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Monthly variations in density of attached algae on solid plates in two lentic and lotic localities from Basrah Province

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Abstract. A comparative study was performed on the Shatt Al-Arab River as a running water environment and a fishpond as a stagnant locality to investigate the distribution and abundance of attached algae. Samples were collected on monthly basis from November 2011 to October 2012. Two stations were selected in the Shatt Al-Arab River and just one in the lentic environment as it represents a thoroughly mixed water. Several ecological factors were analyzed and monthly variations were detected in all conditions, but a notable rise in water temperature and salinity was detected during the warmer period of year. Percentage composition of algae was calculated in the three investigated stations. Diatoms were dominant, followed by blue-green algae in the Shatt Al-Arab, but green algae in the pond. Three main algal taxa were encountered namely, Cyanophyceae, Chlorophyceae and Bacillariophyceae. The latter was represented by more species.

Key words: Shatt Al-Arab River, Fish pond, Density, Epeplic algae, monthly distribution.

Introduction

Algae occupy an important position in the food chain as the main nutritional source for aquatic organisms (15). Algae are considered as primary producers of organic matters and oxygen, as byproduct, in aquatic habitats to stimulate their ability for photosynthesis and also their benefits for other organism. (23). However, the term benthic algae consist of species that live on the muddy bottom or nearby (31), in addition to algae growing on various submerged surfaces (13). Benthic algae are divided into muddy algae that stick or move freely on the surface of the muddy bottom (32), algae attached to submerged aquatic plants (2), algae attach themselves to submerged rocks in water and algae attached to aquatic animals i.e. epizootic algae (33).

Many environmental factors affect rate of primary production of benthic algae including light intensity, duration of light span, water temperature, salinity, Availability of nutrients, chlorophyll-a, the nature of bottom sediments, the effects of tides and the amount of organic carbon in sediments (21), (14) .

Benthic algae are used as bio-indicators to evaluate the contamination of water with organic wastes (9). They are also play an important role in minimizing of environmental pollution through their bioaccumulation ability. (8) has pointed out that some have the ability to concentrate aromatic hydrocarbons and trace elements. Algae also possess an economic value by producing agar and alginates (30) and are used in various medical applications such as the production of antibiotics and as inhibitor to proliferation of microorganisms and tumors (5). Some other species are used for the production of different types of vitamins (3).

The present work is aiming to investigate some ecological factors affecting the productivity, abundance and distribution of attached algae and determining their monthly variations in densities in two, lotic and lentic, localities at Basrah Governorate.

Materials and Methods

Three stations were selected to perform the investigation. The former was at the confluence of the Shatt al-Arab River with Garmat Ali canal near Sinbad Island. (31˚38′ 30 34N,45˚00′ 47 76E) where it receiving considerable amounts of drainage water and industrial wastes released from Al-Najibiyah power plant. The second station (30˚50′ 6601N, 47˚85′ 382E) is located at heavily populated area at Al-Ashar district that receiving large quantities of domestic sewages in addition to wastes released by local boats. The third station(30˚04′ 2956N, 47˚74′ 128E),however, was stagnant locality represented by a fish pond, with an area of 6000-8000m^2, of Basrah University fish farm (MSC) at Garmat Ali location.

Environmental factors, including water temperature, salinity and pH were measured at field using a YSI American-made Model (MPS 556). Current speed measured using Styrofoam floating object and output expressed as meters per second. Algal samples were collected depending on the method described by (11) and listed in (12). Solid plates of 30x15cm were used, fixed by wire and dropped in the water at depth range from 1-2 meters relying on the location. They placed tightly to avoid losing by irritation or effect of current speed. Three replicates of panels per month per stations were adopted and taking into consideration panels exposure during the ebb period. Panels raised monthly from the water source and algae attached on panels were removed with a brush then placed in plastic bottles of 25 cm^3 and logal solution was added for fixation and then transferred to the laboratory for further analyses. References adopted for the classification of algae are including (29), (26), (27), (28), (10) and (33).

Figure (1) Aerial map showing the sampling locations in the study area.

