# Seasonal Study for Habitat of *Myriophyllum spicatum* L. in Al-Burgga Marsh, Hor Al-Hammar, Southern Iraq

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## Abstract:

*Myriophyllum spicatum* distribution in Al-Burgga marsh, Hor Al-Hammar was described in relation to some of the physical-chemical properties for its habitat (water depth, light penetration, water temperature, water salinity, pH, dissolved oxygen, $Ca^{+2}$, $Mg^{+2}$, reactive $NO_2^{=}$, reactive $NO_3^{-1}$, and reactive $PO_4^{-3}$) during 2011, seasonally. CANOCO ordination program (CCA) was used to analyse the data. Its vegetation cover percentage was with its peak at summer, its value was 90 %, while the lowest value was 20 % in winter. Statistically, Positive relationships for WT, sal., $Ca^{+2}$, $Mg^{+2}$, reactive $NO_2^{=}$, reactive $NO_3^{-1}$, and reactive $PO_4^{-3}$ with the vegetation cover percentage were observed. While, negative relationships for WD, pH, and DO with the vegetation cover percentage were observed. Also, the negative relationship between light penetration and the vegetation cover percentage can be attributed to the water depth, which was shallow and the light penetration followed water depth and reached to the bottom during all of the period study. In addition, two species were registered with *Myriophyllum spicatum* community as associated species, which are *Hydrilla verticillata* and *Ceratophyllum demersum*.

**Key words: *Myriophyllum spicatum*. Habitat. Iraqi Marshes.**

## Introduction:

*Myriophyllum spicatum* originated in Europe, Asia, and Northern Africa [1]. Concern over the invasion of non-indigenous plants into natural areas is rapidly increasing, as the number of studies showing the prevalence and effects of such invasions rises [2,3] showed that the ability of alien plant species to invade a region depends not only on the attributes of the plants, but also on the characteristics of the invaded habitat. Aquatic plant habitat is threatened by changes in wetland hydrology, eutrophication, the invasion of exotic plants, and other human-induced disturbances such as agriculture and development [4].

In Iraqi marshes, this species was identified for the firest time by [5] in Al-Suhein marsh, southern Iraq. Also, it was identified in the centeral marshes, southern Iraq by [6]. In Hor Al-Hammar, southern Iraq, this species was registered by [7]to study the epiphytic algae on it, but it was not registered in [8], which showed some notes on the ecology of aquatic plants in Al-Hammar marsh, southern Iraq. [9] observed that some of aquatic macrophytes in Al-Hammar marsh, southern Iraq are threatened by marine invasive creature, which is *Balanus amphitrite*, its existence was attributed to the variation within the marsh habitat.

Within the last few years, major hydrological engineering activities in and around the area of Lower Mesopotamia have resulted in the drying out of vast areas of wetlands in the Central Marches and Al-Hammar, and could eventually lead to the

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disappearance of these systems [10]. Currently, less than 10% of the marshlands in Iraq remain as fully functioning wetlands because of the extensive drainage and upstream agricultural irrigation programs on the Tigris and Euphrates rivers [11]. Now, restoration by re-flooding of drained marshes is proceeding in the Central and Al-Hammar marshlands [12].

One of these Iraqi marshes is Al-Burgga marsh, southern Iraq, which is the largest part of Al-Hammar marsh, (**figure -1-**) which was destroyed by preventing water flow to it during 1990s by dams and applying the water regime for the water amounts, which reach to the south of Iraq. Then at 2003, the restoration process of Iraqi marshes was started by removing the dams, which established on the Tigers and Euphrates Rivers, in addition to the increasing water amounts, which reach to southern areas from Iraq. So that the water reflooded to these areas and the life in these marshes started again, therefore, many flora Iraqi species disappeared, and at the same time, there are another species appeared and distributed, from them was *Myriophyllum spicatum*.

*Myriophyllum spicatum* was observed widely spread and covered large areas in Al-Burgga marsh, so that we decided to identify it, scientifically. In addition, to Study its habitat to know the environmental variables, which were available, that led to its growth and distribution in this marsh.

