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Assessment of Shatt Al-Arab River Water Quality by Using Palmer's Algal Index, Basrah, Iraq

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Abstract: Monthly Algal samples were collected from selected three sampling station of Shatt Al-Arab River from August 2016 to July 2017. The most pollution tolerant genera and species of four groups of algae were recorded from three sites of the river. Palmer (1969) Algal Genus pollution index and Algal species pollution index were employed to study the water quality of Shatt Al-Arab River. The total score of Algal Genus pollution index of station 1, 2 and 3 were 21, 24 and 21 respectively. While total score from the Algal species pollution index at station (1) was 18, station (2) was 21, While at station (3) was 17 recorded from Shatt Al-Arab River. The total score of each station was greater than 20 indicating the confirmed high organic pollution. The present study showed that the water quality of Shatt Al-Arab River was affected from domestic uses at the downstream of the river.

Keywords: Palmers algal Index, Organic pollution, Shatt Al-Arab River, Iraq.

Introduction

Due to constant growth of population, technological and industrial progress the nature of aquatic environment undergoes numerous changes and deteriorating it's quality. In urban area water pollution problems always influence the biological imbalance are both qualitatively and quantitatively (Kshirsagar, 2013). Algae are one of the fastest organisms affected by the aquatic environment, so it is used as a guide to water quality due to their short life span, quick response to pollutants and its easy collection and identification (Barbour *et al*., 1999). Algae have a high growth rate and a very high nutrient uptake rate and are most able to grow year-round in a temperate climate compared to high-end plants (Mulbry and Wilkie, 2001). Algae affects the reduction of environmental pollution and bioaccumulation processes that occur in their tissues. The algae cells have the ability to concentrate pollutants from the surrounding environment and store them inside their body cells (Wang and Dei, 2001). The increase in organic pollutants within cells has an effect on the nutrient level because algae are the first food in the food chain (Sigaud-Kutner *et al*., 2003). Therefore, algae are considered to be important markers in identifying organically contaminated areas (Muse *et al.,*

1999). Shatt al-Arab is considered to be the lifeline of the Basra city. Recently there have been concerns over the water quality of the river Shatt al-Arab from Basra city. The Shatt Al-Arab water is used for bathing, drinking, irrigation and industrial purposes. Due to increasing urban and industrial activity that influence on the water quality of Shatt Al-Arab river. The study (Al-Saboonchi, 1998) showed the possibility of using benthic algae as evidence of organic pollution in the Shatt al-Arab and some of its branches. Jafari and Gunale (2006) used the Nigard Guide and the Palmer Algal Guide to Assessing the Quality of Mutha Water in India. Das and Chakrabarty (2007), through an environmental survey of three tropical regions of East India's water reservoirs using the Palmer's Guide to Genes and Species. In present study Palmer (1969) Algal Genus Pollution Index and Algal Species Pollution Index were employed to study the water quality of Shatt al-Arab river from Basra city. A list of most pollution tolerant genera and species according to Palmers index were calculated for all sampling stations. The purpose of this study is to know the use of Palmer's Algal index to assess the water quality of Shatt al-Arab river.

Materials and Methods:

The study area:

The length of the Shatt al-Arab river from the convergence zone to its outlet in the Arabian Gulf is about 195 km, and its depth varies according to the changes of the sites and according to the tidal conditions, it ranges from 8 to 15 m. The depth varies spatially between 5 m south of the Karoun estuary and 15 m in (Al-Ramadhan, 1988). The average width of the Shatt al-Arab is 500 m (Karim and Salman, 1987), ranging from 400 m in the city of Basra to 2000 m downstream. The level of Shatt al-Arab water is affected by the phenomenon of tides, which are repeated twice a day (Hussein *et al.,* 1991).

Sampling stations

Sampling stations were selected from the Shatt al-Arab, depending on the human and industrial activities and the existence of the natural and artificial substrate of algae (Plants, wood, Iron, Rock).