Results

Water temperature

Figure (2) indicates monthly changes in water temperature in the study area. Changes were found to coincide with those of air temperature, which began to decline gradually during the cold months to reach its lower values at January 12 and 14°C in first and second stations respectively, and 13°C in station3. Then began to rise gradually during the warm months to hit a top values in August 35.7, 37.3°C for first and second stations respectively and 51°C for the latter.

Salinity

Figure (3) reveals monthly variations in salinity in the selected stations during the sampling period. Values were characterized by large difference between moving and stagnant stations and the highest values 2.35, 4.02 and 24.1 ppt. encountered in August in the three stations respectively. Minimum was recorded in January in the first (1.02 ppt) and second (1.04 ppt) stations, but in November (1.1 ppt) in the station 3.

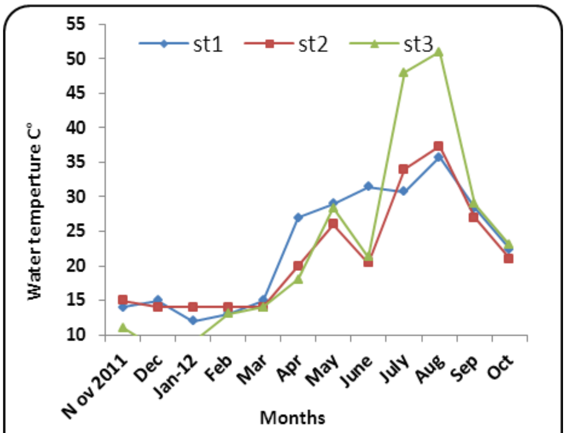

Figure 2: Monthly variation of water temperature at 3 stations

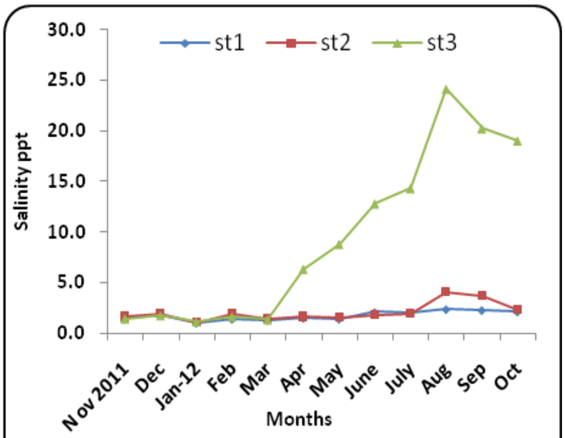

Figure 3 : Monthly variation in the salinity at 3 stations

Hydrogen Ion Concentration (pH)

Figure (4) shows monthly fluctuations in pH values of the selected three stations during the sampling period. The trend was on alkaline direction. Significant changes were not record in pH values among the studied stations. The highest values 8.81, 8.1 were recorded in April in the first two stations respectively, but amounted for (8.91) during June in station3. The lowest (7.7) was encountered in November in the station1, whereas in stations 2 and3 it was 7.4 and 7.5.

Current speed

Figure (5) reveals the monthly changes in current speed in the three investigated locations. The highest value (1.94 m/sec.) was encountered in station1 in

August compared to station2 where the highest (1.05 m/sec.) recorded in January. However, significant changes were not detected in the stagnant locality throughout the study period.

Qualitative study

The total number of algal species recorded during the study period was 86 belong to 38 genera (table 1) .This is clearly shown in figures 6, 7, 8. Diatoms were found to form (56%) of the total number in station1, followed by blue-greens algae (24%), whereas green algae (20%) occupied the last position. In the station2 Diatoms has formed (57%) of the total algae, followed by blue-greens algae (26%), and finally green algae (17%). Diatoms in the station3 formed (65%), green algae (22%) and occupied blue-green algae (13%) ranked third.

