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Assessment of the synergistic pressures on zooplankton in the Euphrates River

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Abstract: The current study clarified the effect of multiple pressures The current study showed the effect of multiple pressures resulting from the Nasiriyah power plant (NPP) such as thermal pollution, total petroleum hydrocarbons, and predation on the composition and density of the zooplankton community in the Euphrates River. Four stations were selected on the course of the river. Several physical and chemical variables with a direct effect on the presence of zooplankton in river water such as air and water temperature, salinity, and electrical conductivity were selected. A search and survey have been conducted for the predatory fish of the zooplankton in the river waters.

The results showed that the density of zooplankton recorded the lowest density in (S4) 260 individuals / m^3 and the highest density was recorded in (S1) (9114.1 individuals / m^3, while the air temperature was at its lowest value at (S1) $8C^0$ and its highest value recorded at (S4) reached $44C^0$ respectively, the water temperature recorded its lowest value 13.8 C^0 at (S1) and its highest value was 44 C^0 in (S4).). The percentage of water salinity recorded the lowest percentage of 1.46% in (S4) and the highest percentage of 3.55% in (S3), while the electrical conductivity values were a reflection of the percentage of salinity which recorded the lowest value of 2286 microsomes/cm in (S4), the highest value was 4120 microsomes in (S2).For total petroleum hydrocarbons. The lowest value was in (S4) in the spring season at 388 Mg/liter, and the highest value was in (S2) in the fall at 678 Mg/liter, The study found a complete dominance of predatory Nile tilapia fish, noting that the river environment is nutritionally poor, as 90% of the fish caught in the study stations and on the course of the river are only Nile tilapia.

Keywords: Zooplankton, Total Petroleum Hydrocarbons, Predation.

Introduction

Zooplankton is the most important link between phytoplankton and organisms with high trophic levels. These plankton are very sensitive to environmental changes, especially water temperature resulting from climate change or human activities, which cause drastic changes in the composition of the zooplankton community. [1] Nassiriyah thermal power plant, hich is built on the Euphrates river, and uses water in the cooling system, generates multiple synergistic pressure on the zooplankton environment and its community composition and on the river water quality, which generates great risks for the loss of biodiversity for the most important link in the food chain, which is zooplankton.[2] Differences in the density of crustaceans depend directly and indirectly on the interaction or overlap between physical, chemical factors, and biotic factors such as predation, competition, and phytoplankton density, predation is one of the important factors affecting the density of zooplankton, whether these predators are fisher crustacean plankton that feeds on each other. The predation of fish and large invertebrates of plankton may be the first reason for the decrease in the density of zooplankton or its loss. In some cases, predation pressure is more influential on the population densities of zooplankton than the water quality, especially when predatory copepod fish and branched tentacles are present.

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[3]. The river is under the complete dominance of the Nile tilapia fish (*Oreochromis niloticus*), which is an invader of Iraqi waters. It is a predatory fish for all vertebrates, invertebrates, and aquatic plants due to its ability to grow, reproduce and feed in different environmental conditions. [4] . The following factors can be very important to explain the phenomenon of decline or loss of zooplankton individual's in some aquatic systems, which include: Total Petroleum Hydrocarbon , Predation , Temperature, Salinity and Heavy metal toxicity. [5]. Power plants are a large source of thermal pollution that occurs in surface waters and human demand for energy continues to increase. o will the amount of cooling water that is withdrawn from and subsequently discharge as superheated wastewater back into these aquatic ecosystems. [6] .Total petroleum hydrocarbons are a clear group, consisting of hundreds of chemical compounds that are originally extracted from crude oil and are found in a range of carbon chains with a range of carbon chains with a range C6 to C35 as a mixture of hundreds of thousands of hydrocarbons. The presence of these compounds in salty and fresh aquatic systems poses a major threat to these water resources. Large quantities of these pollutants reach water resources through oil spills and various human activities such as power plants, sewage, pesticides, and emissions from incomplete combustion of fossil fuels .[7] . Hydrocarbons are toxic and may be fatal depending on the nature of the hydrocarbon molecule, the method of exposure to Imet, and the duration of exposure. Hydrocarbons are toxic and may be fatal depending on the tnatureube of the hydrocarbon molecular the method of exposure to, it, and the duration of exposure.

