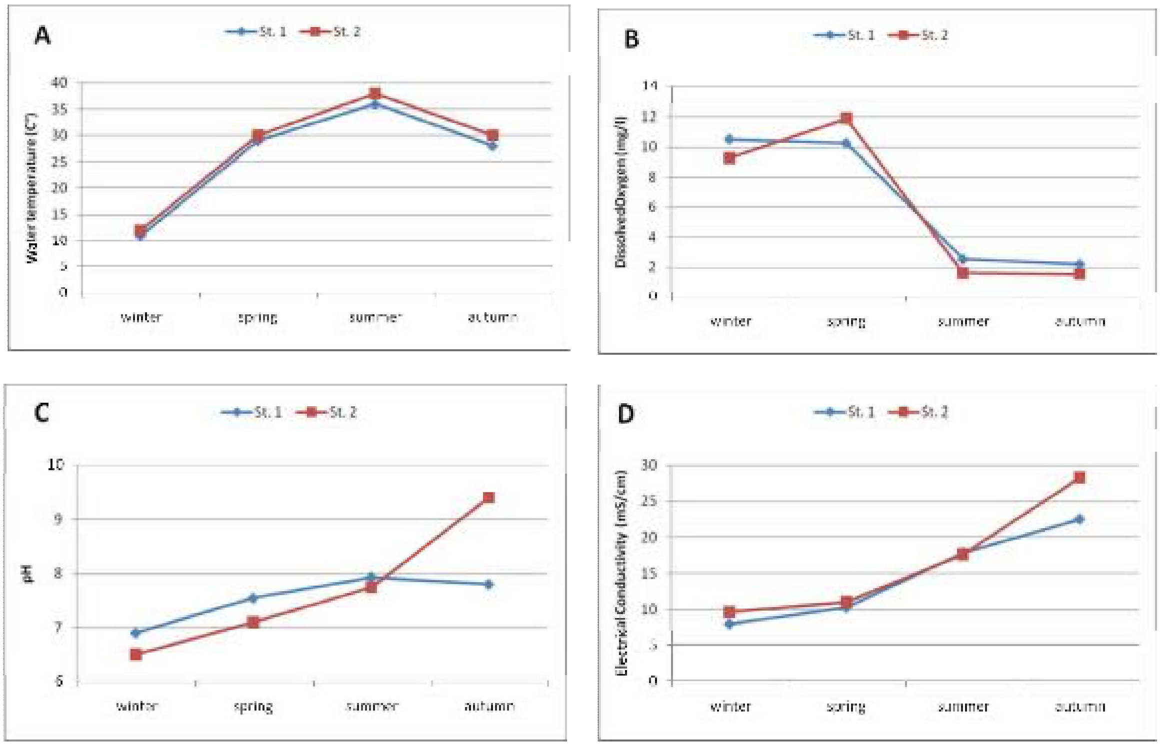

Figure2(A-D): Variations of water temperature, dissolved oxygen, pH and conductivity in Stations 1 and 2 from winter 2008 to autumn 2009 in the SNR.

Table 1: Aquatic macrophytes occurrence in SNR from December 2008 to November 2009 (**E** denotes emergent while **S** submergent species; **+** Denotes presence while – absence of the species).

Species	Habitat	Common Name	Family	Dec 08	Jan 09	Feb 09	Mar 09	Apr 09	May 09	Jun 09	Jul 09	Aug 09	Sep 09	Oct 09	Nov 09
Phragmites australis (Cav.) Trin.ex.Steud	E	Common reed	Poaceae	+	+	+	+	+	+	+	+	+	+	+	+
Schoenoplectus litoralis (Schrad) Palla	E	bulrush	Cyperaceae	+	+	+	+	+	+	+	+	+	-	-	-
Typha domingensis Pers.	E	Cattail	Typaceae	+	+	+	+	+	+	+	+	+	+	+	+
Ceratophyllum demersum L.	S	coontail	Ceratophyllaceae	+	+	+	+	+	+	+	-	-	-	-	-
Myriophyllum spicatum L.	S	Eurasian water milfoil	Haloragaceae	+	+	+	+	+	+	-	-	-	-	-	-
Hydrilla verticillata (L.f.) Royle	S	water thyme	Hydrocharitaceae	+	+	+	+	+	+	-	-	-	-	-	-
Valisneria spiralis L.	S	Wild celery	Hydrocharitaceae	+	+	+	+	+	+	-	-	-	-	-	-
Najas marina L.	S	Spinynaiad	Najadaceae	+	+	+	+	+	+	-	-	-	-	-	-
Potamogeton crispus L.	S	Curley leaf pondweed	Potamogetonaceae	+	+	+	+	+	+	-	-	-	-	-	-
P. pectinatus L.	S	Sago pondweed	Potamogetonaceae	+	+	+	+	+	+	-	-	-	-	-	-
P. perfoliatus L.	S	Perfoliate pondweed	Potamogetonaceae	+	+	+	+	+	+	+	-	-	-	-	-
Chara vulgaris Valliant	S	muskgrass	Charophyceae	+	+	+	+	+	+	-	-	-	-	-	-
		Total		**12**	**12**	**12**	**12**	**12**	**12**	**5**	**3**	**3**	**2**	**2**	**2**