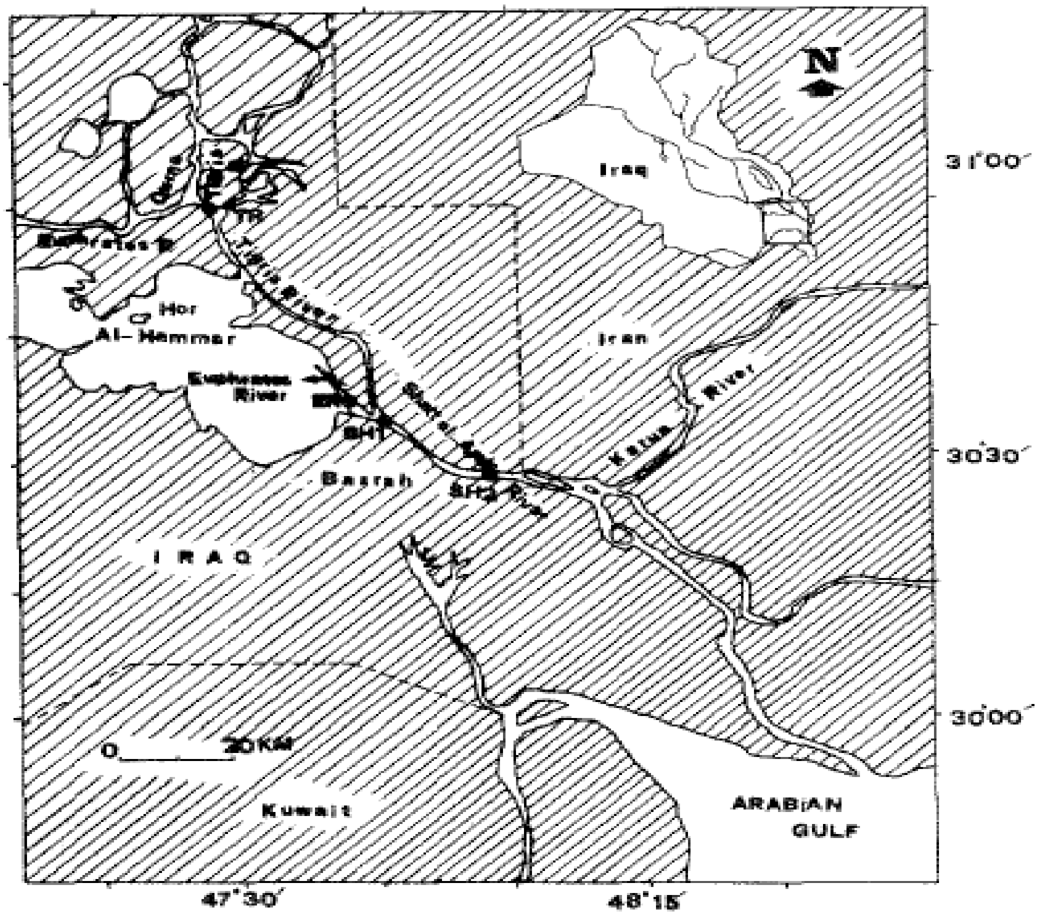


**Fig. -1- Map of the studied location.**

The marsh region is situated in the southern basin (alluvial plain) of the rivers Tigris and Euphrates at 30° 35' - 32° 45' N and 46° 13' - 48° E, with a maximum length of about 210 km and width of 170 km. Its total area of about 35000 $km^2$ is covered by water at the time of peak flood.

The daily mean temperature (30 years) is 12.4 °C in January and 33.9 °C in August. The annual rainfall varies from 84 to 296 mm. The dry period is from June to October. Its area amounts to about 21% of the total marsh area in southern Iraq.

## Materials and Methods:

### *Floristic Study*

The studied macrophyte species was identified in the herbarium of College of Science in the University of Basrah according to [13]. Vegetation Cover percentage is defined as the area of ground within the quadrate, which is occupied aboveground parts of each species when viewed from above. Cover was estimated usually as a percentage, the area of the quadrate is one $m^2$ [14].

### *Environmental variables*

The water environmental variables were measured according to [15]. Five water samples were taken at each season. The water temperature, water salinity, and water pH were measured directly in the field by digital portable multi meter (model 340i/SET, which is made in Germany), in addition the water depth by ironic ruler that is divided from 0- 400 cm and light penetration by Secchi disk (30 cm in diameter). Dissolved oxygen was measured by Azide-modification of Winkler method. Calcium and magnesium ions concentration were measured by titration against standard EDTA (0.01 M). While, the nutrients ($NO_2^{-1}$, $NO_3^{-1}$, and $PO_4^{-3}$) were measured by coloremetric methods.

