Marsh Bulletin *4(2)(2009) 121-136*

MARSH BULLETIN

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Influence of some ecological factors on plant tall, cover percent and biomass of *Phragmites australis* in marshes of southern Iraq after inundation

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Abstract

Common reed (*Phragmites australis* (Cav.) Trin.ex Steud.) is one of the widely distributed plant species on earth, and considered a highly biological and ecological valuable plant species. *P. australis* of three Iraqi marshes (Huwaiza, Chebaish and East Hammar) after inundation was studied from 2006 to 2007. Different main factors were studied for plant vegetation cover in the marshes included water depth, electrical conductivity(EC), nutrient content in sediment and direct human impact. Significant differences in maximal aboveground biomass among the three marshes were observed, with positive correlation between increasing in water depth and nutrient content with plant tall, cover percent and biomass production. The result showed that *P. australis* have acclimatization to deep water with phenotypic plasticity through allocating more resources to stem weight and also by producing taller stems.

1- Introduction

Wetland areas are of extraordinary importance for the conservation of wild life because of the presence of higher aquatic macrophytes. *Phragmites australis* ((Cav.) Trin. ex Steud.), the perennial grass known as common reed, is one of the widely distributed plant species on earth(Struyf *et al*,2007). The species is characterized by a very wide ecological amplitude and thus it occurs in habitats of very different trophic status. It is common in freshwater wetland habitats where it is establish in specific zones with respect to water level (Coops *et*

al., 1996; Vretare *et al*., 2001). It is generally accepted that common reed and other helophyte plants are the most productive of plant communities (Hutchinson 1975,Wetzel 1988,Westlake *et al*. 1998). The structure and function of aquatic macrophytes communities is determined by a large number of factors, biotic and abiotic, and related ecological processes. Identifying these factors and processes and understanding how they interact to influence the patterns of abundance and distribution of both plants and animals is necessary to effectively manage the wide set of biological resources.

Biotic and a biotic factors and their interactions through ecological processes determine the structure and function of biological communities (Frazer *et al*., 2006). In wetlands, the forces shaping aquatic plants assemblages are important because these assemblages play critical roles in supporting healthy ecosystems and human activities (Williams and Heck, 2001). *Phragmites australis* species can be a natural component of a healthy marsh community, it is a wide climatic tolerance and can tolerates flooding, frost, high pH and salts (Marks *et al*., 1994; Duke, 1998).

The importance of water depth in regulating emergent plant species composition, distribution and abundance in marshs and littoral zones has been acknowledged (Spence, 1982; Ostendorp, 1991; Papastergiadou and Babalonas, 1992; van der Valk *et al*., 1994). Water depth is a dynamic factor, changing temporally and spatially in marshes and littoral zones (Rea and Ganf, 1994).

The aim of this study was : to provide a better understanding of relationship between the growth of *P. australis* and the changes in water depth, electrical conductivity, sediment nutrient and human impacts after inundation of Iraqi southern marshes.

2- Study Sites

This study was conducted within three restored marshes of southern Iraq during Jan.2006 to Dec.2007 included Huwaiza, Chebaish and East Hammar (Figure 1). Six sites on the larger portion of the marshes (S1-S6) with a global positioning system (GPS) were chosen for studying recent *P. australis* establishment.