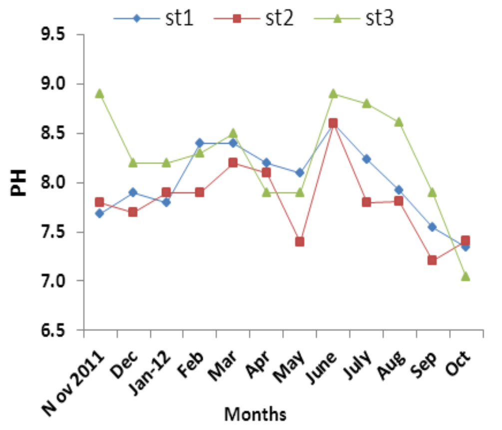

Figure 4: Monthly variation in pH at 3 stations

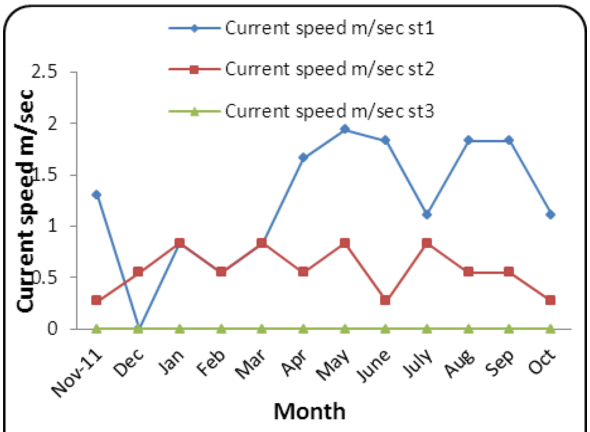

Figure 5: Monthly variation in current speed at 3 stations

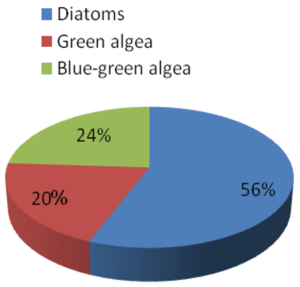

Figure 6: Percentage composition of algea in station 1

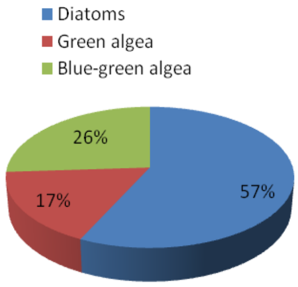

Figure 6: Percentage composition of algea in station 2

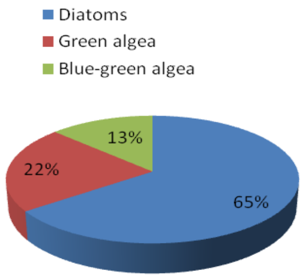

Figure 6: Percentage composition of algea in station 3

Quantitative study

Figure (9) shows monthly changes in composition of algae in station1. Diatoms contribute from 125×10^3 - 1000×10^3 individual/cm^2. The lowest value encountered during August, while the highest in April. Then Green algae which ranged between 34×10^3- 858×10^3

individual/cm^2. The minimal was recorded in August and the maximum in April. Whereas, blue-greens algae ranged between 19×10^3 - 685×10^3 individual /cm^2 .The lowest value was recorded in January and the highest in April. Figure (10) reveals monthly changes in composition of algae in station2 during the investigated period. Diatoms number ranged from $124x10^3$ – $1062x10^3$ individual/cm^2. The lowest encountered in August and the highest in April. Blue-green algae, however, occupied the second position and accounted for $20x10^3$- $1007x10^3$ individual/cm^2. The minimal was recorded in August and the maximum in April. Whereas, Greens algae ranged between 39×10^3 - 720×10^3 individual /cm^2 .The lowest value was recorded in May and the highest in April.