### *Data analysis*

Mean and Standard Error for Water Environmental Variables were done. The computer program, which was used to analyze the data, it was CANOCO [16] to apply Canonical Correspondence Analysis (CCA) method. This program provides ordination axes that maximally show the relationship between the species and the environmental because the ordination axes are constrained to be linear combination of environmental variables. As well as, (CCA) method shows the relationships between environmental variables to each other.

## Results:

### *Floristic Results*

The studied species was identified, which is *Myriophyllum spicatum.* Its vegetation cover percentage was measuered, seasonaly. The lowest value was at winter, when its vegetation cover percentage was 20%. While, its growth reached to the peak at summer, its vegetation cover percentage was 90%, see (**figure -2-**).

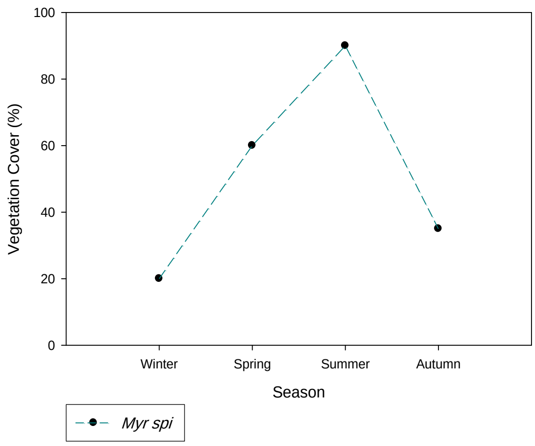


**Fig.-2- Seasonal vegetation cover percentage for *Myriophyllum spicatum.***

### *Environmental variables Results*

The environmental variables are clear in the followed figures down. Whereas the seasonal variation in the water depth value is clear, see (**figure -3-**), when the lowest level was at summer season (57 cm), while the highest level was at spring season (105 cm). The light penetration reached to the bottom during all the study period, this is clear in the (**figure-4-**), it followed water depth, usually. The seasonal water temperature variations was clear, (**figure -5-**), when the lowest value was at winter (9.75 C°), while the highest value was at summer (26.65 C°). Salinity changed during the seasons, clearly, (**figure -6-**), its low value (2.7 ppt.) was at spring, while its high value (5.1 ppt.) was at summer season. The seasonal pH variations were clear, (**figure -7-**), when its low value (7.15) was at summer season, while the highest value (8.82) was at winter. Dissolved oxygen changed clearly during study period, (**figure -8-**), when the lowest value (2.2 mg/l) was in summer, while the highest value (9.3 mg/l) was at winter. The seasonal variations for calcium and magnesium concentrations were clear, (**figures -9-** and **-10-**), when their low values (105.9 mg/l), (63.5 mg/l) respectively were at spring, while their high values (265.7 mg/l), (92.7 mg/l), respectively were at autumn. The seasonal variations in nutrients concentrations ($NO_2$, $NO_3$, and $PO_4$) were clear during the study period, (**figures -11-, -12-,** and **-13-**), when their low values (0.51 µg/l), (1.02 µg/l), and (0.93 µg/l), respectively were at summer, while their high values (1.66 µg/l), (3.39 µg/l), and (2.09 µg/l), respectively were in winter.

These environmental variables were analyzed to know their means and standard errors, see (**table -1-**). As well as, the correlation (r) between environmental variables to each other was done, it clear in the appendix -1-.

**Table -1- Mean and Standard Error for Water Environmental Variables**

| Season | Mean and Standard Error for Water Environmental Variables | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | WD±SE | LP±SE | WT ±SE | Sal.±SE | pH±SE | DO ±SE | Ca±SE | Mg±SE | $NO_2$±SE | $NO_3$±SE | $PO_4$±SE |
| Winter | 92.5±6.5 | 92.5±0 | 9.75±0.24 | 3.5±0 | 8.82±0.03 | 9.3±0.15 | 194.2±13.12 | 86.2±5.15 | 1.66±0.11 | 3.39±0.31 | 2.09±0.04 |
| Spring | 105±4.7 | 104±0 | 11.75±0.15 | 2.7±0 | 8±0.1 | 7.3±0.3 | 105.9±8.29 | 63.5±4.72 | 0.87±0.06 | 1.42±0.09 | 1.21±0.09 |
| Summer | 57±3.5 | 57±0 | 26.65±0.55 | 5.1±0 | 7.15±0.05 | 2.2±0.2 | 172.2±11.06 | 78.4±3.03 | 0.51±0.09 | 1.02±0.11 | 0.93±0.05 |
| Autumn | 66.5±5.1 | 66.5±0 | 18.9±0.2 | 4.7±0 | 7.7±0 | 4.9±0.4 | 265.7±15.01 | 92.7±5.57 | 1.28±0.03 | 2.99±0.02 | 1.77±0.06 |