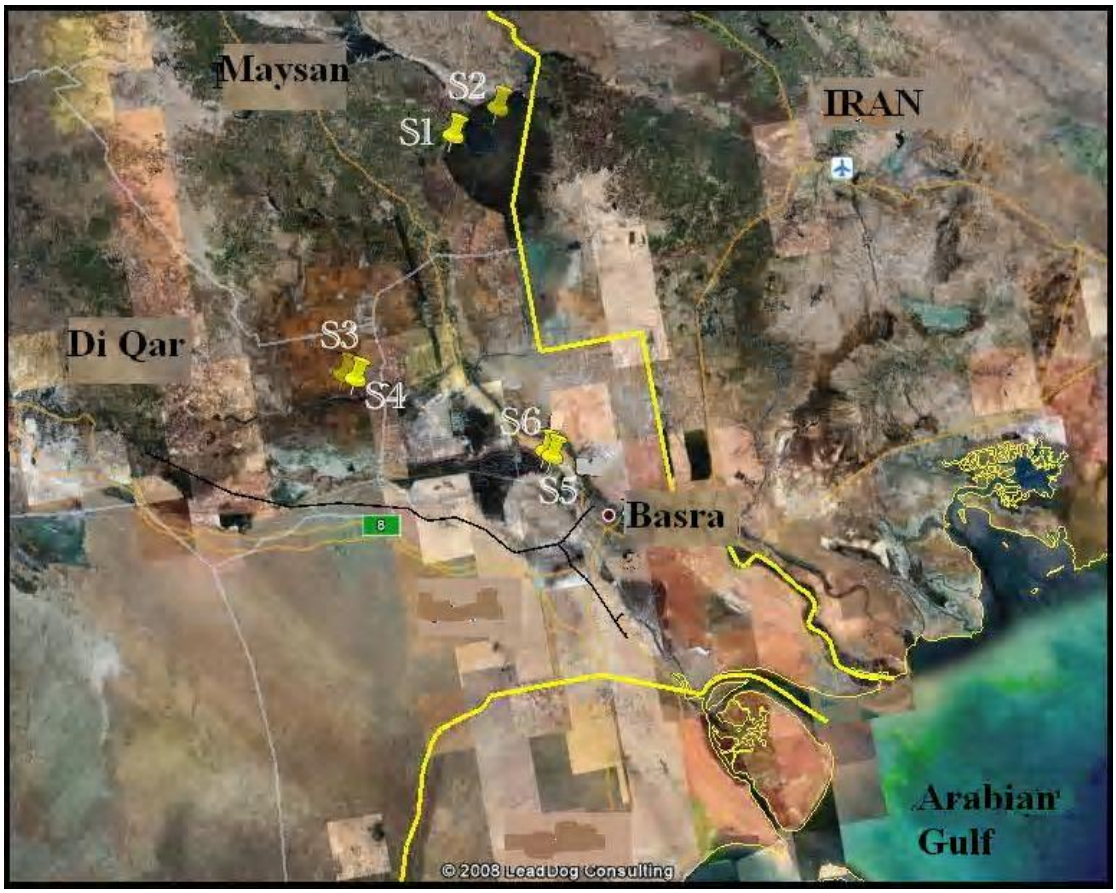


Figure 1: Samples sites from study area (source: Google earth)

3- Material and Methods

Water sampling

Water depth was determined using measured rope, while electrical conductivity was measured in field using Horiba multimeter.

Sediment nutrient

Sediments samples (0-10 cm sediment sections) were collected from six sites. Samples were air dried in the laboratory, ground and passed through a 2mm sieve. The total nitrogen (TN) was determined by the Kjeldahl method according to Jackson (1958), and the exchangeable phosphorus (EP) using Murphy and Riley (1962).

Plant cover

Estimation of cover percent was done using transects and quadrat methods depending on Braun-Blanquet scale. Twenty replicates were taken in each site monthly during study period.

Aboveground biomass

In order to quantify the biomass of *Phragmites australis* in the three marshes,

two sites sampling in each marsh were established in homogeneous vegetation areas. Aboveground biomass sampling was taken in July when plants are fully grown by using 1 m^2 quadrats and harvesting plants near the ground level.

Sampling started in January 2006, and continued until December 2007. A total of 240 samples were thus obtained. They were washed and vigorously shaken in a plastic tray of water to eliminate sediment and epiphytes, air dried in a greenhouse and weighed until fixed. The aboveground biomass of *Phragmites* was estimated as dry weight per surface unit.

3- Results

Water depth and Electrical conductivity

Analysis of some water measurements (Fig. 2 and 3) during 2006 and 2007 showed that the highest values of water depth were recorded in Huwaiza that ranged between 200-310 cm , and it were from 110-250 cm in Chebaish, while the lowest values were recorded in E. Hammar that ranged from 50-180 cm(Fig. 2).

The highest values of EC were recorded in E. Hammar that ranged between (3037-6260 $uS.cm^{-1}$), and it were between (2699-5738 $uS.cm^{-1}$) in Chebaish, while the lowest values were recorded in Huwaiza that ranged between (936-1923 $uS.cm^{-1}$). (Fig. 3).

Sediment nutrients

In sediment samples (Fig. 4), it was clear that the highest values of total nitrogen (%TN) were recorded in Huwaiza and Chebaish during2006- 2007 that averaged 0.25%, while it was 0.16% in E. Hammar. The highest mean of Exchangeable phosphorus values were found in Huwaiza (1.68), while it was 1.39 and 0.96 mg/g in Chebaish and E. Hammar respectively (Fig. 5).

Plant Tall, cover and biomass

(Fig. 6 A,B and C) showed that *Phragmites australis* in Huwaiza marsh recorded the highest values of plant tall, cover percent and biomass in comparison with other marshes during 2006 and 2007.

Positive relationship was found between water depth and plant tall, cover percent and biomass of *Phragmites* in all marshes. The highest value of water depth makes the highest value of plant tall, cover percent and biomass.

The results showed the same direct of plant tall, cover percent and biomass of *Phragmites* (Fig. 6) related with water depth and EC in the different marshes.

Fig. 7showed negative relationship between electrical conductivity of water and plant tall, cover percent and biomass of *Phragmites* in all marshes. The highest value of EC makes the lowest values of plant tall, cover percent and biomass.

Fig. 8 and 9 showed that sediment nutrient (%TN and EP) had clear positive effects on plant tall and also on cover percent and biomass of *Phragmites*.

The results showed positive relationships between all of plant tall, cover percent and biomass of *Phragmites* in both study years (Fig 10).

