

**Primary productivity in Bahr Al-Najaf Depression Reservoir/Iraq**

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**Abstract:-**

The primary productivity was calculated depending on pelagic and benthic biomass. Monthly samples were obtained from four study stations (February 2015 to January 2016). The pelagic primary productivity values were ranged between 1.26 mg. cm<sup>-2</sup>. year<sup>-1</sup> to 4.31mg. cm<sup>-2</sup> .year<sup>-1</sup>, and benthic primary productivity was ranged between 0.01mg. cm<sup>-2</sup>.year<sup>-1</sup>to 0.12 mg cm<sup>-2</sup>.year<sup>-1</sup>. The highest pelagic productivity was observed in spring and the lowest one was in autumn while the highest benthic productivity was obtained in autumn and the lowest productivity in winter. The highest phytoplankton abundance was observed in spring and the lowest was recorded in summer, while the highest Epipelagic abundance was observed in autumn and the lowest in spring. Statistical analysis showed that spring significantly affect pelagic net primary productivity, while autumn significantly affect benthic net primary productivity

Keywords: Bahr Al-Najaf depression Reservoir, pelagic and benthic primary productivity.

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### **Introduction:-**

Primary

productivity is a measure of new organic matter created in the water body. It can be determined by the oxygen production fluxes during short periods of 1-3 h per unit volume of water and it is influenced by a number of physical and chemical factors. (40).

Primary producers form the energetic base of most ecosystems on this planet. The carbon which is fixed by plants through photosynthesis, the basis of almost all terrestrial and marine food webs. Algae are most often the dominant primary producers in lentic system, and are responsible for carbon fixation and sequestration of essential nutrients such as nitrogen and phosphorus to consumers. Algae are critical ecosystem components of both nutrient cycles and food webs in lakes (39)

The basic control factors of primary production are light, nutrients, rain, wind in addition to dissolved gases and bottom feature

varying their relative importance in the ecosystems according to their dynamics. (28)

Primary productivity had been studied in different regions of the world by several researchers such as (14, 17, 20, 21, 23 and 34). However there are a few studies on primary productivity in the Iraqi aquatic environments such as, (1, 3, 5, 10 and 38). Bahr Al-Najaf is a depressed area, composed of a lake or marsh-like area with limited cultivated orchards beyond surrounded by vast desert or semi desert areas, located to the west and south-west of Holy Najaf city (32). It extends at north west-south east direction of an area about 360-750 Km<sup>2</sup>, of coordinates longitude 43° 40' - 44° 25' E and latitude 31° 40' - 32° 10' N and altitude elevation of about 11 m a. s. l. (13) Productivity in Bahar Al-Najaf Depression Reservoir (BNDR) relied on biomass for pelagic and benthic algae and productivity value of BNDR lower than value recorded in Al-Razaza lake due to adopted method, the nature of study

area in terms of high salinity, and other factors cause environmental pressure on organisms. BNDR has been studied by (7 and 27).

### Materials and Methods

Four sampling sites were chosen in BNDR, the water sources in site 1 (st.1) considered to be clean as freshwater resources; site 2 (st.2) and site 3 (st.3) were saline water; site 4 (st.4) was closed to the sewage sources (Fig.1).

One liter triplicate subsurface water samples were taken monthly

(February 2015 to January 2016), 20 µm phytoplankton net were used for quantities and qualities study of microalgae and Ekman grab sampler for quantitative estimation of epipellic algae. All samples were fixed with Lugol's solution (19).

The algal-biomass was estimated according to: Eker-Develi, and Kideys (2003), Hillebrand *et al* (1999), Sun, and Liu (2003), and Aktan (2005). Total phosphorus (TP), total nitrogen (TN), dissolved oxygen (DO) were measured according to Al-Zurfi (2010).