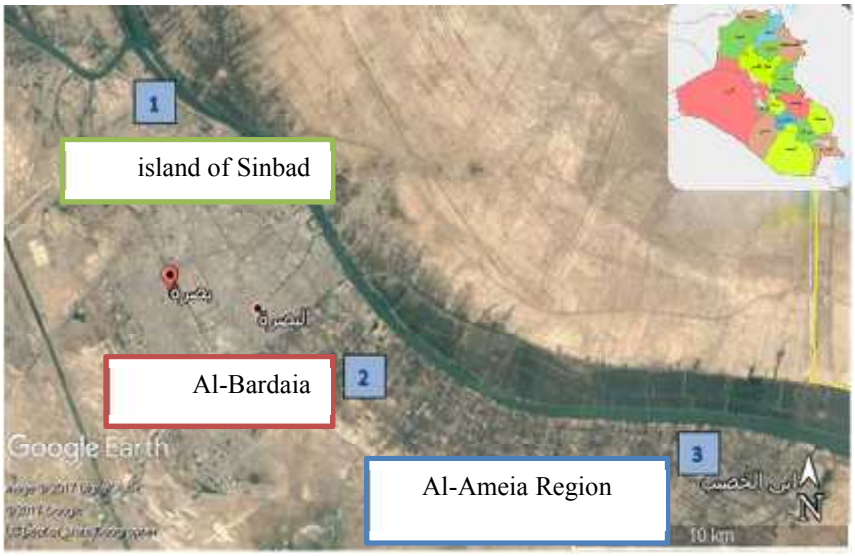

Fig. (1): Satellite map showed location of the sampling stations of the study area (station 1, 2 and 3).

The first station is located on the island of Sinbad (30°34'26.0"N 47°46'47.0"E) in the north of Basrah about 7-8 km, second station in the area of Bardaia (30°30'02.8"N 47°51'30.8"E) near the presidential palaces and away from the first station about 10.29 km, and the third in the area of the (Al-Ameia Region in Abu Al-Khaseeb)(30°27'16.7"N 48°02'06.1"E) and 12 km away from the second station Shatt al-Arab. (Fig. 1).

Table (1): Algal genus pollution index (Palmer, 1969), Following numerical values for 0-10= Lack of organic pollution, 11-15 =indicated moderate pollution, 16-20= probable high organic pollution, 21 or more =confirm high organic pollution.

Genus	Palmer pollution index	Genus	Pollution index
Anacystis	1	*Micractinium*	1
Ankistrodesmus	2	*Navicula*	3
Chlamydomonas	4	*Nitzschia*	3
Chlorella	3	*Oscillatoria*	5
Closterium	1	*Pandorina*	1
Cyclotella	1	*Phacus*	2
Euglena	5	*Phormidium*	1
Gomphonema	1	*Scenedesmus*	4
Lepocinclis	1	*Stigeoclonium*	2
Melosira	1	*Synedra* (=*Ulnaria*)	2

Table (2): Algal species pollution index of Palmer (1969): Following numerical values for 0-10= Lack of organic pollution, 11-15 =indicated moderate pollution, 16-20= probable high organic pollution, 21 or more =confirm high organic pollution.

species	Palmer pollution index	species	Pollution index
Ankistrodesmus falcatus	3	*Nitzschia palea*	5
Arthrospira jenneri	2	*Oscillatoria chlorine*	2
Chlorella vulgaris	2	*Oscillatoria limosa*	4
Cyclotella meneghiniana	2	*Oscillatoria princeps*	1
Euglena gracilis	2	*Oscillatoria pulrida*	1
Euglena viridis	6	*Oscillatoria tenuis*	4
Gomphonema parvulum	1	*Pandorina morum*	3
Melosira varians	2	*Scenedesmus quadricauda*	4
Navicula cryptocephala (=*N. veneta*)	1	*Stigeoclonium tenue*	3
Nitzschia acicularis	1	*Synedra ulna* (=*Ulnaria danica*)	3

The periphytic algal were collected monthly from August 2016 to July 2017 at the selected sampling station 1, 2 and 3. The samples were collected from submersible media (wood, plant, iron and rocks). Remove the algae layer with a brush with the added of tap water and pass in a 200 µm sieve. The sample was divided into two subsample, the first once (algae samples) was preserved in the Lugols solution. The second one represented diatoms samples were preserved in 5% Formalin solution. All the specimen were examined and diagnosis by Olympus microscope at 1000x. Palmer (1969) proposed

a pollution index based on algal genus and species used in the rating water sample for high or low organic pollution. The pollution tolerant genera and species of algae were recorded from selected sampling stations. A list of most pollution tolerant genera and species according to palmer's index factor was sampling station. A pollution index factor was assigned to each genus and species by determining the relative number of total points scored by each alga. The pollution status of sampling stations of Shatt Al-Arab river was determined based on their index as shown in Table (1 & 2).