Table 2: Variability of terrestrial species in the SNR from December 2008 to November 2009.

Plant species	Common name	Habitat	Family
Ziziphus spina-christi	Paliurus	Tree	Rhamnaceae
Cynanchum acutum L.	Stranglewort	Shrub	Asclepiadaceae
Lycium barbarum	Chinese box thorn	Shrub	Solanaceae
Tamarix ramosissima	Salt cedar	Shrub	Tamaricaceae
Suaeda aegyptica (Hasselq.) Zohary	Annual seep weed, seablite	Sub shrubs	Chenopodiaceae
Suaeda vermiculata Forssk.	Annual seep weed, seablite	Sub shrubs	Chenopodiaceae
Alhagi graecorum Boiss.	Camel thorn	Herb	Leguminosae
Atriplex leucoclada Boiss.	Saltbush	Herb	Chenopodiaceae
Chenopodium mural L.	Nettle leaf goosefoot	Herb	Chenopodiaceae
Erodium cicutarium	Storks bill	Herb	Geraniaceae
Hordeum vulgare	Barley grass	Herb	Poaceae
Malva parviflora	Khubbaz	Herb	Malvaceae
Picris babylonica	Huwaithian	Herb	Asteraceae
Polygonum aviculare	Birds tongue	Herb	Polygonaceae
Salsola soda	Opposite leaved saltwort	Herb	Chenopodiaceae
Senecio desfontainei	Liferoot, ragwort	Herb	Asteraceae
Silybum marianum	Blessed milk, Blessed thistle	Herb	Asteraceae
Sisymbrium irio	Wild mustard	Herb	Cruciferae
Sonchus oleraceus L.	Hog grass, common sow	Herb	Asteraceae
Spergularia salina L.	Lesser sea spurrey	Herb	Caryophyllaceae
Trigonella anguina	Factorovskya	Herb	Leguminosae

Amongst all the macrophyte species Phragmites australis has shown to be an effective and successful invasive plant sexually reproducing by seeds and expanding also through rhizomes having the ability to rapidly recover after damage to aboveground growth (Meyerson *et al*., 2000); Figure 3 shows this specie growing during low water levels.

It is important to pint out that a variation in the vegetation cover as percentage and the number of individuals per square meter occurred in the SNR through out the period of study (Tables 3 &4 and Fig. 4). During the first months (Dec 2008-Feb 2009) an increase in density and cover occurred as result of the rainy season resulting in the higher values. Later on although the plant cover was high the density fell with the decline of emergent wetland vegetation showing a variation in plant dynamics and diversity. These must likely was due to the high rates of evaporation and continuous loss of soil moisture followed by increasing salinity (Shalyout and El-Sheikh, 1993; Keddy, 2000; Alvarez-Cobelas and Cirujano, 2007). Finally after July until the end of the study (November 2006) both the cover and density reached the lowest levels also due to water shortage.

Figure 5 illustrates the contrast between the growth of common reed in January 2009 and July of the same year in terms of biomass production. The peak was reached in July of the same year with 1355 g dw. m^{-2} as the plant stored most of the organic matter. On the other hand, submerged plants did not record any significant cover or biomass production.

Figure 3. Dense growth of the macrophyte *Phragmites australis* during low water in certain areas of the SNR. (photo by: D. A. Al-Abbawy)

Table 3: Monthly average vegetation cover as percentage and Standard Deviation (± SD) of *Phragmites australis* in SNR from December 2008 to November 2009.

