MARSH BULLETIN 17(2) September (2022) 125– 135

MARSH BULLETIN

ISSN 1816-9848

The effect of environmental factors on the presence of aquatic plants, coverage percent and their biomass in the Euphrates River in Al-Muthanna province /Iraq

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Abstract

An environmental survey was conducted during the years 2020-2021 to study the impact of environmental factors on the coverage prestige and the biomass of aquatic plants in four sites in the Euphrates River in Al-Muthanna Governorate. Water temperature, pH, electrical conductivity, light transmittance, and dissolved oxygen were measured as environmental factors for water samples, and 13 aquatic plant species were recorded in the study stations. The results of the study recorded the highest values of plant coverage for *Phragmites australis*, *Ceratophyllum demersum*, *Eichhornia crassipes* and *Potageton crispus*, which amounted to 45%, 32%, 28%, and 22%, respectively, and the lowest vegetation cover was for *Azolla filiculoides*, which amounted to 12%, and *Typha domingensis*, which amounted to 5%, while were the highest values of the biomass of the dominant and most abundant aquatic plants during winter and summer for. *Eichhornia crassipes* and *Ceratophyllum demersum*, respectively 714.26 gm dry weight/m^2 and 902.73 gm dry weight/m^2 during summer, while *Phragmites australis* showed the highest value of biomass in the winter season, which was 978.51 g dry weight \ m^2.

Keywords: plant coverage, plant biomass, aquatic plants, Euphrates River.

Introduction

Aquatic plants represent one of the most important keys to the ecosystem. Knowing the functional characteristics of the dominant aquatic plants enables us to know the characteristics of the aquatic ecosystem. In addition, it gives a clear picture of the aquatic environment's reality and its use as a vital indicator to monitor its environmental condition (Hatzenbeleret. al, 2004). Aquatic plants play a major role in protecting and perpetuating rivers and water bodies. Its geographical distribution, cover percent, and biomass are directly affected by the water system and its chemistry and indirectly by changing biological diversity through the fragmentation of places and the creation of different environments, as well as its role in maintaining the aquatic ecosystem in terms of physical, chemical and biological aspects. In addition to softening the aquatic environment in terms of shading, preventing unusual fluctuations in temperature, controlling the state of the food impact, providing habitat and food for many aquatic organisms. Controlling fertilizers may be suitable for the growth of bacteria responsible for the cycle of nutrients and decomposing organic matter, as well as for the treatment and use of waste and sewage (Siracusa and La Rosa,2006).

Studying the constituent species and environmental and biological conditions related to aquatic plants are more important

steps for preserving and developing plant diversity. The main factor controlling the distribution of aquatic plants is the depth and duration of flooding. The growth and distribution of aquatic plants in water bodies are influenced by various environmental factors, including light and higher temperature, nutrient concentrations, and salinity in water bodies (Tamire and Mengistou 2013).

The length of the Euphrates River is about 2940 km, originating from eastern Turkey, and most of its flows are inside the Iraqi territory, about 1158 km (Vander, 1975). It has Five main tributaries along its course, but without any tributary inside Iraq. Trays through Syria enter the Iraqi territory from the central western part, run westwards to the central part of Iraq, and then meet with the Tigris River in the southern part (Sissakian et al., 2018). The Euphrates River is considered one of the important rivers in the Al-Muthanna Governorate. The river is used for agriculture, power generation, and as a source of water for drinking water purification plants. The length of the Al-Muthanna Governorate is about 110 km (Al-Khafaji, 2020).

May studies were conducted on the Euphrates River. Still, only a few do not give sufficient information about the impact of environmental factors on aquatic plants in the Al-Muthanna Governorate Al-Hadiary and Al-Zurfi (2014) conducted an environmental survey of the distribution of some aquatic plants in the Kufa River and recorded 61 species of aquatic plants belonging to 30 families. The direction of the river plants to the bottom was the dominance of the o species f submersible plants and the relinquishment of the species of floating plants. Al-Asadi (2014) examined the impact of some environmental factors on the distribution and abundance of submersible aquatic plants in Shatt Al-Arab River and marsh Al-Hammar. She explained that they are the most frequent during the study period of the *Ceratophyllum demersum* L. and the Hydrilla verticillata and Potamogeton community.