Identification were done using standard keys of algae which appeared in some studies (Prescott, 1984; Al-Saboonchi and Al-Saad, 1988; Al-Saboonchi *et al*., 1990, Al-Ankush, 2013; Al-Shaheen, 2016)

Result and Discussion

Palmer (1969) made the first attempt to identify and prepare a list of genera and species of algae tolerance to organic pollution. He prepares a list of 60 genera and 80 species tolerant to organic pollution. According to Palmer, scores of 20 or more are indication of high organic pollution. The pollution tolerant genera and species belonging to four groups of algae from three stations of Shatt Al-Arab river were recorded.

Table (3): Pollution index of algae genus according to Palmer (1969) at three stations of Shatt al-Arab river (F: Flagellates, D: Diatoms, B: Blue greens, G: Greens).

NO.	Genus	Group	Palmer pollution index	Station		
				1	2	3
1	*Anacystis*	B	1	-	-	-
2	*Ankistrodesmus*	G	2	-	2	-
3	*Chlamydomonas*	F	4	4	-	-
4	*Chlorella*	G	3	3	-	-
5	*Closterium*	G	1	-	1	-
6	*Cyclotella*	D	1	1	-	-
7	*Euglena*	F	5	5	5	5
8	*Gomphonema*	D	1	1	-	1
9	*Lepocinclis*	F	1	-	-	-
10	*Melosira*	D	1	-	1	1
11	*Micractinium*	G	1	-	-	-
12	*Navicula*	D	3	-	3	3
13	*Nitzschia*	D	3	-	3	3
14	*Oscillatoria*	B	5	5	5	5
15	*Pandorina*	G	1	-	-	1
16	*Phacus*	F	2	2	2	-
17	*Phormidium*	B	1	-	-	-
18	*Scenedesmus*	G	4	-	-	-
19	*Stigeoclonium*	G	2	-	-	2
20	*Synedra* (=*Ulnaria*)	D	2	-	2	-
		Total score		21	24	21

Table (4): Pollution index of algae species according to Palmer (1969) at three stations of Shatt al-Arab river.

No.	Species	Group	Palmer pollution index	Station		
				1	2	3
1	*Ankistrodesmus falcatus*	G	3	-	3	-
2	*Arthrospira jenneri*	B	2	-	-	-
3	*Chlorella vulgaris*	G	2	2	-	-
4	*Cyclotella meneghiniana*	D	2	2	-	-
5	*Euglena gracilis*	F	1	1	-	1
6	*Euglena viridis*	F	6	-	6	-
7	*Gomphonema parvulum*	D	1	1	1	1
8	*Melosiravarians*	D	2	-	1	1
9	*Navicula cryptocephala* (=*N. veneta*)	D	1	-	1	-
10	*Nitzschia acicularis*	D	1	-	1	1
11	*Nitzschia palea*	D	5	5	-	-
12	*Oscillatoria chlorina*	B	2	2	-	2
13	*Oscillatoria limosa*	B	4	-	-	-
14	*Oscillatoria princeps*	B	1	1	1	1
15	*Oscillatoria pulrida*	B	1	-	-	-
16	*Oscillatoria tennis*	B	4	-	4	-
17	*Pandorina morum*	G	3	-	-	3
18	*Scenedesmus quadricauda*	B	4	4	-	4
19	*Stigeoclonium tenue*	G	3	-	-	-
20	*Synedra ulna* (=*Ulnaria danica*)	D	3	-	3	3
		Total score		18	21	17

Totally all 20 genera and 20 species are recorded in Table 3 and Table 4. The algae from station 2 were indicated the highest degree of organic pollution, showed the dominance of *Oscillatoria, Melosira, Navicula, Nitzschia, Gomphonema,* and *Euglena*, which considered to be indicator of organic pollution. The similar observation were encountered by Ahmed (2015). Sladecek (1962) stated were *Oscillatoria* indicated eutrophic water. The present study showed 15 pollution tolerant algal genera were found at all sampling stations which *Chlorophyceae* comprised, belonging to the following families *Cyanophyceae*, *Bacillariophyceae* and *Euglenophyceae* (Table 3). The total score of Algal genus pollution index of station 1, 2 and 3 were 21, 24 and 21 respectively (Table 3, Fig. 2). While total score from the algal species pollution index at station 1 were 18, station 2 were 21 and station 3 were 17 (Table 4, Fig. 2).