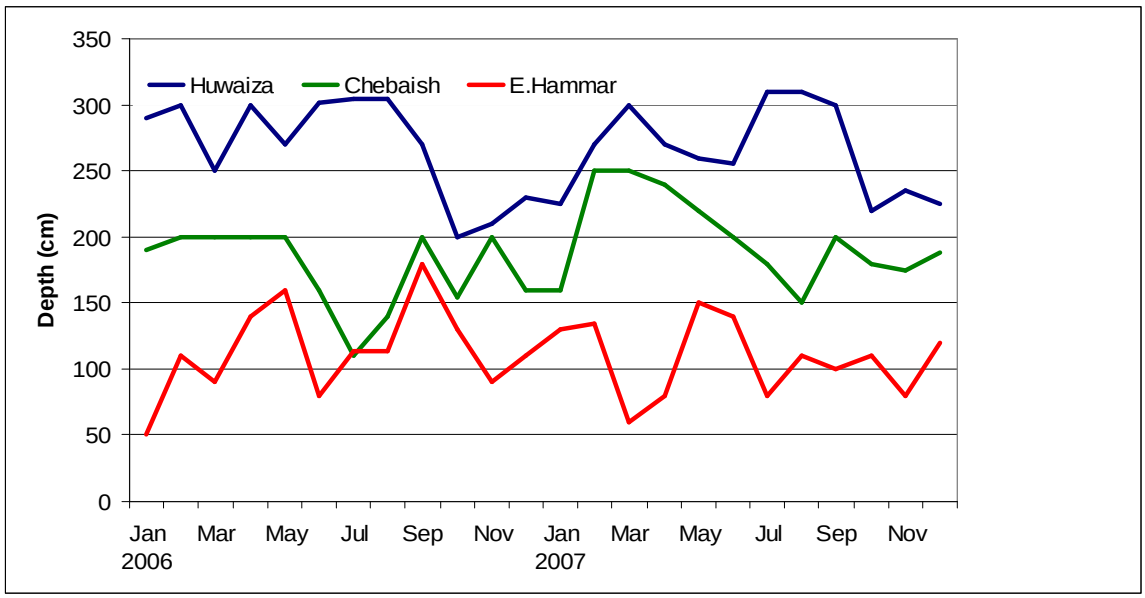


Figure 2: Monthly variation of water depth in different marshes during 2006-2007

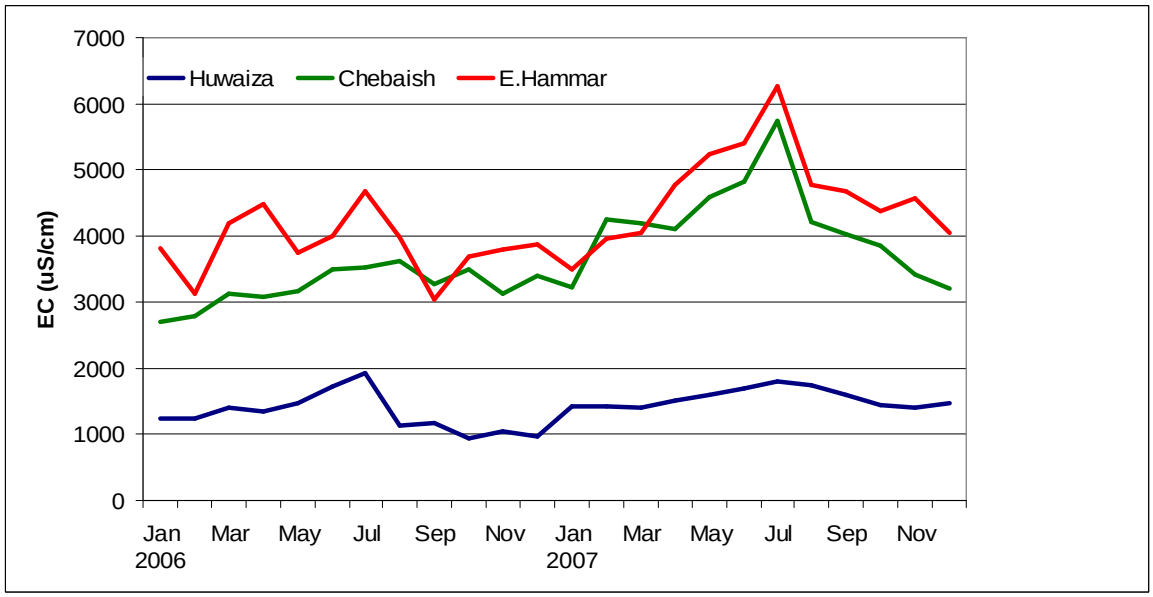


Figure 3: Monthly variation of water EC in different marshes during 2006-2007

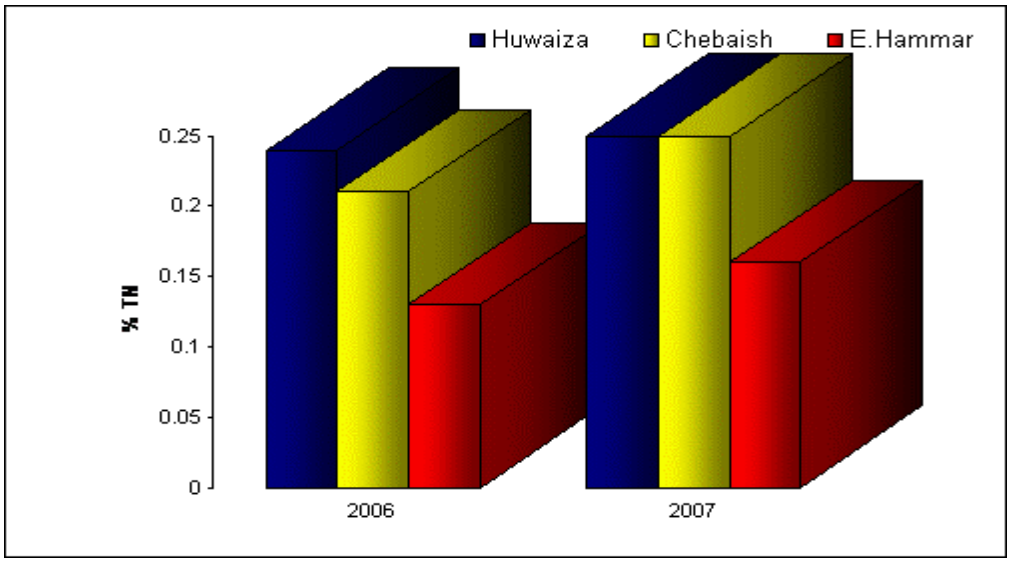