Al-Zaidi (2017) explained the assessment of the condition of submersible aquatic plants in some areas in the Shatt al-Arab, southern Iraq, and recorded the presence of three species of submersible aquatic plants and indicated their presence, coverage ratios, and biomass as Calculating biodiversity indicators, and noted that the sudden rise in salinity values and the increase in nutrients led To the deterioration of water quality, which affects the density of submerged aquatic plants. Al-Mayah and Al-Asadi (2018) recorded 31 species and estimated the status of aquatic plants in Shatt al-Arab River in southern Iraq, showing that the effect of high salinity values leads to the disappearance or decline of aquatic plant species in Shatt al-Arab River. Sabbar (2019) studied plant diversity in the Shatt al-Arab in southern Iraq, showing the species of aquatic plants, their distribution, coverage ratios, frequency, and biomass, as well as calculating plant diversity evidence, and recorded 104 plant species belonging to 70 genera that belong to 29 families, including 19 families of dicotyledons and 10 families of Monocotyledons and a family of ferns. Ali (2020) studied the effect of some environmental factors on the presence and spread of aquatic plants in the Tigris River in Maysan Governorate, southern Iraq, and 12 species of aquatic plants were recorded in this study. Yuns (2021) studied some environmental factors and aquatic plants in the Shatt al-Arab in Basra, southern Iraq, and the effect of environmental factors on their growth and spread and on terrestrial plants that thrive in humid areas near the banks and edges of the Shatt al-Arab.

Material and Methods

Study sites

The study was conducted on the Euphrates River within Al- Muthanna province, southern Iraq, from autumn 2020 to summer 2021. Four ifferent sampling stations located on the Euphrates River banks were selected in Al-Muthanna province. The GPS device determined the geographical locations of these stations.

Station 1:(31°42'40.34"N - 45°45'11.16"E) is located in Al-Hilal area, which belongs to Al- the Rumaitha District, distinguished by fishing activities and the dominance of many aquatic plants. Station 2:(31°.39748"N-45°.19188"E) before the Euphrates river enters samawa, it is characterized by the spread of aquatic plants such as the *Ceratophyllum demersum*.

Station 3: (31°31'49.46"N - 45°.29'72.79"E)in the samawa center near the Euphrates beach restaurant. It receives sewage water from Samawa city.

Station4:(31°.115265"N-45°.323829"E)in Khidr District south of the city of samawa, distinguished by agricultural activities and an abundance of aquatic plants.

Water samples from 10 cm below the surface were collected in three replicates on both sides of the river. Some physical and chemical factors are measured at stations directly, including water temperature, using a mercury thermometer of 0-100ºC and pH, and electrical(ECmS⁄cm), which was measured using a calibrated Horiba portable multimeter analyzer. Light penetration by Secchi disk (30 cm in diameter) and dissolved oxygen (mg/l) were measured following the procedures described in (APHA,2017). The plant samples collected for vegetation cover and aboveground biomass were (5) replicates for cover percents and (3) replicates for biomass. Samples were taken at each site using the quadrate method (1mx1m) by Willis (1973). Biomass samples were taken twice a year, in mid Summer and mid-Winter.