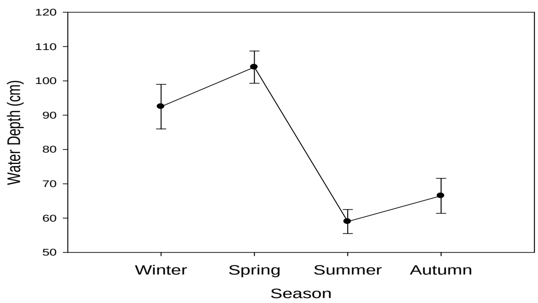


**Fig.-3- Seasonal water depth variations with standard error.**

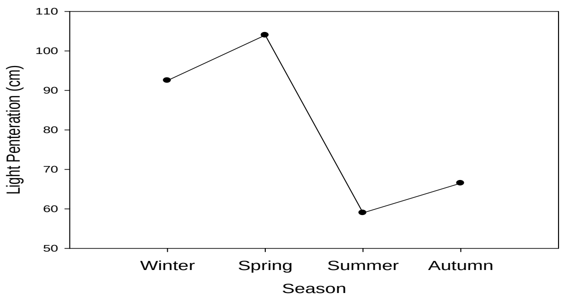


**Fig.-4- Seasonal light penetration variations with standard error.**

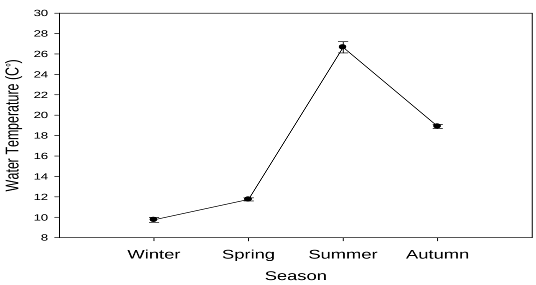


**Fig.-5- Seasonal water temperature variations with standard error.**

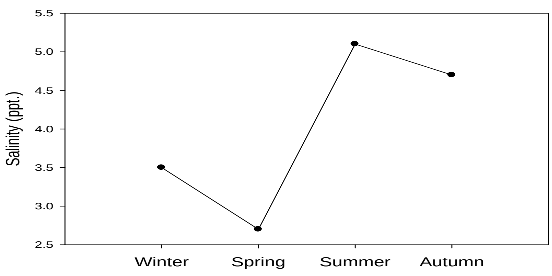


**Fig.-6- Seasonal salinity variations with standard error.**

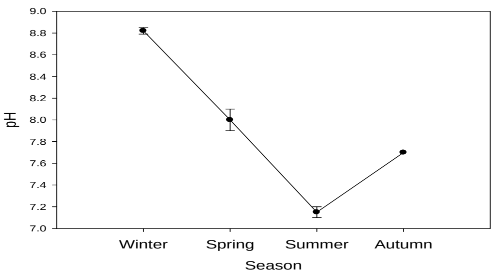


**Fig.-7- Seasonal pH variations with standard error.**

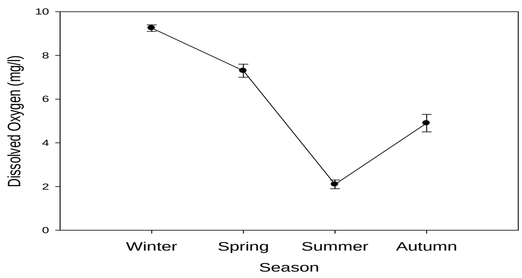


**Fig.-8-Seasonal dissolved oxygen variations with standard error**

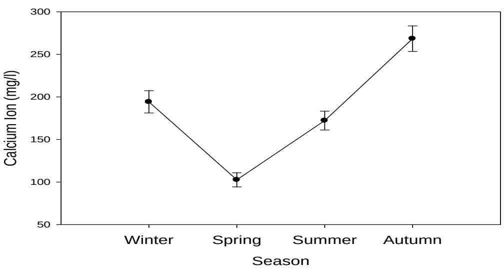


**Fig.-9-Seasonal calcium ion concentration with standard error.**

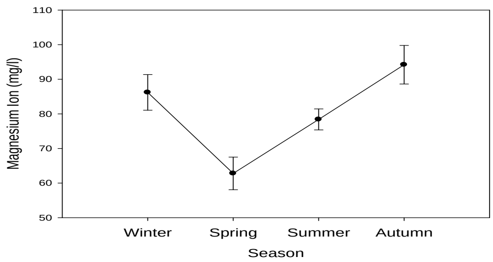


**Fig.-10-Seasonal magnesium ion concentration with standard error.**

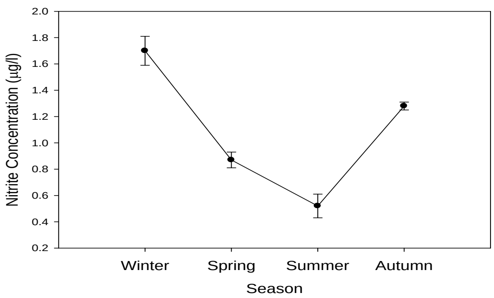


**Fig.-11-Seasonal nitrite variations with standard error.**

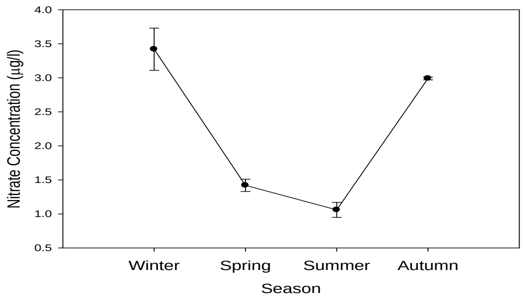


**Fig.-12-Seasonal nitrate variations with standard error.**

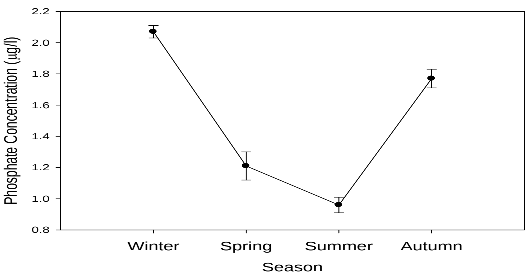


**Fig.-13-Seasonal phosphate concentration variations with standard error.