Figure 4: Variation of %TN in sediment of different marshes during 2006-2007

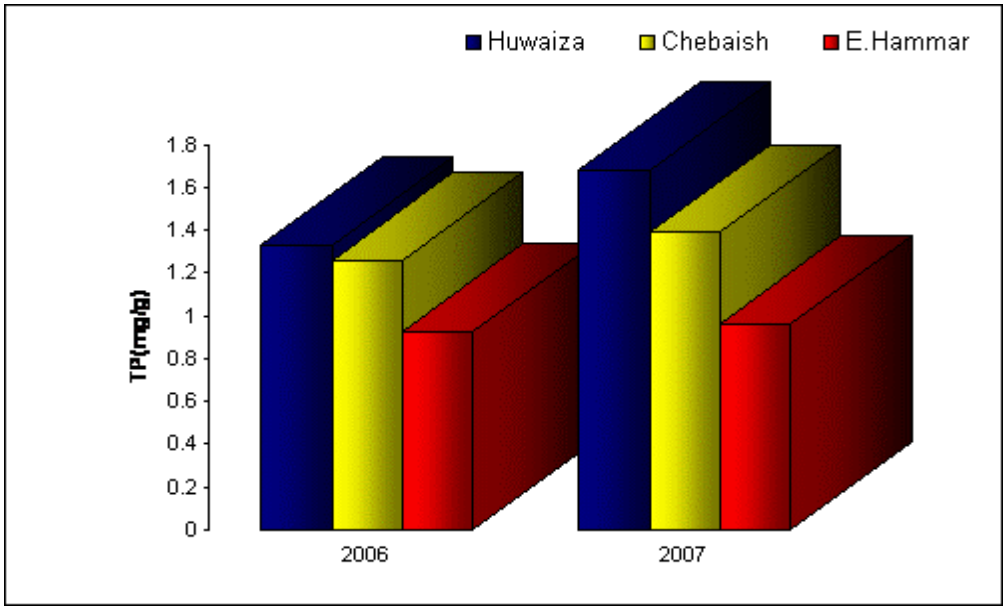


Figure 5: Variation of EP in sediment of different marshes during 2006-2007

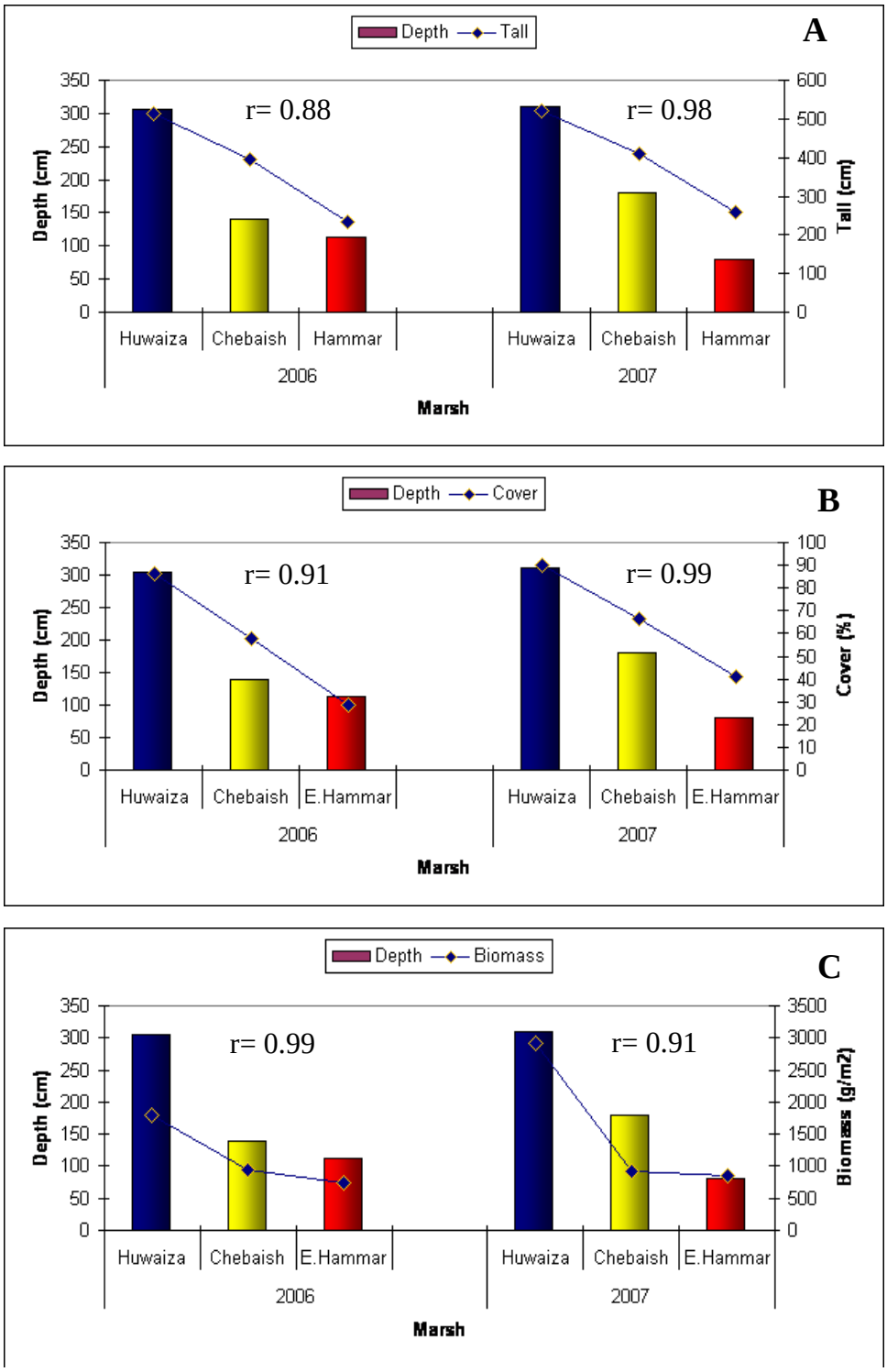