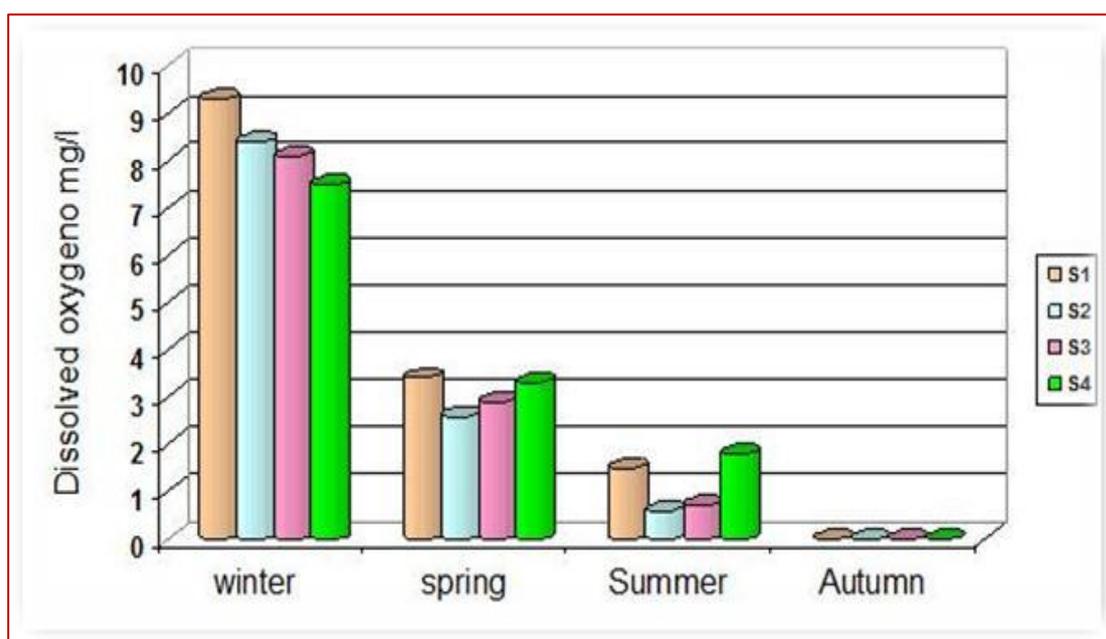


Figure 1: The study sites in Bahr Al-Najaf.

**Results and Discussion:**

DO concentration generally was high in winter which reached a maximum value of 9 mg.l<sup>-1</sup> may be related to the effect of decreasing the temperature, growth of algae and aquatic plants and good mixing between water layers (35), but decreased to ND during

summer and autumn may be due to increase of organic material, water temperature which led to increase activity of microorganisms that cause decomposition of organic material and consumption of oxygen (18). Results of present study were in agreement with (37) and (26). (Figure, 2)



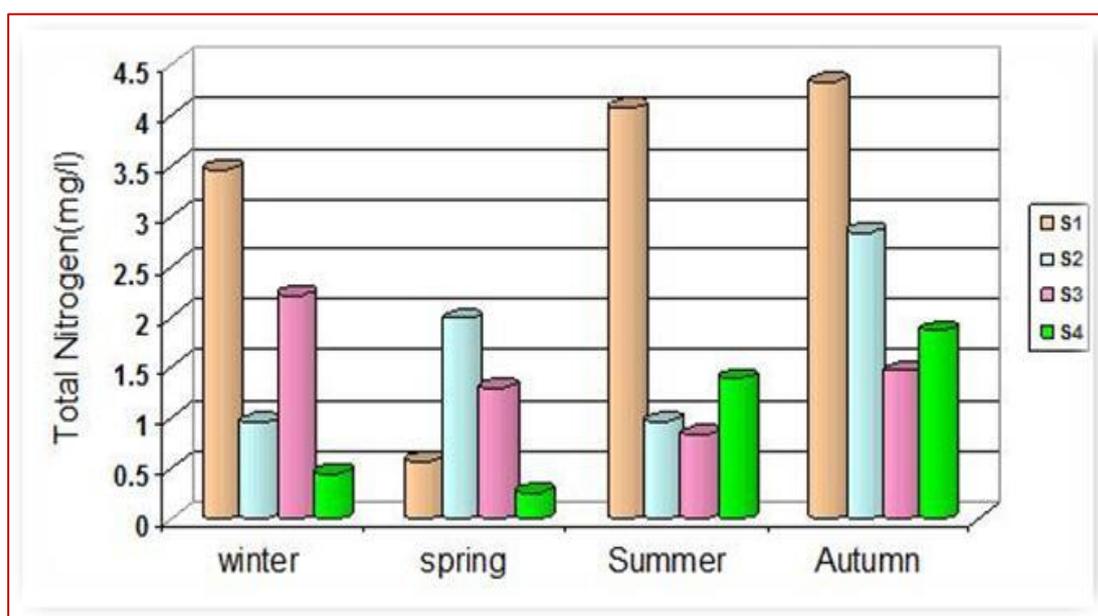
**Figure 2: Seasonal variation for dissolve oxygen value in study sites**