**

Also, the relationships between environmental variables and species were concluded, statisticaly by CCA method, whereas positive relationships were observed between vegetation cover percentage for *Myriophyllum spicatum* and the values of water temperature, salinity, calcium ion, magnesium ion, reactive nitrate, reactive nitrite, and reactive phosphate. Their correlation (r) values were (0.853, 0.557, 0.939, 0.919, 0.746, 0.702, and 0.663), respectively. While, negative relationships were observed between vegetation cover percentage for *Myriophyllum spicatum* and the values of the other environmental variables, which are water depth, pH, and dissolved oxygen. Their correlation (r) values were (-0.980, -0.624, and -0.575), respectively. On the other hand, light penetration reached to the bottom during the study period, totally. So that its correlation (r) value with vegetation cover percentage for *Myriophyllum spicatum* followed water depth, it was -0.980. See figure -14- and appendix -1-.

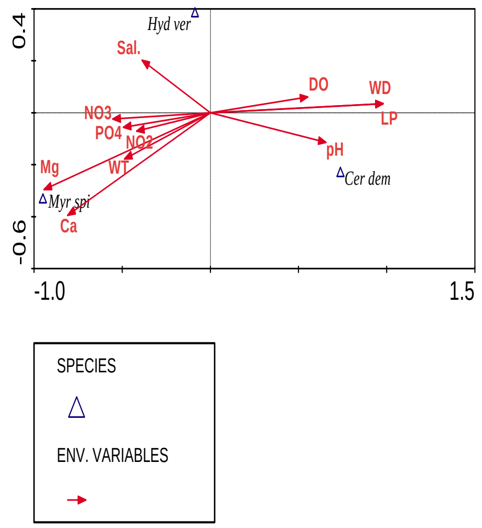


**Fig. -14- The relationships between environmental variables and species by CCA method.**
**Note;**
*Myr spi= Myriophyllum spicatum, Cer dem= Ceratophyllum dimerisum, Hye ver= Hydrilla verticellata*

## Discussion:

The fluctuation in the growth of *Myriophyllum spicatum* in the present study may be due to the physical and chemical conditions for its habitat [17]. Its large distribution may be due to changing of the marsh ecological conditions after restoration that should be led to become appropriate habitat [18].