Figure 6: Relationship between water depth and plant tall (A), Cover percent (B) and Biomass (C) of *P. australis* in the three marshes during 2006-2007

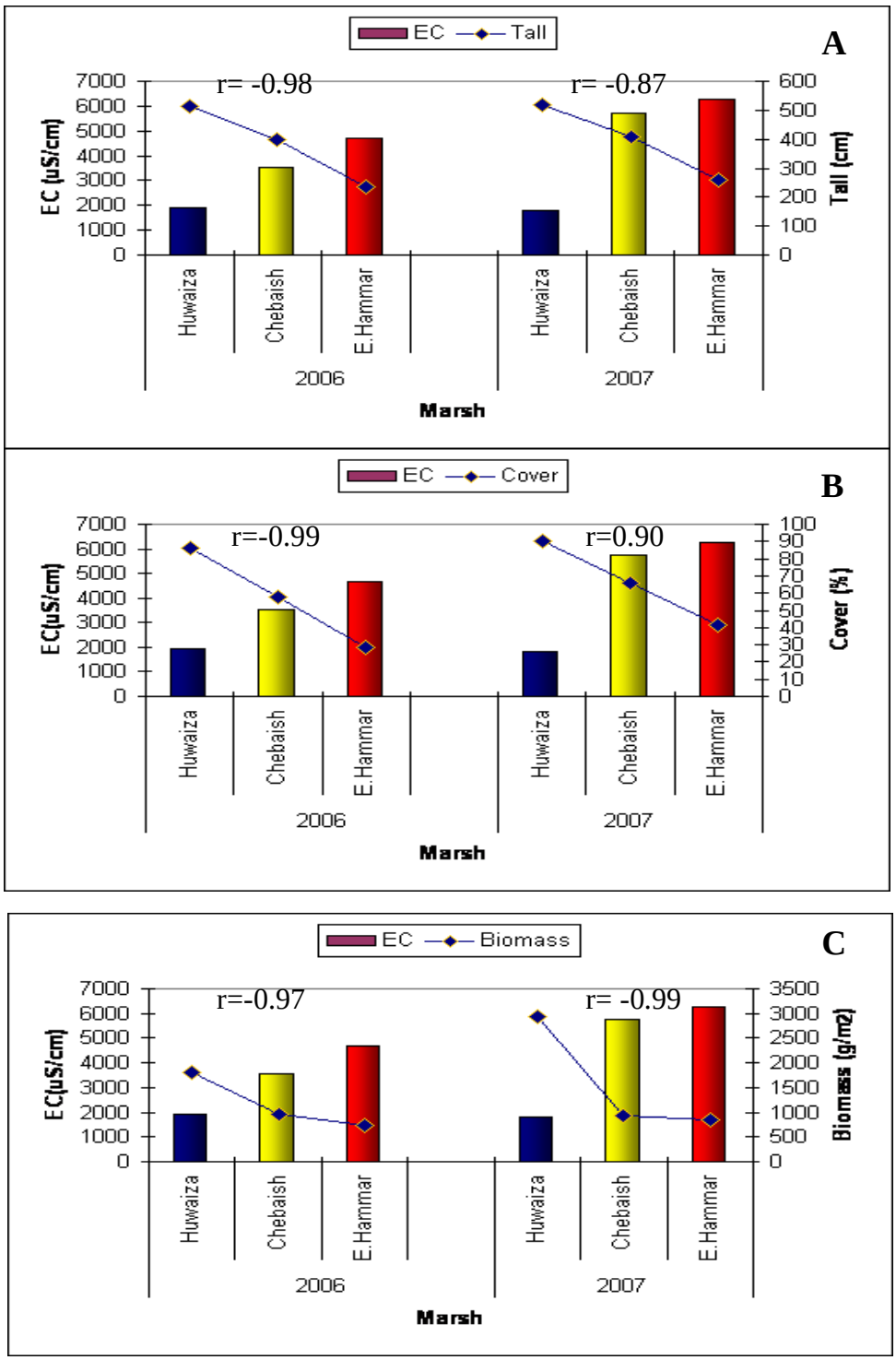
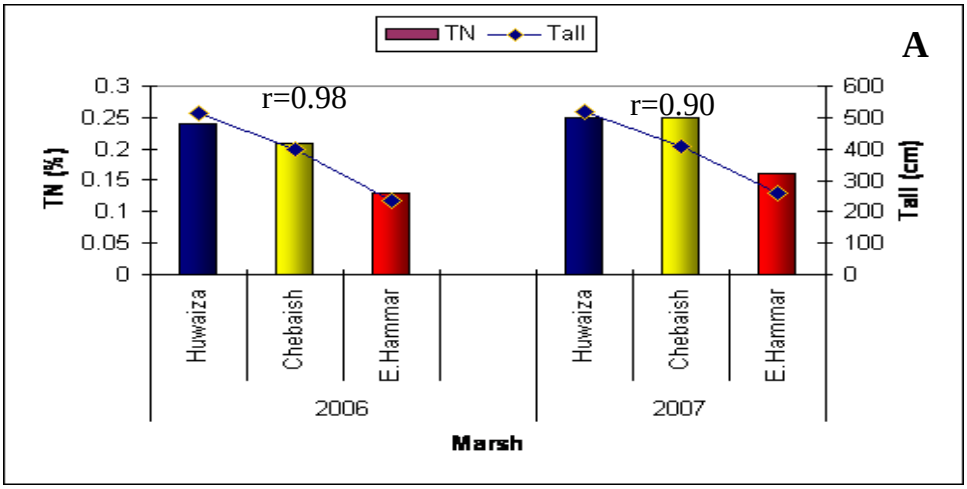
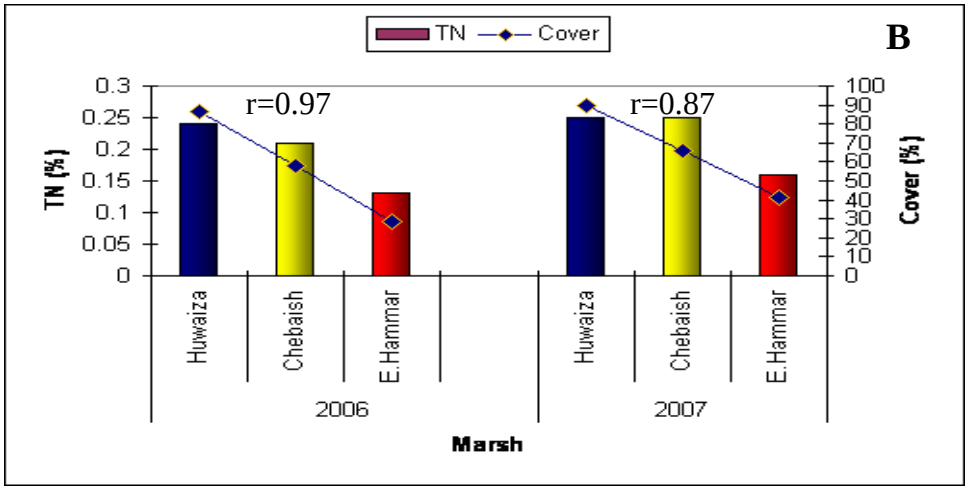