The total nitrogen concentration generally was high during autumn season due to bacterial activity ,decomposition of organic matter , decrease in the up take by phytoplankton and low water level(15) while lowest value was

observed during spring(Figure, 3). This may be related to increase up take by aquatic plants and phytoplankton (31).The TP concentration was relatively low in winter due to increased uptake by aquatic plants during this seasons

0.009 mg.l<sup>-1</sup> ,but it was increased in summer to 0.02 mg.l<sup>-1</sup> due to decomposition of aquatic plants and organic matter as well as decreasing water level, evaporation or decrease up take by phytoplankton (33).(Figure, 4) . On the other hand TN and TP concentrations were higher during autumn and summer in sediments

which were 75 mg.l<sup>-1</sup> and 0.95 mg.l<sup>-1</sup> respectively. (Figure, 5 and 6) because of the anaerobic conditions, lack of oxygen(11) and low water level and receive sewage water (2) or decomposition of aquatic plants and organic matter (30). Results of present study were in agreement with (26) and (6)



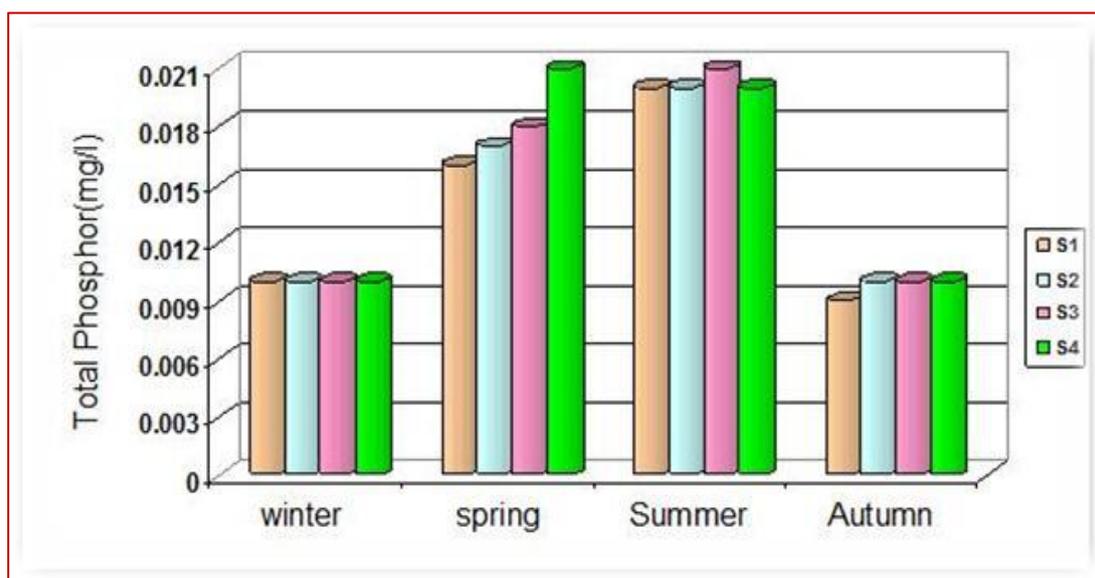
**Figure 3: Seasonal variation for total nitrogen in study sites**