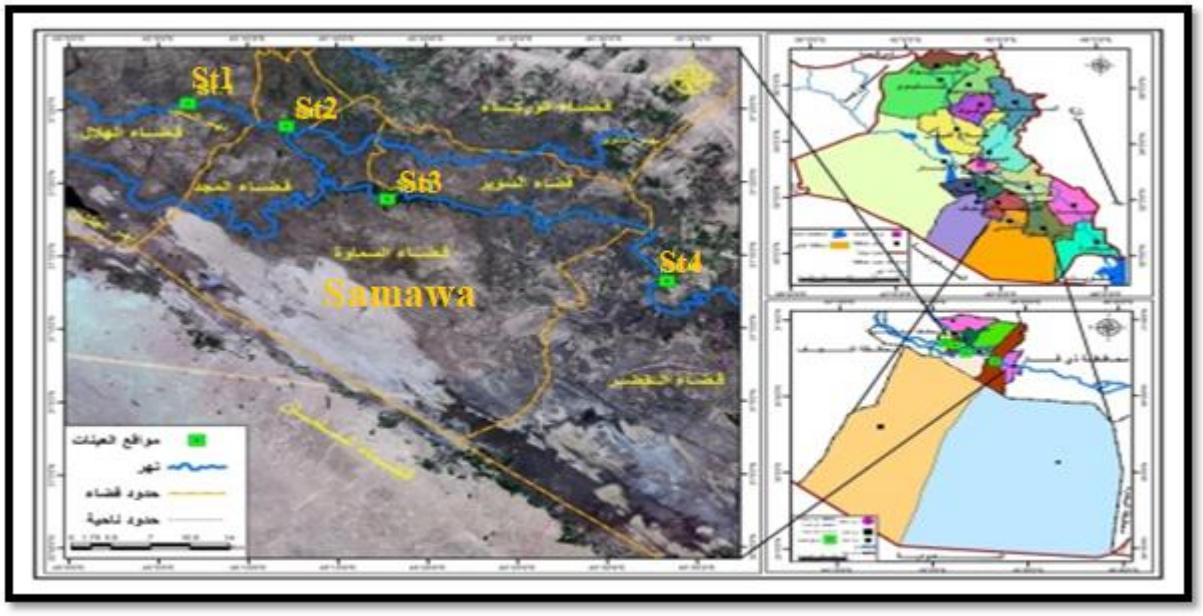

Fig. 1: Map of the study stations

Results and discussion

Environmental factors

Many Environmental factors affect the distribution, the coverage ratio, and the biomass of aquatic plant communities in the aquatic environment (Capers et al., 2010). Water temperature is one of the most important. Fig. 2 shows the seasonal and site variations in water temperature for the four selected study sites. The highest water temperature was 27º C during the summer. The lowest was 10.33º C during the winter. This is because the Euphrates River is affected by the nature of the climate of Iraq in general, where it is hot and dry in summer (Al-Atbee, 2018). Statistical analysis showed significant differences between the seasons of the year and all study stations at the probability level ($p \leq 0.05$). Except for the spring and winter seasons, no significant differences were observed at the probability level ($p \geq 0.05$).

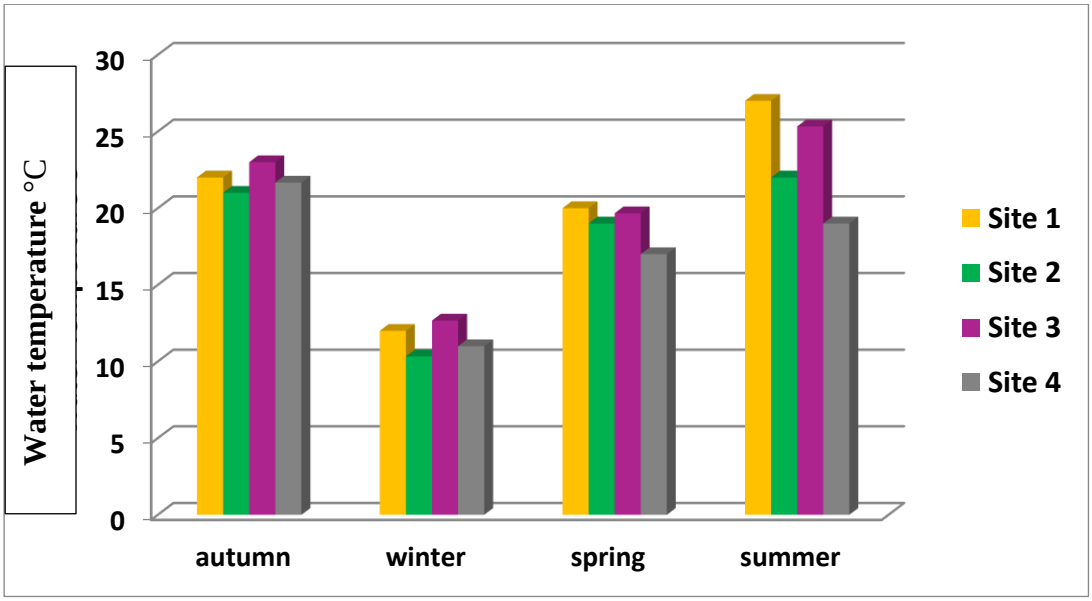

Fig 2: Seasonal changes in average water temperature (ºC) for the study stations.

Fig. 3 shows the seasonal and site variations in pH for the four selected study sites. The highest pH was 8.76 during the autumn, while the lowest was7.50 during the summer and spring. The pH value changes in one day due to the change in the balance between photosynthesis and respiration due to the change in the intensity of light and temperature throughout the day (Al-Khafaji,2021). The results of the statistical analysis showed that there were no significant seasonal and locational differences for all study stations at the probability level ($p \geq 0.05$)), except for the first and second stations and the summer season, in which Significant differences were noted at the probability level ($p \leq 0.05$).