Figure 7: Relationship between EC and plant tall (A), Cover percent (B) and Biomass (C) of *P. australis* in the three marshes during 2006-2007





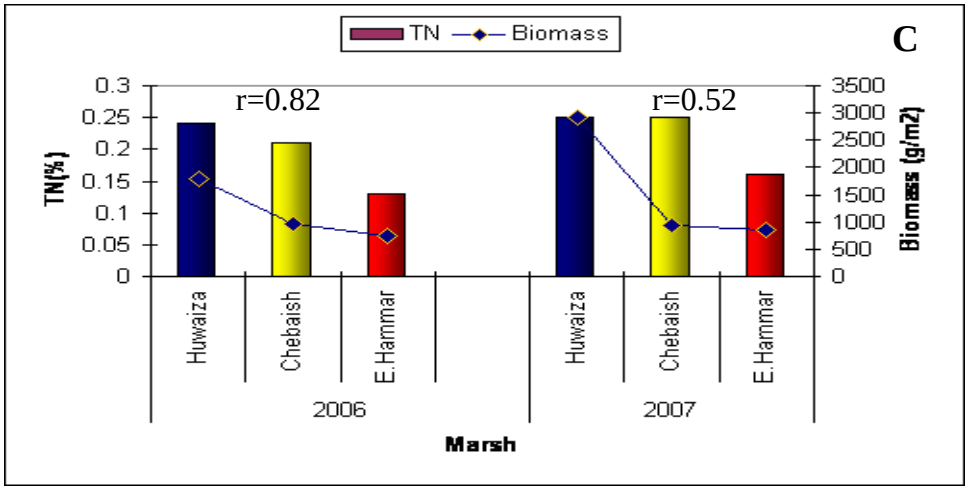


Figure 8: Relationship between %TN and plant tall (A), Cover percent (B) and Biomass (C) of *P. australis* in the three marshes during 2006-2007