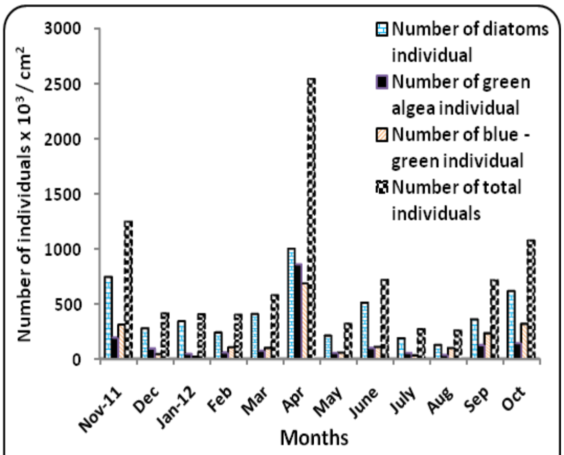

Figure 9 : Monthly varitions in the number of algea in station 1

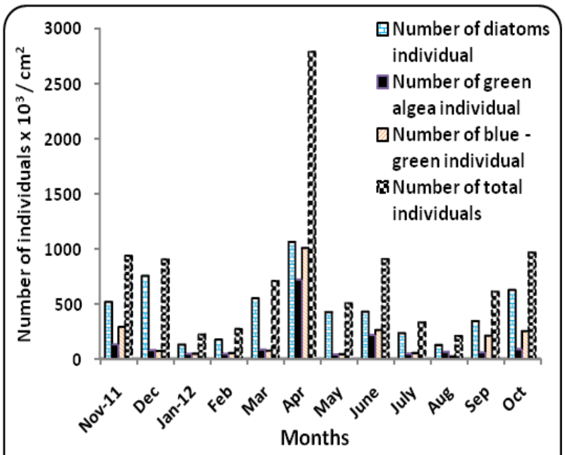

Figure 10 : Monthly varitions in the number of algea in station 2

Figure (11) shows monthly differences in number of algae in station3 during the study period. Diatoms range from $44x10^3$ to $1515x10^3$ individual/cm^2. The lowest value was encountered in January and the highest in April. Green algae, however, occupied the second position and accounted for $4x10^3$- $1072x10^3$ individual/cm^2. The minimal was recorded in August and the maximum in April. Then blue-green algae which ranged between $10x10^3$- $188x10^3$ individual/cm^2 encountered in January and April respectively.

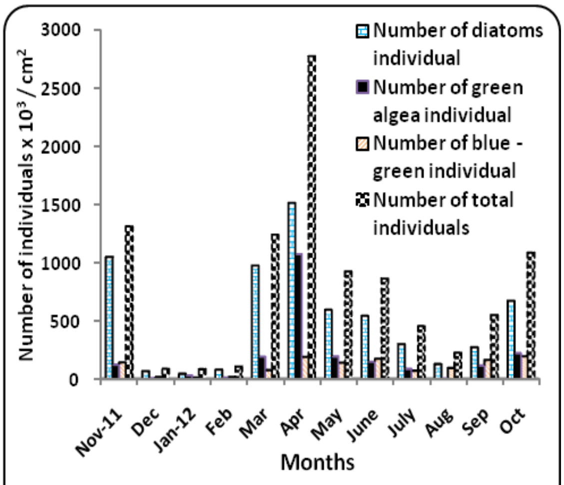

Figure 11 : Monthly varitions in the number of algea in station 3

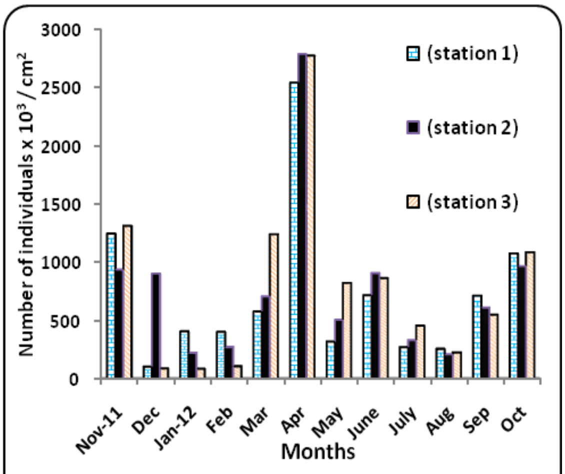

Figure 12 : Monthly varitions in total number of algea in the study area

Figure (12) shows monthly variations in total number of algae in the three selected station of the study area. The lowest values were recorded in station1 ($102x10^3$ individual/$cm^{2)}$ and station2 ($207x10^3$ individual/cm^2). However, the lowest ($83x10^3$

individual/cm^2) was found in January in station3, whereas the highest $2543x10^3$, $2789x10^3$ and $1775x10^3$ were recorded in April for the three stations respectively.