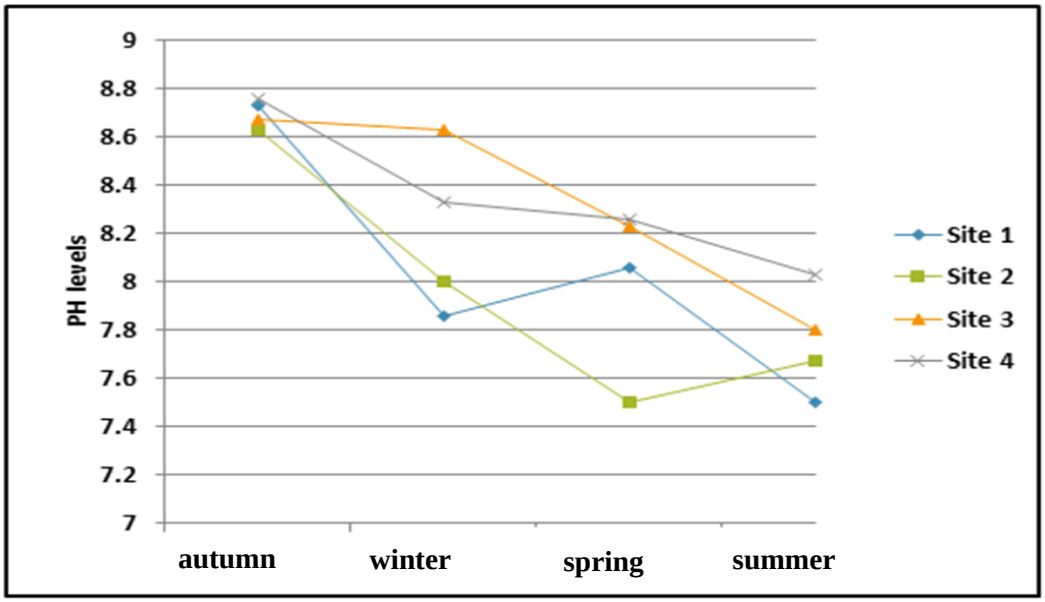

Fig 3: seasonally and Location changes in the pH values of the study stations

Figure.4 shows the seasonal and site variations in electrical conductivity for the four selected study sites. The highest 5083 µS/cm during the autumn. The lowest was3144 µS/cm during the summer because the low water level, which led to the concentration of dissolved salts, affected the studied area by agricultural land. It exposes the river to household waste and wastes that are thrown into the river without treatment or because the area is surrounded by limestone to reduce river erosion (Al-Shammari, 2014). The results of the statistical analysis showed that there were significant differences between the study seasons and stations at the probability level ($p \leq 0.05$), except for the fall and winter seasons, in which no significant differences were observed at the probability level ($p \geq 0.05$).

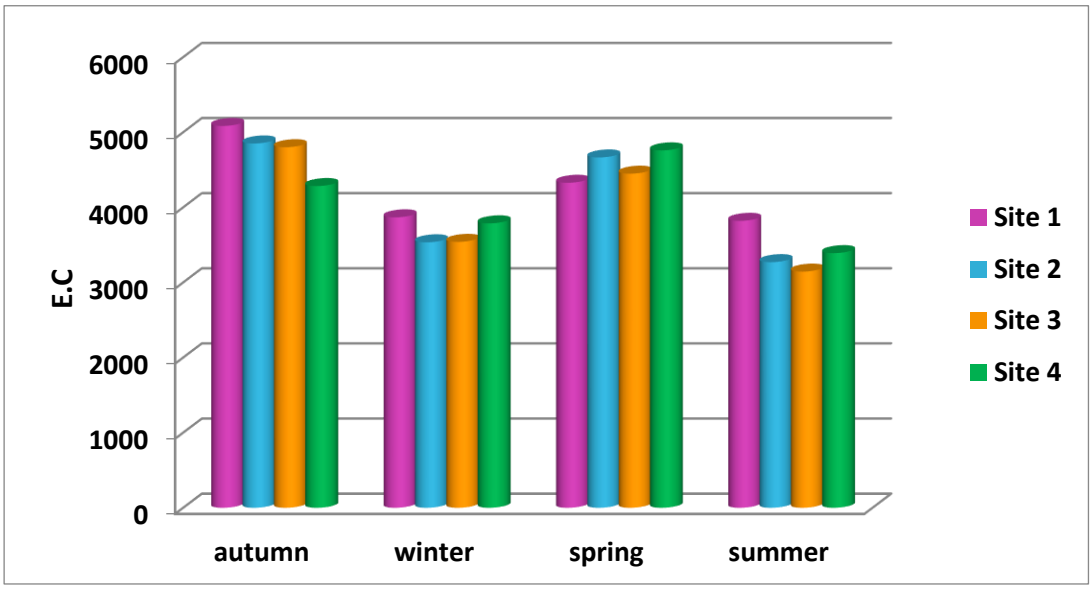

Fig 4: Seasonal and local changes in electrical conductivity values (µS/cm) for study sites.