Study Area

The Euphrates River is one of the main rivers in Iraq, with a length of (2775 km) and it is classified among the longest rivers in the world. It is considered one of the largest rivers in the Middle East and its number is (27) in the world. (13) The Euphrates River penetrates the geographical area of the city of Nasiriyah from the northwestern border (Al-Batha) at 911.5 km from the Euphrates River. The Nasiriyah power plant was established at the beginning of the river's entrance to the city, as large quantities of water are used for cooling purposes. Nasiriyah Thermal Power Plant was established in 1978 at the beginning of the river entrance, 7 km from the city center. The study area extends about 10 km. The first station is to the north of the generation station, about 2 km away from the hot liquid waste disposal point. It is considered the control point and a reference station for the rest of the study stations, as it is characterized by the presence of agricultural lands on both sides of the river and before the civil facilities of the generation station.

The second station is near the hot liquid waste discharge point for the NPP. The third station is 2 km from the second station, and it represents the point of merging the station's waste streams with the river water. The area is characterized by the presence of orchards and scattered agricultural villages.

The fourth station is 6 km from the third station. On the side of the river, there are drinking water purification stations used by local residents. The locations of the stations were determined using a GPS device.

Material and Methods

Samples were collected in the study area every month and were expressed quarterly from June 2021 to the end of April 2022. Four stations were selected (S1) as a control station and (S2) as the impact area, the power station, which releases hot water flows into the river, and two other stations were chosen, namely (S3) and (S4), each one km away from the other and the point of impact as well. Samples were taken at a depth of 30 to 50 cm from the surface of the water using 1-liter plastic bottles to measure salinity, electrical conductivity, total petroleum hydrocarbons, and air and, water temperature. The samples were kept in a cooler box until they were taken to the laboratory for laboratory tests. The air temperature was measured in the field with a mercury thermometer with grades from zero to 100 degrees Celsius, as well as the water temperature, and conductivity was measured in the field using a portable electronic device type Com80 HM – digital. To measure total petroleum hydrocarbons in water samples, they were determined using the method described by the [8] .The proportion of total petroleum hydrocarbons was measured using a spectrophotometer (Shimadzu RF –540), emission range (290-420 nanometers) during excitation (360 nanometers). Zooplankton samples were collected from study stations with a depth of 30 to 50 cm from the surface of the water and a volume of 40 liters using a graduated bucket. The samples were poured through a plankton net of size 55 micrometers, and 4% formalin was added to the samples for biological preservation

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and were placed in a cooler box-shaped on crushed ice until transported. They were taken to the laboratory and were identified under the compound microscope by type (KrussMBL 2100). The number of plankton on the samples and for each station was determined using the following references [9,10,11,12]. The results were determined by the number of individuals per cubic meter (Ind / m3). Fish samples were collected during the study period from the Euphrates River and one sample per month using gill nets with holes 20 and 30 mm, where the nets are set from five in the morning until seven in the morning. The caught fish were placed in refrigerated containers and preserved by freezing and transferred to the Animal Resources and Fisheries Research Center / Agricultural Research Department - Ministry of Science and Technology for classification, as it was found that 90% of them are Nile tilapia.

Results and Discussion

The results of the study showed that the high values of air temperatures were recorded in the summer and the low values were recorded in the winter, and this is a reflection of the climate of Iraq, which is generally hot, dry in summer, and cool and rainy in winter. [13]. The results of the study showed that the highest value of air temperature was in the fourth station 44 C^0 in August and the lowest recorded in the first station 8 C^0 in December, the water temperature is a reflection of the air temperature where the highest degree was recorded in the second station (S2) 43C^0 in the month Ib is the point of hot flows from the generation station and the lowest water temperature was recorded in the first station at 13.8 C^0 in December. Temperature is the most important physical variable affecting aquatic systems, like the composition, abundance, and nutritional efficiency of zooplankton communities are closely related to water temperature and it is a direct physiological response .[14] , where the temperature is the important driver of the growth rates of fish and invertebrates and rates of decomposition in the aquatic environment . [15] . There is clear evidence of an increase in non-predatory mortality within the zooplankton community due to the increase in water temperature .[16]. For example the abundance of zooplankton carcasses downstream of warm waters is 2-7 times higher than What is in the water source .[17]. The results of the study showed that the percentage of salinity of river water was recorded at high levels compared to previous studies on the Euphrates River, where the lowest value of salinity was recorded at the fourth station (1.46%) in October and the highest value of salinity at the second (2.63%) in June. Through the statistical analysis, there is a positive correlation between the percentage of salinity and electrical conductivity in all the studied stations with an increase in the values recorded near the second and third stations, and this may be due to the effect of station fluxes, as well as due to the ionic strength of the liquid waste, as well as the high evaporation rates at the point of impact in addition to it Increasing the water temperature .[18]. The recorded values of electrical conductivity were a reflection of the salinity values recorded in the studied stations, where it reached the lowest value (2286 µse./cm) in the fourth station of October and the highest value recorded (4120 µse./cm) in the second station of June. Salinity in ecosystems Aquatics is one of the most influential environmental variables .[19] , and consequently the negative effects of salinity on survival (i.e. reduced growth rate), reproduction (i.e. delayed maturation), and zooplankton abundance affect higher trophic levels .[20]. High salinization of inland waters alters the natural characteristics of aquatic ecosystems, limits the distribution of aquatic invertebrates and reduces biodiversity. The high concentration of salts in water is toxic to freshwater organisms and affects their basic physiological and biological functions [21] . The levels of petroleum hydrocarbons were evaluated in the surface waters of the river and in all stations, where the concentration of petroleum hydrocarbons varied widely in the study area. Mg/liter in the second station of the autumn season has the highest value, and these percentages recorded in our study, in general, exceeded the standard limit of the standards of the European Union Environmental Protection Agency [22]. According to the maximum limits in rivers and basins, which amount to (300 mg/liter) of mineral oils in the water, this indicates the dangerous impact of liquid waste from the power plant, where the Euphrates River is exposed to serious pollution that threatens aquatic organisms in general, including humans, and emphasizes the need for rapid treatments to prevent accumulated environmental and health damages. The spatial distribution of hydrocarbons shows that the highest concentration of them was in the second station, which explains to us the number of dangerous pollutants that are emitted by the flows of the generation station that uses crude petroleum fuels, while the first station, which is the control station, showed the lowest concentration of