Month	Dec 08	Jan 09	Feb 09	Mar 09	Apr 09	May 09	Jun 09	Jul 09	Aug 09	Sep 09	Oct 09	Nov 09
Average	15	48.3	51.5	65	61.6	58.5	65.5	24	9	5	5	5
± SD	6.3	29.3	18.7	23.0	13.6	11.3	12.3	10.1	4.89	0	0	0

Table 4: Monthly number of individuals per m^2 and Standard Deviation (± SD) of *Phragmites austalis* in the SNR from December 2008 to November 2009.

Month	Dec 08	Jan 09	Feb 09	Mar 09	Apr 09	May 09	Jun 09	Jul 09	Aug 09	Sep 09	Oct 09	Nov 09
Average	31	54	74	47	65	50	73	52	64	42	37	37
± SD	11.8	7.7	30.9	30.1	17.8	10.1	12.1	21.5	13.4	10.1	8.3	15.8

Figure 4: Variations of *Phragmites. australis* in the density (ind / m^2) and as cover percentage in the SNR from winter 2008 to autumn 2009.

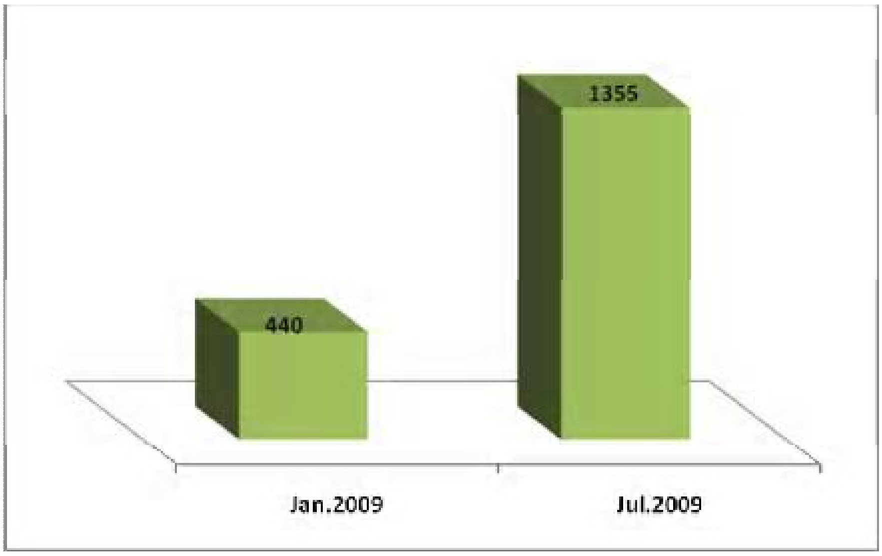

Figure5: The pick value in Biomass production (g/m^2) of *Phragmites. australis* in the SNR appeared in July 2009 while the lowest in January of the same year.

4- Discussion

The present study showed that the most dominant specie in SNR was the common reed *Phragmites australis* due to its wide tolerance range to changes in water levels, salinity and soil dryness (Table 1). The plant often forms monocultures with very densely vegetation cover under strenuous conditions (Ailstock, 1999; Alwan, 2006; Al-Hilli *et al.*, 2009). Other wetland species such as *Typha domingensis* and *Scoenoplectus litoralis* which are more sensitive to salt (Abd El-Ghani, 2000) showed restricted growth in the form of small patches where water was still present. As it happens, *Phragmites* communities occurred often where moisture was the lowest and salinity was the highest, while *Ceratophyllum* and *Potamogeton* communities occurred where moisture was the highest and salinity was the lowest.

Increasing of water temperatures during the hot dry months in Iraq augment evaporation rates resulting in a continuous water decreased levels in the Tigris and Euphrates rivers flowing from Turkey and Syria as well as from the Al-Kargha River, Al-Masharah and Al-Kahla Rivers from Iran into the Reserve. This situation also affects the water depth and transparency. The high evaporation decreases dissolved oxygen while increases salt concentration increasing the stress on many aquatic species.

It is worth to highlight that the recent closing of the river flow from Iran (Al-Kargha, Al-Masharah and Al-Kahla Rivers) has enormously increased the degradation speed and desertification process in the Reserve resulting in most serious effects on many aquatic macrophytes. This has led to the clear deterioration of the wetland vegetation, particularly of submerged species and habitats resulting in their disappearance in large areas.