Pelagic and benthic primary production exhibited clear seasonal changes (Figure, 7).The pelagic production was 4.31mg. cm<sup>-2</sup> .year<sup>-1</sup> during spring and 1.26 mg.cm<sup>-2</sup> .year<sup>-1</sup> during autumn. While benthic production was 0.12mg.

cm<sup>-2</sup> .year<sup>-1</sup>during autumn and 0.01 mg. cm<sup>-2</sup> .year<sup>-1</sup>during winter, the changes in the production followed the changes in the pelagic and benthic algal-density. The increasing of primary production in spring and autumn due to the algal

biomass increase for the following dominant species: *Chroococcus turgidus* var *maximus*, *Spirulina major*, *Merismopedia glauca*, *Cyclotella meneghiniana*, *Gyrosigma attenuatum*, *Cyclotella*

*stilligera*, *Amphora commutate*, *A.ovalis*, *Nitzshia sigmoideae*, *Osillatoria tenuis*, *Cocconies placental*, *S. subsala*, *Cymbella cistulla*, *Gyrosigma accuminatum* (Table: 1 and 2).



**Figure 4: Seasonal variation for total phosphorus in study sites**

The result showed that there was a positive correlation between pelagic productivity and water temperature ( $r=0.52$ ) due to increase of carbon incorporation rates under light saturation, on other hand, warming led to an increase of algae biomass in the absence of the consumer pressure (29), while primary productivity was not related to total phosphorus or total inorganic nitrogen

concentrations and that in line with the data of Keithan and lowe (28).

Bahr Al-Najaf Depression Reservoir exhibited very low benthic production and dominated by phytoplankton production this is agree with (16); (8), and (25) who describes the negative feedback pelagic and benthic primary producers on each other's growth. Benthic production reduces nutrient influx from the sediments

to the pelagic habitat, whereas light attenuation caused by phytoplankton development limits benthic algae growth. Statistical analysis showed that spring season

had significant effect on pelagic net primary productivity while autumn season had significant effect on benthic net primary productivity

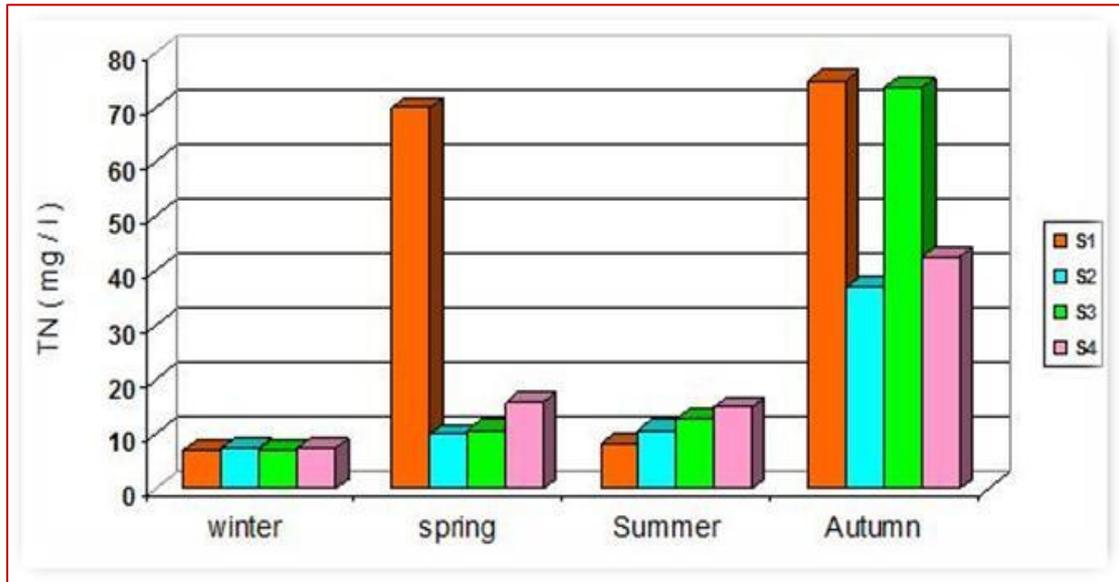


Figure 5: Seasonal variation for total nitrogen value in study sites of sediments