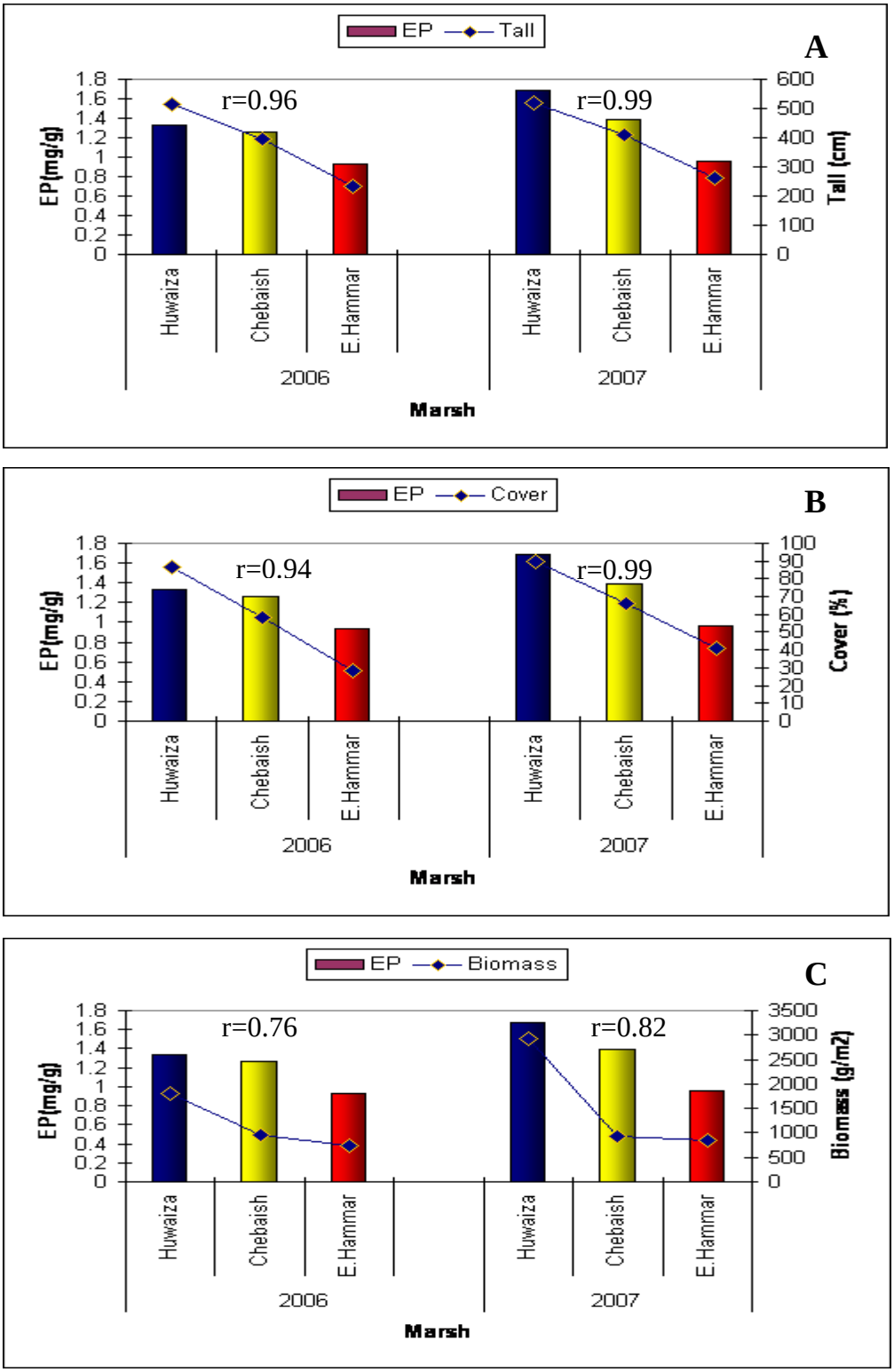


Figure 9: Relationship between EP and plant tall (A), Cover percent (B) and Biomass (C) of *P. australis* in the three marshes during 2006-2007

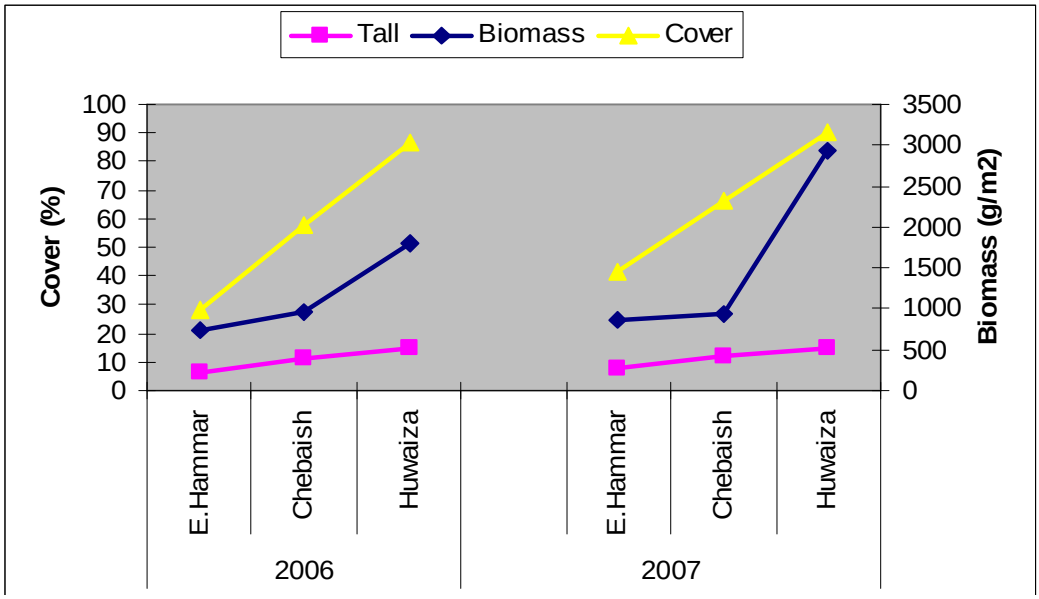


Figure 10: Relationship between plant tall, Cover percent and Biomass of *P. australis* in the three marshes during 2006-2007

Photographed by: D. A. H. Al-Abbawy

Discussion

The environment is a complex system of many interacting biophysical and socioeconomic components whose properties vary at different spatial and temporal scale**.** Macrophytes species are of crucial important in aquatic ecosystem as they serve major ecological roles in their environment. *Phragmites australis* community was the dominant species observed during the survey in all sites of the three marshes. It is grow very densely and cover large areas and is the obvious dominated community (Alwan, 2006). A wide tolerance range in water levels, salinity and dryness might explanation the dominance of this species in the study sites (Al-Hilli *et al*., 2009).