The present study has highlighted the fact that there is a continuous negative effect as a result of decreasing water quality and quantity in the SNR and also high turbidity, growth of filamentous algae and an increase in salinity, which in turn also has a direct effect on the freshwater ecosystem as a whole and biomass production particularly in aquatic plants (Williams, 1998; Watt *et al*., 2007; Al-Abbawy, 2009). All these reasons causing important shifts in plant community composition as well as loss of biodiversity. The fact that as much as one hundred percent of the submerged species have disappeared in many areas and the reduction of up to 83% of plant biodiversity in the Reserve, there is a real threat to the wildlife. This situation is particularly representative of what is happening in the Al- khabtta site (Fig. 6).

Another cause related to the degradation and disappearance of the macrophytes in the SNR is the continued and direct impact through the burning processes of common reed by local villagers which have negative impact on the plant's life cycle and the biodiversity as a whole in the SNR. burning processes of common reed by local villagers (Fig.7A-B).

There is also the need bear in mind that the absence or lost of many important native submerged species will certainly have a direct impact on the whole productivity of the marshland of Iraq such as shrimps, fish and birds (including migratory species). Further, the changes in the ecological conditions such as increasing in soil salinity will create a favorable environment for establishing salt tolerant communities such as salt bush *Atriplex leucoclada* and salt cedar *Tamarix ramosissima* is heavily altering the original characteristics of the marsh ecosystems. There is an ongoing biodiversity disaster and conservation failure in the Reserve.

As a an alternative, it would also be necessary to consider the transfer of water into the SNR from nearby sources such as branch of Tigris River, The possibility of building an artificial channel for the purpose may prove to be most also crucial for the survival of the reserve's ecosystem and biodiversity; but is is vital that for the survival and the wellbeing of the SNR the restoration of vital water flows with the border with Iran from the east through the Al-Kargha River and via Al-Masharah and Al-Kahla Rivers from the north.

Further, similar strong and decisive efforts should be intensified at a national and international levels to ensure better water inflow of the Tigris and Euphrates from Turkey, Syria and Iran so that more water is release to sustain life in the marshes of Southern Iraq.

Figure 6: Disappearance of aquatic macrophytes and vegetation cover in Al-khabtta in November 2009 accelerating the desertification process in the SNR. **(photo by: D. A. Al-Abbawy)**

Figure(A-B) 7: Continuous burning processes of reed beds by the local villagers in SNR destroyed ecotone and enhanced soil and bank erosion. **(photo by: D. A. Al-Abbawy)**

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حالة النباتات المائية في محمية الصافية الطبيعية جنوب هور الحويزة في العراق

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الخلاصة

درست النباتات المائية في محمية الصافية الطبيعية للمدة بين شهر كانون الأول 2008 إلى شهر تشرين الثاني 2009 لمعرفة حالة المجتمعات النباتية فيها ووضع قاعدة بيانات لها. أخذت عينات شهرية لتحليلها نوعيا وكميا،اذ تم تسجيل 33 نوعا نباتيا منها 12 نوع تعود الى النباتات المائية . كان مجتمع نبات القصب *Phragmites australis* سائدا في المحمية بينما تواجد نباتي البردي *Typha domingensis* والجولان *Scheonoplectus litoralis* في مساحات صغيرة فقط.

تم ملاحظة تغايرات في تركيب الانواع وانخفاضا في النسب المئوية للتغطية النباتية وخلال الاشهر الثلاث الاخيرة من الدراسة(ايلول ،تشرين الاول ،تشرين الثاني)اختفت النباتات المائية في المحمية ماعدا نباتي القصب والبردي واصبحت النباتات الملحية كنبات الاثل *Tamarix ramosissima* سائدة في المحمية . تعاني محمية الصافية من التصحر الذي يعود الى قلة في كميات المياه الداخلة اليه من نهري دجلة والكرخة وقد اصبح الوضع حاليا اسوأ ويعود ذلك الى اغلاق الجدول المغذي للمحمية من الجانب الايراني.

ان اختفاء الكثير من انواع النباتات المائية المتوطنة في جنوب العراق في المحمية اشارة سلبية على التأثيرات العديدة على التنوع الاحيائي.