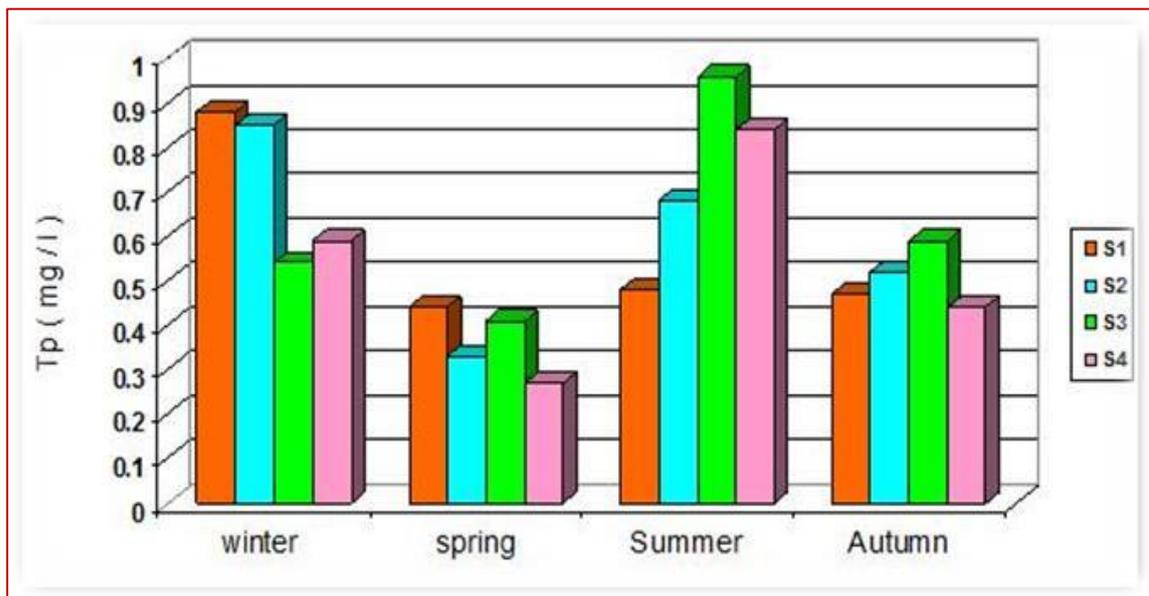


Figure 6: Seasonal variation for total phosphorus value in study sites of sediments

**Table 1: Phytoplankton abundance and biomass in BNDR, 2015.**

Date/Site	1	2	3	4	Mean
Winter	312*	201	142	230	221.25
	7003**	38174	1389	14374	15235
Spring	233	233	381	294	285.25
	309	45250	3333	542	12358.5
Summer	165	127	87	250	157.25
	32490	34650	8149	94153	42360.5
Autumn	133	162	108	255	164.5
	567	524	808	15612	4377.75
Mean	210.75	180.75	179.5	257.25	207.0625
	10092.25	29649.5	3419.75	31170.25	18582.9375

\*:Abundance  $\times 10^3 \text{ ind.L}^{-1}$ , \*\*: Phytoplankton biomass  $\text{mg.L}^{-1} \times 10^4$ .