Thus it was observed that the higher score for Palmer index at station 2 indicating high organic pollution. Palmer's (1969) has shown that the genera like *Oscillatoria*, *Euglena, Scenedesmus, Navicula, Nitzschia* and *Ankistrodesmus* are the species found in organically polluted waters supported by Al-Nashy (2016). Similar genera are recorded in present investigation. Ali and Al-Mahdawi (2015) has reported that *Oscillatoria*, and *Euglena*, *Chlorella* and *Ankistrodesmus* are

typical in habitats of heavily polluted waters. Patrick (1965) concluded that *Euglena* and *Oscillatoria*are highly pollution tolerant genera and therefore reliable indicators of eutrophication in present study similar of these genera with very high grade points of Palmer's scale, like *Euglena viridis, Euglena gracilis, Oscillatoria limosa, Oscillatoria chlorine* and *Oscillatoria tennis* were recorded. Pearsall (1932) was the first to show a clear correlation between organic pollution and bluegreen algal and centric diatoms. Because of the planktonic form's namely. *Pandorina*, *Scenedesmu, Navicula* and *Melosira* are observed in present study which are the indicators of the organically pollution tolerant species. In the present investigation the dominant of Bacillariophyceae like *Navicula, Nitzschia, Gomphonema* and *Synedra* observed at downstream station. Similar observation were tallied by Al-Ankush (2013) when he provided detailed account of dominant species of diatoms being used as indicator of water quality. As a result, the algae from station 2 were polluted water showed the dominance of *Euglena viridis, Oscillatoria tennis, Synedra ulna* and *Ankistrodesmus falcatus* throughout the year which are considered to be indicators of organic pollution.

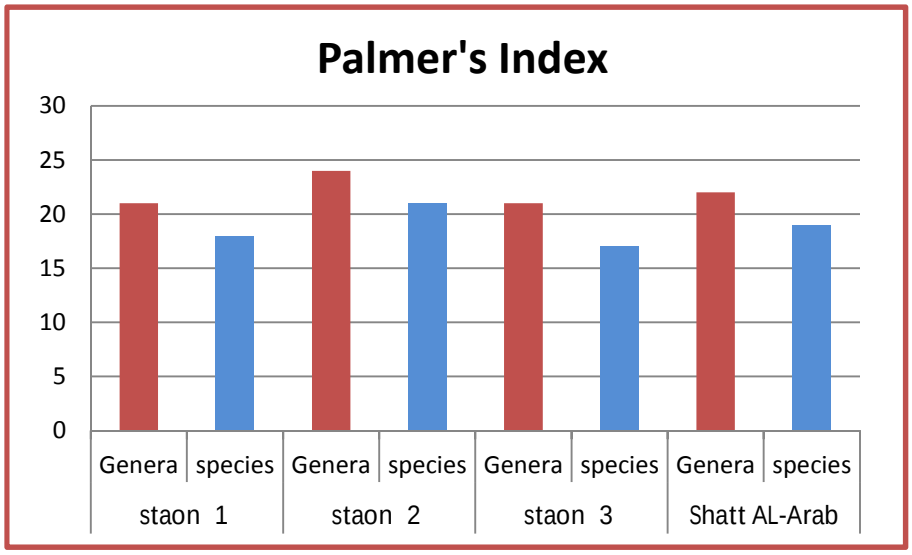

Fig. (2): Pollution index score of algal genera and species as selected sampling station of Shatt Al-Arab river.

Conclusions

The present study showed that the water quality of Shatt Al-Arab River was affected from domestic uses at the downstream of the river. The *Oscillatoria*, and *Euglena*, *Chlorella* and *Ankistrodesmus* are typical in habitats of heavily polluted waters, hence it could be concluded that *Euglena* and *Oscillatoria*are were highly pollution tolerant genera; Therefore, there were reliable indicators of eutrophication in present study similar of these genera with very high grade points of Palmer's scale such as *Euglena viridis, Euglena gracilis, Oscillatoria limosa, Oscillatoria chlorine* and *Oscillatoria tennis* .

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