Figure 5 shows the seasonal changes in light transmission values through the water column in the four study stations. The highest value was recorded at 74 cm in the

winter season and the lowest at 19.67 cm in the summer. It allows suspended substances to precipitate and thus leads to a decrease in turbidity and an increase in light transmittance in the water column (Yunus, 2021). The results of the statistical analysis showed that there were significant differences between the study seasons and stations at the probability level ($p \leq 0.05$), and no significant differences appeared for the fall and summer and the second and third stations at the probability level($p \geq 0.05$).

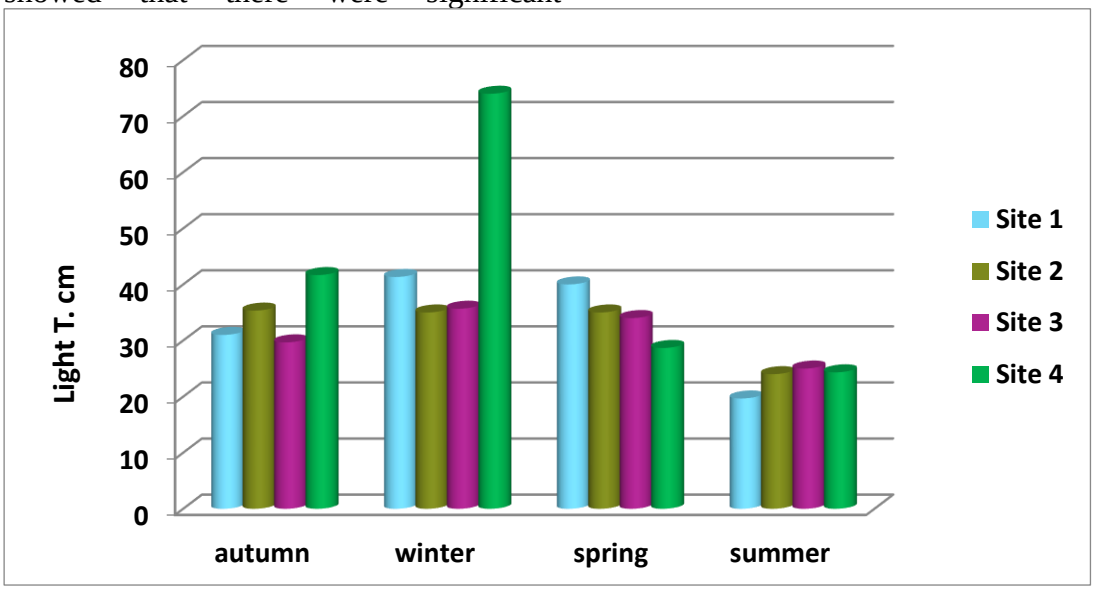

Fig 5: Seasonal and local changes in Transmission of Light values (cm) for study stations

Figure 6 shows the seasonal and local changes in dissolved oxygen values in the four study stations, the highest of which was 14 mg/L in the spring and the lowest at 4.83 mg/L in the fall, due to the increase in the efficiency of the photosynthesis process by aquatic plants and plankton that lead to a rise in the concentration of dissolved oxygen in the water (Jhashy,2014). The results of the statistical analysis showed that there were no significant seasonal and local differences for the study stations at the probability level ($p \geq 0.05$)), except for the first station, a significant difference was noted at the probability level ($p \leq 0.05$).