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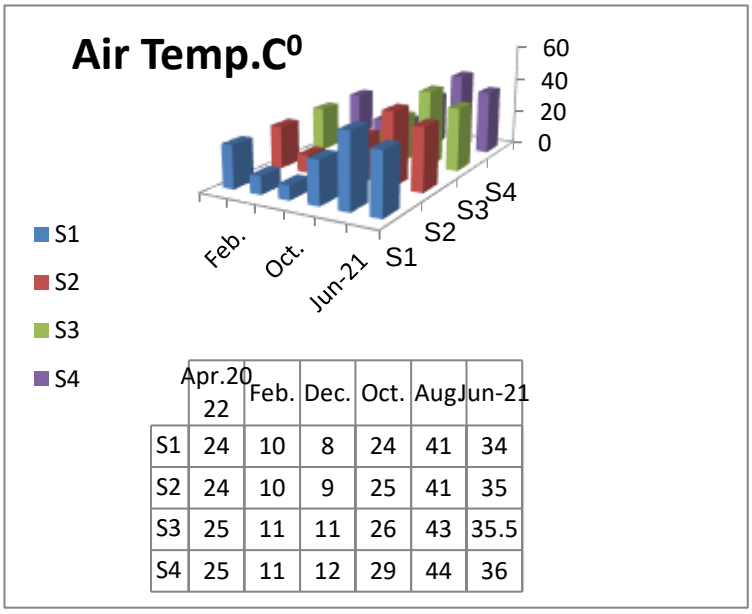
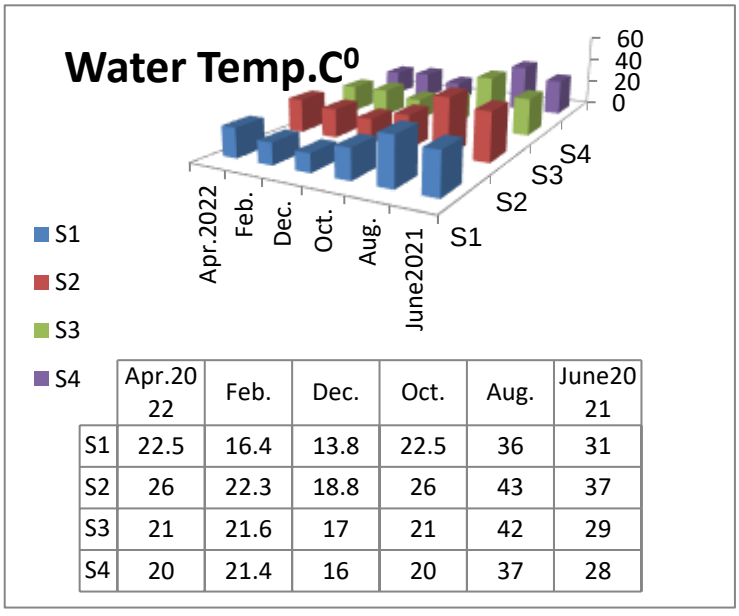
petroleum hydrocarbons being far from the impact area of the generation station. While the distribution The time shows that the summer season, in general, is less concentrated in the content of petroleum hydrocarbons in the river water than in the rest of the seasons, and this may be due to the large water releases that reach the river basin during the summer season to maintain the work of the power plant. This study confirms the pollution of the Euphrates River in southern Iraq with petroleum oils at high levels that affected living organisms in general, especially zooplankton, as their density and species diversity decreased, and this was reflected in the decrease in the presence of local fish in the river and the prevalence of invasive species of Nile tilapia fish that are highly resistant to environmental pressures such as increasing water temperature and other pollutants. The results of the current study showed a significant decrease in the density of zooplankton and a decrease in the diversity of species in all the studied stations spatially and in all the months of the study in time. The first (9114.1 Ind./m3) in April and this density indicates the distance of the control point from the impact of the polluted generation station flows. Our study found that all study stations after the point of hot flows of the generation station had a small total density of zooplankton, which was recorded in the third and fourth stations as well In the second station, which is the point of influence. The planktons recorded in the study were formed from wheelchairs by 45.4%, cladocera by 4.2, and copepods by 51.4%, respectively. The low density of cladocera is due to its high sensitivity to high water temperatures and salinity compared to the rest of the species. The size and taxonomic structure of zooplankton communities are regulated by their physical and chemical environments . [23]. Human development and global warming are a threat to zooplankton, which serve as biological indicators of multiple stresses due to their short life cycles and sensitivity to environmental shocks such as changes in salinity and temperature, and this is evidenced by the change in the structure of the plankton community [24]. The study area in particular and the Euphrates River in, the general was characterized by the presence of great abundance and complete control of the Nile tilapia fish over the rest of the local species. and competition. Fish samples were taken from the different study stations and sent to the Fish Research Center of the Iraqi Ministry of Science and Technology to diagnose the species and anatomy of the alimentary canal samples of them to know the method and type of their feeding. The samples included all study stations and for different seasons. The study found that this type of fish has complete dominance over the study area, and because of its distinctive feeding method, its ability to multiply rapidly, its resistance to pollutants, and lack of food, it has complete dominance over the rest of the fish species. Because of its predation and feeding on plankton, this led to a decrease in the biodiversity of the plankton and a decrease in its density, and a disruption in the societal structure of the plankton in general, animals, and plants.