Discussion

Water temperature possess great importance in aquatic life as affect the aquatic organisms directly or indirectly, and lead to impose essential impacts on properties of fresh water (16), through effecting content of dissolved oxygen and the rate of photosynthesis by the aquatic plants (22). However, salinity is considered as one of the most important ecological factors heavily fluctuates in our inland water environments (17). Therefore, it plays a substantial role in abundance and distribution of aquatic organisms (1). Results indicate that the concentration of salinity in winter was much less than those in summer. This may relate to direct correlation with temperature and increased evaporation in addition to decline in water quantities supplied by Tigris and Euphrates. Many reasons may affect current velocity namely wind movement, as is wind in addition to the variation in the temperature distribution and abruptly change at atmospheric pressure and rain showers (23). The importance of current velocity may determined as a complement to the quality of water and assist to provide a source of food and spawning locations and pathways for fish migration (24). Results were evident that there are monthly changes in current speed.

pH is vital environmental character in aquatic habitats. Values at alkaline direction are more preferred by aquatic organisms. However, all values encountered in the present work were in this level, but the relative decline in values in summer months may be attributed to decomposition of organic matters and release of carbon dioxide (22) winter more recognized with increase in pH which may be due to the role of aquatic plants and phytoplankton in imposing low rates of photosynthesis leading to shortage in CO_2 consumption.

Results of the present study revealed an apparent dominance of Diatoms within other algal aggregation and this phenomenon was encountered in the majority of Iraq inland waters, and is due to water content of sufficient quantities of silica (7);(9); (19), or may be due to the richness of sediment with organic matter and calcium (6). Some genera showed sovereignty within class of Diatoms of which are *Naviculla*, *Nitzscha*, *Rhopalodai gibba*, *Cocconei placentula* var. *euglypta Mastigloia smithii* var. *lacustris.* The same result were record (8) showed these species appeared with small numbers and rate of (5×10^3 - 418×10^3) individual/cm^2 in the station1 and in the second station (141×10^3- 673×10^3), ($37x10^3$ -503×10^3) individual / cm^2, respectively. The blue-greens algae has come in second place after Diatoms within stations 1 and station2 with rate (41×10^3 -2.8×10^3) (31×10^3 -310×10^3) individual/cm^2, respectively. The two genera *Oscillatorai* and *Lyngby* were dominant. The presence of these species indicates that the locality of collection is representing an organically polluted environments. This is was also confirmed by (9) and (4). the green algae ranked third in stations1 and 2 (6×10^3 - $205x10^3$), ($5x10^3$ - $67x10^3$) individual/cm^2 respectively, At station 3, the green algae appeare with rate ($4x10^3$.-$1072x10^3$) individual/cm^2 followed by blue – green algae ($10x10^3$-$193x10^3$) individual/cm^2 .

Results showed that there are seasonal changes in algae composition, as it was noted that there are two peaks in spring and autumn. This may be attributed to the prevailing appropriate temperature and reasonable light penetration in addition to amble nutrients content. Environmental factors in particular water temperature has great impact in stimulating the bacteria to decompose organic matters thereby increasing nutrients followed by algal growth and reproduction (9); (32) and (23).

Table (1). shows species of benthic algae in the investigated stations for the period from November 2011 to October 2012.

Station			List of Taxa
St1	**St2**	**St3**	
			Class: Cyanophyceae
++	+	+	*Anabaena orientalis Dixit.*
++	++	++	*Lyngby limnetica Lemm.*
-	+	-	*L. martensiana Men.*
++	+	-	*Merismopedia glauca (Ehr.)*
+	+	-	*Microcoleus acutissimus Grad.*
-	+	-	*Nodularia spumigena -Mert.*
++	++	-	*Nostoc sp.*
++	++	+	*Oscillatoria acuminata Gomont.*

Table 1. Continued.