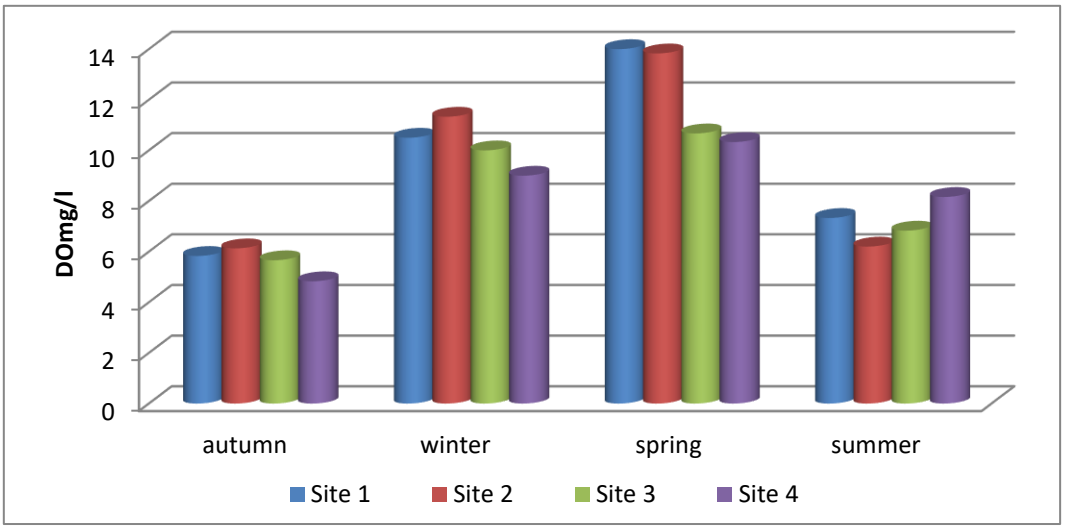

Fig 6: Seasonally changes in dissolved oxygen values (mg/L) for the study stations

Environmental survey of plant species in the studied sites

The Euphrates River course in Al-Muthanna Governorate is characterized by a high density of vegetation cover, especially in the areas near the river banks, which differ in their livelihood. Species of aquatic plants belonging to 11 plant families and 13 plant genera are shown in Table (1)

Table1: List of aquatic plant species in the Euphrates River during the study period.

No.	Botanical name	Family	Site			
			1	2	3	4
1	*Azolla filiculoides L.*	Salviniaceae	+	+	+	-
2	*Ceratophyllum demersum L.*	Ceratophyllaceae	+	+	+	+
3	*Potamogeton perfoliatus L.*	*Potamogetonacea*e	-	-	-	+
4	*Potamogeton crispus L.*	*Potamogetonaceae*	+	+	+	+
5	*Eichhornia crassipes(Mart)solms.*	Pontederiaceae	+	+	+	+
6	*Cyperus malaccensis Lam*	Cyperaceae	-	+	-	+
7	*Phragmites australis (Cav.)Trin ex Staud*	Poaceae	+	+	+	+
8	*Plantago lanceolate L.*	plantaginaceae	-	+	-	+
9	*Populous euphratica Oliv.*	Salicaceae	+	+	+	+
10	*Arundo donax L.*	Gramineae	+	+	+	-
11	*Salix acmophylla L.*	Salicaceae	+	+	+	+
12	*Typha domingensis pers*	Typhaceae	+	+	+	+
13	*Vallisneria spiralis L.*	*Hydrocharitaceae*	-	+	+	-

+ presence - Absence

Vegetative coverage

The percentage of vegetation coverage showed a clear discrepancy between the study stations, as *Phragmites australis* recorded the highest percentage of vegetation cover in the second station during the fall season 45% and the lowest in the same station in the summer season, 7%, as in the figure(7) .while *Typha domingensis* recorded the highest percentage of vegetation cover in the first station in the spring season is 5%. The lowest is in the first, second, and third stations, respectively, during the winter and autumn seasons. The study stations varied in the percentage of vegetation cover among aquatic plant communities due to many factors, whether they were environmental factors or human activities that play an important role in the distribution of aquatic plants in freshwater environments such as salinity, temperature, the concentration of organic matter and organic matter, and the difference in water levels and grazing activities. Weeding and dam building all cause a difference in the percentage of vegetation cover (Kheder and Lovett-Doust, 2000).

The study's results gave a clear picture of the increase in the density of some submersible aquatic plants, especially the Shambalan *C. demersum* community, found in all study stations. The highest percentage of vegetation cover was recorded in the first station during the autumn season, 32%, and the lowest in the same station during the

winter season, 0.8%, followed by 0.8% of *Potamogeton crispus*, in which the highest percentage of vegetation cover was reached in the second station during the spring season, where the highest percentage of vegetation cover was in the second station during the spring season. The lowest was in the fourth station during the same season. The results of the current study showed the reason for the high values of submerged vegetation cover due to several environmental factors, the most important of which is the amount of lighting, which plays an important role in increasing the rate of vegetation coverage of submerged aquatic plants, as stated by (Barker et al., 2008).