### Conclusion

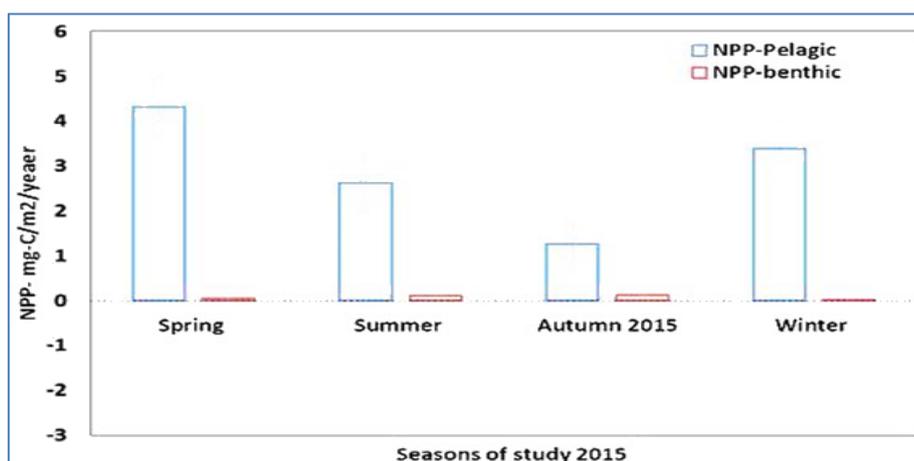
It can be concluded that the pelagic productivity were higher than benthic productivity. Spring season

significantly affect pelagic productivity and autumn season significantly affect benthic productivity.

**Table 2: Epipellic abundance and biomass in BNDR, 2015.**

Date/Site	1	2	3	4	Mean
Winter	0.463*	0.576	0.821	0.496	0.589
	122**	761	34	754	417.75
Spring	0.18	0.11	0.07	0.1	0.115
	639	639	665	32	493.75
Summer	0.207	0.62	0.466	0.53	0.45575
	127	258	39	38	115.5
Autumn	0.686	0.73	0.92	0.38	0.679
	736	699	641	33	527.25
Mean	0.384	0.509	0.56925	0.3765	0.4596875
	406	589.25	344.75	214.25	388.5625

\*: Abundance  $\times 10^4 \text{ ind.L}^{-1}$ , \*\*: Epipellic biomass  $\text{mg.L}^{-1} \times 10^4$ .



**Figure 7: Seasonal variation of Net primary production in Pelagic and benthic**

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**الإنتاجية الأولية في منخفض بحر النجف /العراق**

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**المستخلص :-**

حسبت الإنتاجية الأولية بالاعتماد على الكتلة الحية للطحالب الهائمة والملتصقة . اخذت عينات شهرية من محطات الدراسة الاربع للفترة من شباط/2015 ولغاية كانون الثاني/2016. تراوحت انتاجية الطحالب الهائمة بين 1.26 ملغم.سم<sup>2</sup>.سنة<sup>1</sup> الى 4.31 ملغم .سم<sup>2</sup>.سنة<sup>1</sup> وتراوحت انتاجية الطحالب الملتصقة بين 0.01 سنة<sup>1</sup> الى 0.12 سنة<sup>2</sup>. لوحظت اعلى انتاجية للطحالب الهائمة في فصل الربيع واقل انتاجية الخريف بينما سجلت اعلى انتاجية للطحالب الملتصقة في الخريف واقلها في فصل الصيف . لوحظت اعلى وفرة للطحالب الهائمة في فصل الربيع بينما اقل وفرة في فصل الصيف بينما اعلى وفرة للطحالب الملتصقة لوحظت في فصل الخريف واقل وفرة في فصل الربيع . بينت نتائج التحليل الاحصائي ان فصل الربيع قد اثر بشكل معنوي على انتاجية الطحالب الهائمة بينما فصل الخريف اثر بشكل معنوي على انتاجية الطحالب الملتصقة .  
الكلمات المفتاحية: منخفض بحر النجف ، الانتاجية الاولية للطحالب الهائمة والملتصقة

تاريخ الاستلام: 16-4-2017

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البحث جزء من أطروحة دكتوراه للباحث الثالث