+	++	+	*O. amoena (Ktz.) Gomont*
-	-	+	*O. angustissima W. West and G. West*
+	++	-	*O. formosa Bory*
++	+	-	*O. limosa Ag. ex. Gomont*
+	-	-	*Phormidium retzii (Ag.) Ktz ex. Gomont*
+	+	-	*Scytonema leptobasis Ghose.*
++	++	+	*Spirulina major Ktz.*
			Class: Chlorophyceae
++	++	++	*Cladophora glomerata (L.) Ktz.*
+	+	-	*C. secunda Ktz.*
-	-	++	*Coelastrum microporum Naglei*
++	++	++	*Enteromorpha intestinalis (L.) liink.*
++	++	++	*Hyalotheca dissiliens (Smith)Breb.*
+	++	++	*Oedogonium sp.*
+	+	++	*Rhizoclonium hiroglyphicum(Ag.)Ktz.*
+	-	++	*Scenedesmus acuminatus(Lag.)Chodat*
-	-	++	*S.dimorphus (Turp.)Ktz.*
-	+	-	*S.opoliensis P.Richter*
-	+	-	*S. quadricauda (Turp.) Breb.*
++	+	++	*Ulothrix cylindricum Prescott*
+	+	++	*U. variabilis Ktz.*
			Class :Bacillariophyceae
			Centrales
++	++	++	*Cyclotella meneghiniana Ktz.*
+	++	-	*C. ocellata Pant.*
+	++	-	*C. striata(Ktz.)Grun.*
++	+	++	*Coscinodiscus sp.*
			Pennales
++	++	++	*Amphora ovalis Ktz.*
++	+	++	*Bacillaria paxillifer (Muller) Mars.*
++	+	++	*Caloneis borealis Carter*
+	-	-	*C. permagna (Bail.) Cleve.*
++	++	++	*Cocconies pediculus Ehr.*
++	+	++	*C. placentual var lineata(Ehr.) Cleve.*
++	++	++	*Cymbella affinis Ktz.*
+	+	-	*C. aspera (Ehr.) H. Perag*
-	+	-	*C. cistula (Ehr.) Kirck.*
+	-	++	*C. kolbei Hust.*
-	-	++	*C. tumid (Breb.) Van Heurck*
+	-	-	*C. ventricosa Ktz*
++	++	++	*Diatoma teune Ag.*
+	++	++	*D. vulgare Bory.*
+	+	-	*Diploneis pseudovalis Hust.*
+	++	++	*Epithemia sorex Ktz.*

Table 1. Continued.

+	+	-	*Euntia sp.*
++	++	-	*Fragolaria capucina Desm.*
+	+	-	*F. Vaucheria (Ktz.)peters.*
+	+	++	*Fragolaria sp.*
++	++	++	*Gomphonema acuminatum Ehr.*
+	+	++	*G. angustatum (Ktz.) Rhab.*
-	+	-	*G. clevei Frick*
+	+	-	*G. parvulum var. micropus (Ktz.) Cleve*
++	+	++	*Gyrosigma acuminatum (Ktz.) Rab.*
+	-	-	*G .attenuatum (Ktz.) Rab.*
+	+	-	*G. spencerii var. nodifera (Gurn.) Cleve*
+	-	-	*G. tenuirostrum (Gurn.) Cleve*
++	++	++	*Mastogloia smithii Thw. Ex. Smith*
++	++	++	*Navicula atomus (Ktz.) Gurn.*
+	+	++	*N. cryptocephala Ktz.*
-	+	-	*N. cuspidata Ktz.*
+	+	++	*N. mutica var. undulta (Hilse) Gurn.*
++	++	++	*N. pygmaea Ktz.*
++	++	++	*N. radiosa Ktz.*
++	++	++	*Nitzschia apiculate (Greg.)Grun.*
++	+	-	*N. circumstance (Bailey) Gurn.*
+	+	-	*N. dissipata (Ktz.) Grun.*
+	++	++	*N. fasciculata Gurn.*
-	+	-	*N. filiformis (Smith) Hust.*
-	+	-	*N. frustulum (Ktz.)Gurn.*
++	++	++	*N. hungarica Grun.*
++	++	++	*N. obtusa Smith*
++	++	++	*N. sigma (Ktz.) Smith*
++	+	++	*N. sigmoidea(Nitz.) Smith*
++	+	++	*Pleurosigma delicatulum Smith*
-	-	++	*Rhopalodia gibba (Ehr.) O.Muller*
+	+	-	*Surirella capronii Breb.*
+	+	-	*S. ovata Ktz.*
+	-	-	*S. robusta Ehr.*
++	++	++	*Synedra capitata Ehr.*
++	+	-	*S. fasciculata (Ag.)Ktz.*
++	+	++	*S. ulna (Nitz.) Ehr .*
-	-	++	*S. ulna var oxyrhnchus (Ktz.) V.H.*

(+) species present; (-) species not present; (++species is abundant)

References

1-Abowei, J. F. N. (2010). Salinity, dissolved oxygen, pH and surface water temperature conditions in Nkoro River, Niger delta, Nigeria. Advance J. Food Sci. and Technol., 2(1): 36-40.