*Myriophyllum spicatum* growth was with its peak at summer that may be attribute to the environmental conditions should be changed to be more appropriate, while the environmental conditions are not suitable to growth of macrophytes at winter [18].

Water depth is one of the important ecological factors. In this study, the negative correlation between vegetation cover (%) for *Myriophyllum spicatum* and water depth my be because the increasing of water depth leads to decreasing of light penetration to submerged aquatic plants, which affects the photosynthesis [19]. On the other hand the increasing of water level leads to dilute the nutrients which are required to growth of plants this agrees with [6,20,21]. Light penteration is very important factor for growth and distribution of the aquatic macrophyte, but this study showed there was negative correlation between light penteration and the growth that attribute to the water in the studied site was shallow so that light penetration followed water depth value and reached to the bottom during all the study period [6].

The positive relationship, which was observed between water temperature and vegetation cover (%) for *Myriophyllum spicatum* may be because the increasing of water temperature should enhance evapotranspiration, photosynthesis and microbial activity, the microbial organisms perform the degradation to dead bodies at warm season, so that the nutrients that are required by plants would be added to the ecosystem, so that temperature has positive effect on nutrients [21,22]. As well as, temperature affects chlorophyll content, whereas chlorophyll leaf concentration has positive correlation with temperature (chlorophyll concentration increases with increasing temperature) [23]. Also, the peak of vegetation cover (%) for this species was at summer season, when the day lengths more than others seasons, whereas increasing day length at summer season should result increasing photosynthesis that should be led to more growth [23]. This agrees with [6,20].

The positive effect for water salinity on the vegetation cover (%) for *Myriophyllum spicatum* may be due to the indirect relationships between salinity and nutrients availability, that led for increasing growth of plant and reached to the peak at summer, when the salinity was in the highest value [22]. The results of the present study agree with [6.20], which found that the low salinity was alone resulted in reduced reproductive effort of macrophyte communities.

Calcium and Magnesium ions are essential nutrient for plants, whereas they share in structure of the cell wall and chlorophyll. The positive relationships between vegetation cover (%) for *Myriophyllum spicatum* and these ions may be because these ions have effects on the microbial organisms, which performs the degradation for dead materials, that causes availability of nutrients which are required by aquatic plants, so that the growth of this species should be with the peak at the warm season (the growth season). These results agree with many studies [6,24,25]

Availability of nutrients is considered one of the main factors affecting the aquatic plants growth. Of the many nutrients required for growth, nitrogen (N) and phosphorus (P) are the elements typically of shortest supply in aquatic ecosystems and therefore most likely to affect the growth of aquatic macrophytes species [24].

The positive relationships between vegetation cover (%) for *Myriophyllum spicatum* and and nutrients ($NO_2^{-1}$, $NO_3^{-1}$, and $PO_4^{-3}$) may be because the high growth requires big amounts from nitrogen and phosphorous compounds to metabolic processes [26].

Whereas, the nitrogen compounds are required by plants to share in protein structure, that should be led to increasing in the growth [24]. On the other hand, at winter and autumn, when there was no growth, there was no taking up for nitrogen compounds by plants, in addition, the concentrations that are added by the rain and the degradation process for the dead materials, so that their concentrations should be increased at these seasons [6,21,26]

The same case for phosphate concentration, its positive effect on vegetation cover (%) for *Myriophyllum spicatum* may be because it is important for plants; it shares in structure of the cell wall, protein, nucleotide and ATP [27]. This result agrees with [6,22].

Many studies have found that pH has important influence on aquatic plants growth and distribution [6,22,26]. In this study, the negative correlation between pH value and vegetation cover (%) for *Myriophyllum spicatum* may be because that pH is affected by dissolved inorganic carbon, which is available for photosynthesis [22]. As well as, the variations in dissolved inorganic carbon availability may account for differences in the growth and distribution of *Myriophyllum spicatum* among low and high dissolved inorganic carbon locations [26]. This result agrees with many studies [6,22,24]

The negative correlation between dissolved oxygen concentration and vegetation cover (%) for *Myriophyllum spicatum* may be because gas exchange between the atmosphere and surface water during the growth season (summer) is controlled primarily by the gas concentration gradient and the boundary layer thickness [24]. As well as, aquatic macrophytes produce structural material (lignin, cellulose, and hemicelluloses), and this material decomposes relatively slowly, and at that time the microbial organisms consume more dissolved oxygen during the degradation process for these materials during the growth season, so that the dissolved oxygen will be decreased, and inverse this case at the winter season, this agrees with many studies [6,25,26].