Water is the main source of material transfer into and out marshes. Freshwater marshes of south Iraq receive its water mainly from Tigris and Euphrates and E. Hammar also receive from Shatt Al-Arab River.

The results from monitoring water quality give a picture of the conditions present at the time, and in the sites of the study. Water depth, electrical conductivity and nutrient concentrations monitoring were measured. Individually, these characteristics may not reveal much information about marsh's water quality but when examined together a much clear picture of a marsh's health that seen in *Phragmites* community. Continued monitoring over a long time period gives an indication of how a marsh behaves throughout a year.

The effect of biotic parameters on the vegetation appears sometimes dramatic like saltiness occurred after marshes drainage before 2003. After inundation with a large quantity of water through opening many dikes by Arab marsh, the situation that gave a chance to different species such as *Phragmites australis* to regrow again. Vretare *et al*. (2001) mentioned that the importance of water depth is a regulating of emergent plant species distribution and abundance in wetlands and littoral zones.

Vegetation belts of *P. australis* are strongly depending upon variations in water qualities, inducing a seasonal variation in density (Talling and Lemoalle, 1998). *Phragmites* is highly competitive and produces aboveground biomass typically around 1000 g dw.m^{-2} (Struyf *et al*., 2007). *P. australis* stands are oxidize their rhizosphere with consequences for nutrient cycling and it is sequestration nitrogen and phosphorus highly compared to other species, so variations in biomasses will appear in values for nutrient accumulation (Sorrel *et al*., 1997; Struyf *et al*., 2007). The highest values of plant tall, plant cover and biomass of *P. australis* were recorded in

Huwaiza marsh which have the highest water depth and lowest values of EC with high values of nutrient content in its sediment beside the lowest human impact on vegetation by cutting and grazing during study period. The lowest values of plant tall, cover percent and biomass were seen in E. Hammar marsh that was because of high values of EC, *P. australis* can be affected because osmotic forces can cause lethal water loss and also affected nutrient uptake, and that reflect the lowest values beside other factors such as water depth and human impact. Rolletschek and Hartzendorf (2000) explain the role of salinity both on production and morphology of reed. Chebaish marsh have good values of water depth and nutrient, but extensive human impact by cutting and animal grazing made the values of plant tall, cover percent and biomass go down.

P. australis serves as an excellent stabilizer of soil and acts as an efficient nutrient sink through its accumulation of large quantities of persistent biomass (Kuusemets and Lohmus, 2005). The amount of nutrient stored in the sediment can continue to fertilize the marsh for years into the future, so *P. australis* will have a continuous growth because of the presence of these available sedimentary nutrients in the study sites. It is clear that Huwaiza marsh was the precedence comparing with other two marshes in nutrient concentration available to *P. australis*.

Sediment and nutrient rich runoff due to human activities can lead to nutrient entering to the marshes via its sources and the thick helophyte belt acts an active filtration system for thin particles beside its role in the nutrient cycle to and from the sediment.

Finally damaged by human activities (settlement and livestock grazing) made negative effects on plant cover that led to small amounts of biomass in comparison with marshes of less or no human activities of plant cutting .

It can be concluded the main factor that may directly effects on plant tall, plant cover and biomass of *Phragmites australis* were water depth and electrical conductivity, sedimentary nutrient and human impacts.

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تأثير بعض العوامل البيئية على الطول والغطاء النباتي والكتلة الحية لنبات القصب في أهوار جنوب العراق بعد إعادة أغمارها

دنيا علي حسين العباوي و عبد الرضا أكبر علوان المياح
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الخلاصة

يعد نبات القصب *Phragmites australis* (Cav.) Trin.ex Steud أحد أكثر الأنواع النباتية انتشاراً على الأرض، وذو أهمية بيولوجية و قيمة بيئية عالية. درس نبات القصب في ثلاثة أهوار عراقية (الحويزة و الجبايش وشرق الحمار) بعد إعادة أغمارها من عام ٢٠٠٦ إلى عام ٢٠٠٧، وقد أظهرت النتائج وجود تأثير لبعض العوامل و هي عمق المياه والتوصيلية الكهربائية ومحتوى المغذيات(EP،TN)والتأثير المباشر للإنسان على الغطاء النباتي والكتلة الحية. وجد اختلافات معنوية في قيم الكتلة الحية فوق سطح التربة في الأهوار الثلاثة، و بوجود علاقة ارتباط موجبة بين زيادة عمق المياه وإنتاج الكتلة الحية. أوضحت النتائج أن نبات القصب يتأقلم للمياه العميقة من خلال خاصية المطاطية المظهرية عبر تجميع مصادر الغذاء لإنتاج كتلة حية وسيقان أطول.