2-Al-Jaafar. A. M. E. (2004). Studies on the contents of some micro-algae of vitamins. PhD. Thesis, Coll. Educ., Basrah Univ. pp72. (in Arabic)

3-Al-Khayon, Th. Th. H. (2001). Impact of paper plant effluents on mud algae of the Shatt Al-Arab River. MSc. Thesis Basrah Univ., Coll. Agriculture, pp. 67.

4-Al-Kubaisi, H.K.B. (2001). The inhabiting ability for alcoholic extract from *Nitzschia palea* in bacterial chain. MSc. Thesis. Coll. Sci., Baghdad Univ. pp. 151. (in Arabic)

5- Al-Lami, A.A.; Al-Saadi ,H.A. ; Kassim, T.I. and Farhan, R.K. (1999).Seasonal changes in epipelic algae communities in north part of Euphrates River, Iraq. J. Coll. Educ. for Women, Univ. Baghdad. 10(2): 236-247.

6-AL –Mousawi A.H. ;AL–Saadi, H.A. and Hadi, R.A.(1986). A Comparative study on the phytoplankton of the Shatt Al- Arab estuary up and down stream of Basrah city center (Iraq) .Bull. Basrah. Nat. Hist. 6:45-63.

7-Al- Saboonchi, A.A. and H.T. AL-Saad (1988). Check list of algae from Shatt AL- Arab River, Iraq. J. Univ. Kuwait (Sci.) 15: 79-96.

8-Al-Saboonchi, A. A. (1998). Using of benthic algae as bio-indicators to organic pollution in Shatt Al-Arab River and some of its branches. PhD thesis, Coll. Agriculture, Basrah Univ., 108 pp. (in Arabic)

9-Al- Saboonchi, A.A.; Ghani, A.A. and Abdul- Hussein, M.M. (1990). Non–Diatom algae from Shatt AL- Arab River, Iraq. Marina Mesopotamica. 5 (1): 89-126.

10-Brook, A. j. (1954). The bottom living algae flora of slow sand filter bed to establishment species on the beds . Hydrobio. 6: 333-351.

11-Eton , j.w. and Moss, B.(1966) .The estimation of numbers and pigment content in Epipelic algae population Limnology and Oceanography. 11 (4) ,584 -595 pp.

12- Gonulol, A.; Ersanli, E. and Baytut, O. (2009). Taxono. and numerical comparison of epipelic algae from Balik and Uzun lagoon, Turkey. J. Environment. Biol.

13-Hussein, S.A.; Al-Sabonchi and Fahad, K. K. (2006). Ecological characteristics of Euphrates River at Al-Nasyriya city. I. Seasonal variations in physico-chemical conditions Thi Qar Univ. journal. Vol.2 (2) P. 2-6. 7/54/1447. Date 13 August, 2006.

14-Hussein, S. A.; I.J. Al-Shawi and A. M. Abdullah (2008). Effect of heated effluents discharged from Al-Hartha electricity power station on the ecosystem of the Shatt Al-Arab River. II. Seasonal variations in abundance and distribution of algae. 3rd Nat. Conf. Ecol. 7-8, Nov. (2008) (Basrah J. Sci.)

15-Hussein, S.A.; Abed, J. M. and Salem, N.K. (2008a). The a biotic ecological characteristics of three selected fish farms in Babylon and Basrah Provinces, Iraq. Iraqi J. Aquaculture 5(2): 87-96.

16-Hussein, S. A. (2009). Causes of water scarcity, its high salinity, the sources of abuse of inland waters and their environmental and health consequences along with proposals to address the future. Submitted to the workshop on the impact of water scarcity in Basrah province on the natural environment and social development. Held for the period from 18-19/ November, 2009.

17-Hussein, S. A. and Kamel K. Fahad (2012). Seasonal variations in concentration of trace elements in sediments from Al-Garaf canal, one of the main branches of Tigris River/ Thi Qar province. J. Thi Qar Univ. for Agri. Research, (2): 65-75.

18-Kassim, Th. I. (2007). Benthic attached algae in Hemren reservoir, Iraq. Um Salama J. Sci., 4(2), 208-214.