**Appendix -1- The correlation (r) between environmental variables and vegetation cover (percentage) for *Myriophyllum spicatum*. Also, between environmental variables to each other.**

| | WD | LP | WT | Sal. | pH | DO | Ca | Mg | NO3 | NO2 | PO4 | *Myr spi* |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **WD** | 1.000 | | | | | | | | | | | |
| **LP** | 1.000 | 1.000 | | | | | | | | | | |
| **WT** | -0.378 | -0.378 | 1.000 | | | | | | | | | |
| **Sal.** | 0.026 | 0.026 | 0.824 | 1.000 | | | | | | | | |
| **pH** | 0.480 | 0.480 | -0.922 | -0.864 | 1.000 | | | | | | | |
| **DO** | 0.708 | 0.708 | -0.986 | -0.869 | 0.973 | 1.000 | | | | | | |
| **Ca** | -0.934 | -0.934 | 0.544 | -0.085 | -0.403 | -0.413 | 1.000 | | | | | |
| **Mg** | -0.961 | -0.961 | 0.503 | -0.247 | -0.270 | -0.236 | 0.969 | 1.000 | | | | |
| **NO3** | -0.379 | -0.379 | 0.977 | 0.894 | -0.979 | -0.998 | 0.369 | 0.195 | 1.000 | | | |
| **NO2** | -0.153 | -0.153 | 0.960 | 0.945 | -0.912 | -0.965 | 0.181 | -0.020 | 0.971 | 1.000 | | |
| **PO4** | -0.285 | -0.285 | 0.980 | 0.918 | -0.955 | -0.991 | 0.297 | 0.108 | 0.994 | 0.991 | 1.000 | |
| ***Myr spi*** | **-0.980** | **-0.980** | **0.853** | **0.557** | **-0.624** | **-0.575** | **0.939** | **0.919** | **0.746** | **0.702** | **0.663** | **1.000** |

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# دراسة موسمية لبيئة نبات ال *Myriophyllum spicatum* L. في هور البركة من اهوار الحمار، جنوب العراق

**محمد عبدالرضا حمدان الكنزاوي***

*قسم علوم الحياة- كلية العلوم للبنات- جامعة بغداد

**الخلاصة:**

تم درسة علاقة توزيع نبات *Myriophyllum spicatum* L. في هور البركة في منطقة اهوار الحمار مع بعض المتغيرات الفيزيائية والكيميائية للبيئة (عمق الماء، نفاذ الضوء، درجة حرارة الماء، الملوحة، الاس الهيدروجيني، الاوكسجين المذاب، ايون الكالسيوم، ايون المغنيسيوم، النتريت الفعال، النترات الفعال، والفوسفات الفعال)، بصورة موسمية خلال سنة 2011. وتم استخدام النظام الاحصائي الكونوكي لتحليل البيانات، حيث كانت نسبة الغطاء الخضري لهذا النبات في اعلى قيمها خلال موسم الصيف وهي 90% في حين كانت النسبة الاقل خلال موسم الشتاء وهي 20%. وتبين احصائيا بأن هناك علاقة ايجابية بين النسبة المئوية للغطاء الخضري لهذا النبات مع كل من درجة حرارة الماء، الملوحة، الكالسيوم، المغنيسيوم، النتريت الفعال، النترات الفعال، والفوسفات الفعال. في حين كانت العلاقة سلبية مع عمق الماء، الاس الهيدروجيني، وتركيز الاوكسجين. وأيضا ان العلاقة السلبية بين نفاذ الضوء والنسبة المئوية للغطاء الخضري يمكن ان تعزى الى ان المياه كانت ضحلة وان الضوء ينفذ بالعمق ويصل القاع خلال كل فترة الدراسة. وتم تسجيل نوعين من النباتات المائية الغاطسة بصفة مندمجة مع مجتمع نبات *Myriophyllum spicatum* L. وهما النوعان *Hydrilla verticillata* و *Ceratophyllum demersum*.