It is noted from the results of the current study that there is a wide vegetation cover for some free-floating plant communities, especially the Nile flower plant *Eichhronia crassipes*, where the highest percentage of vegetation cover was in the first and second stations during the summer season, 28% and 27%, respectively. The lowest in the third station in the fall season was 1%, as in figure7. While the fern *Azolla filiculoides* recorded much less vegetation cover than that restricted to the summer season only. The highest percentage of vegetation cover was in the second station 12%. The lowest in the third station was 4.6% which is characterized by its rapid growth at high temperatures and the availability of sufficient concentrations of nutrients and the formation of dense mats on the surface of the water and thus misleading the water column and any vegetation cover located under it (Espinar *et al.*, 2015)

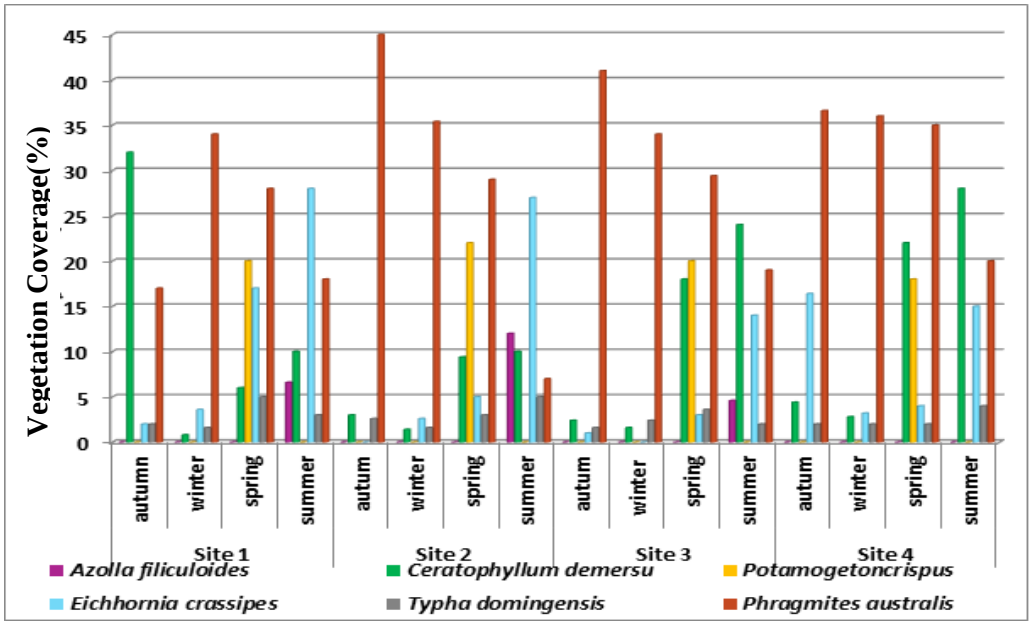

Fig 7: plant cover percentage (%) of plant species in study stations

The biomass of dominant aquatic plants

The biomass of the dominant aquatic plants in the study stations during the winter and summer seasons, such as *Phragmites australis*(emerged), *Ceratophyllum demersum L*(submerged), and *Eichhornia crassipes*(free-floating) during the study period, was estimated for the seasonal and locational changes in the biomass values of the dominant aquatic plants. The results of the study showed that in the winter season, the reed *Phragmites australis* was dominant in all study stations, and its highest biomass was 978.51 gm dry weight/m^2 as in figure (8). in the fourth station, and the lowest was 525.87 gm dry weight/m^2 in the third station. The reason for the high biomass of *Phragmites australis* in the winter season is due to its ability to grow better and with

higher biomass in brackish water compared to saline water, as well as the ability of the rhizomes to seize the amount of nutrients in their tissues and remain stored in them until the next growing season (Ma et al., 2017).

Ceratophyllum demersum L, the submerged aquatic plants, recorded the highest biomass in the fourth station, 902.73 g dry weight / $m^{2,}$ and the lowest in the third station 689 g dry weight / $m^{2,}$ as in the figure (8). The reason for this is its high ability to take nutrients and its easly of movement in the water, allowing it to expand its coverage areas and produce more biomass (Al-Abbawy, 2009).