19-Kassim, T. I. and Al-Lami, A. A. (2000). The epidemic algal flora of the river Tigris, Iraq.1st National scientific in Environmental pollution and Means of production. Baghdad, Nov. 5-6 (2000): pp133-141.

20-Morarty, D.J.; Pollard, P.C. and Hunt, W. G. (1985).Productivity Of Bacteria and Microalgae and The Effect Of Grazing by Boloththurion in Sediments or a coral reef flat. Mar. Ecol. Prog. Ser., 85: 293-300.

21- Mondal, N. K., Datta J. k. and Banerjee A. (2011). Pond alkalinity: Astudy in Burdwan municipality, Burdwan, west Bengal India. International J. Environment. Sci.

22-Nahar, K.; Khondker, M. and Sultana, M. (2010). Seasonality and Diversity of epipelic Ditoms in two wetlands of Bengladish. Bengladish J. Bot. 39 (1): 29 –36.

23-Nhapi, I. and Tirivarombo, S. (2004). Sewage discharges and nutrient levels in Marimba River Zimbabwe .ISSN 0378- 4738 , Water SA Vol. 30 No.1 .

24-Null , S. E. ; Deas , M. L. and Lund , J.R. (2009). Flow and water temperature stimulation for habitat restoration in the Shasta River, California. River. Res. Apply.

25-Nurl – Islam, A. K. M. (1969). A preliminary report on the phytop-lankton and other algal flora of chit agony Hill – Tracts. Phytoplankton of C. Hill Tracts, Vol. 14, No. 3.

26-Nurl – Islam, A. K. M. and K. M. Zaman. (1975). Limnological studies of the river Buriganga. III. Biological aspect. J. Asiatic Soc. Bangladesh (SC.), 1 (1): 45–65.

27-Pentecost, A. (1984). Introduction to freshwater algae. Richmond publi-shing Co. Ltd. England. 247 PP.

28-Prescott, G. W. (1978). How to know freshwater algae. 3rd ed. Wmc. Brown Co. Publishers USA. 293 PP.

29-Qari, R. and Siddiani, S. (1993). Biochemical composition and yield of agar from the seaweed Gracelariacorticata of Karachi coast (Pakistan) Marine Res. 3: 16-32.

30-Round, F. E. (1964). The ecology of benthic algae In: Jackson, D.F. (ed.), Algae and Man. PP. 138- 184.

31- Plenum Press, New York.31-Sahin, B. (2004) .Species composition and Diversity of Epipelic algae in catalo Lake (Turk. J. Biol.) 28:103-109.

32-Sulaiman, N. I. and Al-Saadi, H. A. (2006). Algal science, Arabic publication. Jordan. pp. 253.

33-Wehr, J. D. and Sheath, R. G. (2003). Freshwater algae of North America ecology and classification. Academic Press. USA, 918 PP.

الاختلافات الشهرية في كثافة الطحالب الملتصقة على الاسطح الصلبة من بيئتين متحركة وساكنة في مدينة البصرة

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الخلاصة. انجزت دراسة مقارنة لنهر شط العرب كبيئة متحركة و حوض تربية اسماك كبيئة ساكنة، لدراسة توزيع وكثافة الطحالب الملتصقة. جمعت العينات على اساس شهري من تشرين الثاني 2011 الى تشرين الاول 2012. إذ اختيرت محطتين في نهر شط العرب اعتمادا على المتغيرات البيئية، وواحدة في البيئة الساكنة كونها تمثل مياه منسجمة الاختلاط. حللت العديد من الخصائص البيئية وسجلت التغيرات الشهرية في كافة الخصائص المدروسة، وأظهرت النتائج زيادة ملحوظة في درجة الحرارة والملوحة خلال الاشهر الدافئة من السنة. كما حسبت النسب المئوية لمساهمة الطحالب. وكانت الدايوتومات هي السائدة تلتها الطحالب الخضراء المزرقة وجاءت الطحالب الخضراء بالمرتبة الثانية في البيئة الساكنة. سجلت ثلاثة مجاميع تصنيفية للطحالب وهي: Cyanophyceae, Chlorophyceae and Bacillariophyceae. وتمثلت الاخيرة بعدد أكثر من أنواع الطحالب.