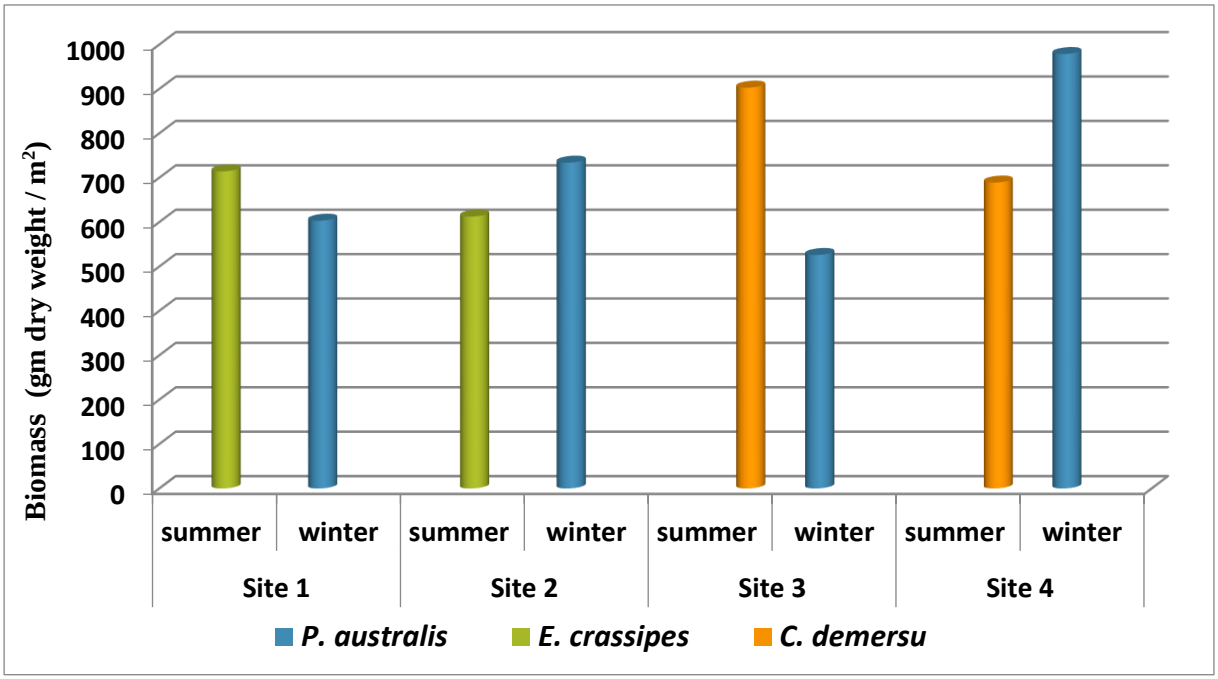

Fig 8: The biomass of the dominant aquatic plants (gm dry weight / m^2) in the study stations

Conclusion

The variation in environmental conditions according to the different seasons of the year has the greatest impact on the distribution and spread of aquatic plants. The decline and deterioration of some aquatic plants and their disappearance in the Euphrates River due to the change in water quality and the increase in human activities.

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تأثير العوامل البيئية على وجود النباتات المائية و نسبة التغطية والكتلة الحية لها في نهر الفرات في محافظة المثنى / العراق.

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المستخلص

تم اجراء مسح بيئي خلال عامي 2020-2021 لدراسة تأثير العوامل البيئية على وجود النباتات المائية ونسبة التغطية والكتلة الحية لها في أربعة مواقع في نهر الفرات في محافظة المثنى . وجرى قياس درجة الحرارة الماء والاس الهيدروجيني والتوصيلية الكهربائية ونفاذية الضوء والاوكسجين المذاب كعوامل بيئية لعينات الماء وسُجل 13 نوعا نباتيا مائيا في محطات الدراسة , سجلت نتائج الدراسة اعلى قيم للتغطية النباتية لمجتمع نبات *Phragmites australis* و *demersum Ceratophyllum* و*Eihornia crassipes(Mart)solm* و*Potageton crispus* التي بلغت 45% و 32% و28% و22% على التوالي واقلها غطاء نباتي *Azolla filiculoides* التي بلغت 12% و *Typha domingensis* التي بلغ 5%, كذلك اعلى قيم للكتلة الحية للنباتات المائية السائدة والاكثر تواجد خلال فصلي الشتاء والصيف للانواع *crassipes Eihornia*و *Ceratophyllum demersum* التي بلغت 714.26 غم وزن جاف \ م^2 و902.73 غم وزن جاف \ م^2 خلال فصل الصيف بينما سجل نبات *Phragmites Australis* اعلى قيمه للكتلة الحية في فصل الشتاء بلغت 978.51 غم وزن جاف \ م^2

الكلمات المفتاحية: التغطية النباتية ,الكتلة الحية , نهر الفرات , نباتات المائية .