	Apr.2022	Feb.	Dec.	Oct.	Aug	Jun-21
S1	24	10	8	24	41	34
S2	24	10	9	25	41	35
S3	25	11	11	26	43	35.5
S4	25	11	12	29	44	36

Figure (1): Seasonal variations of the Air temperature in Euphrates during June 2021- April 2022.



	Apr.2022	Feb.	Dec.	Oct.	Aug.	June2021
S1	22.5	16.4	13.8	22.5	36	31
S2	26	22.3	18.8	26	43	37
S3	21	21.6	17	21	42	29
S4	20	21.4	16	20	37	28

Figure (2): Seasonal variations of the Water temperature in Euphrates during June 2021- April 2022.

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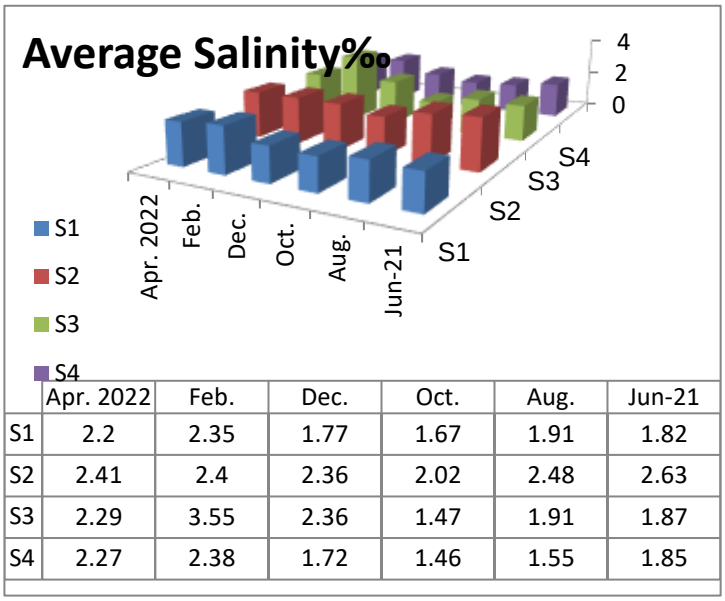
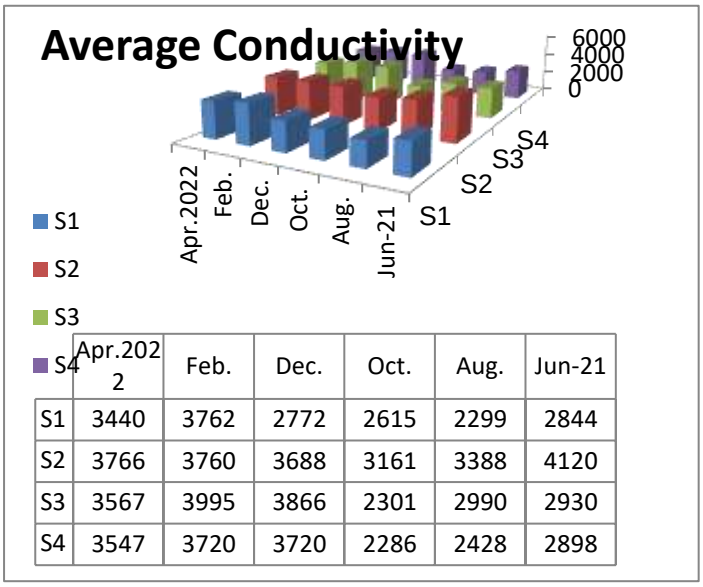
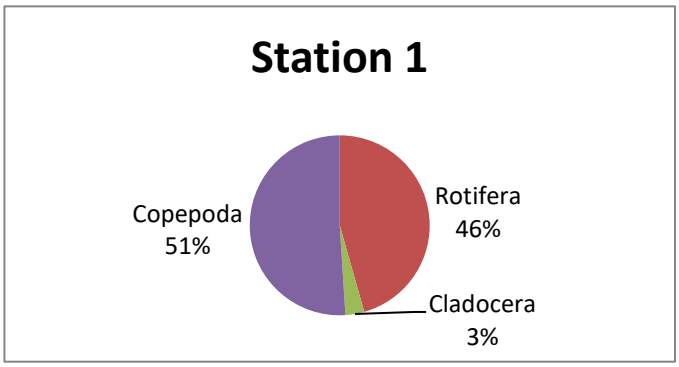
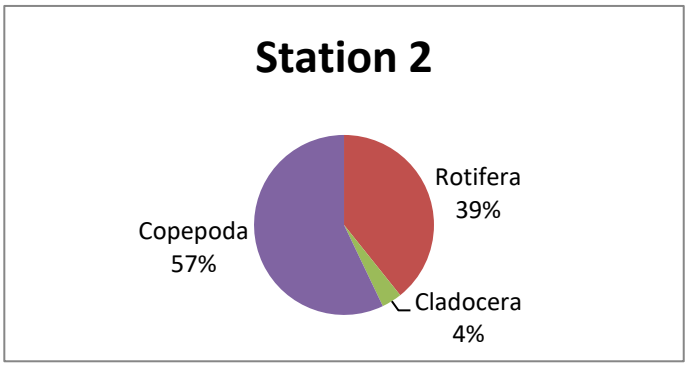


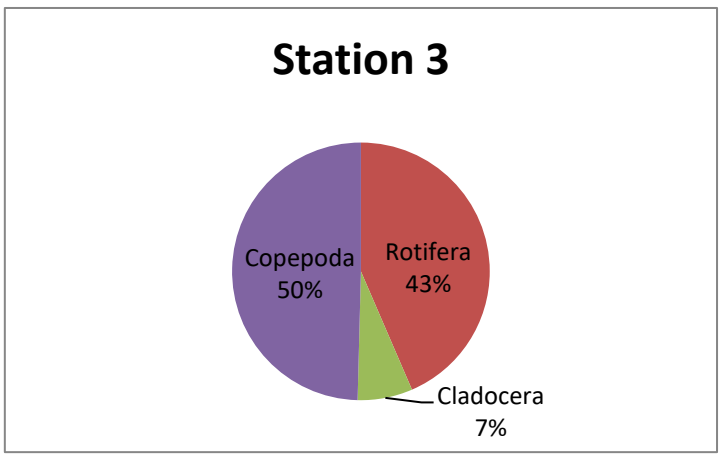
	Apr. 2022	Feb.	Dec.	Oct.	Aug.	Jun-21
S1	2.2	2.35	1.77	1.67	1.91	1.82
S2	2.41	2.4	2.36	2.02	2.48	2.63
S3	2.29	3.55	2.36	1.47	1.91	1.87
S4	2.27	2.38	1.72	1.46	1.55	1.85

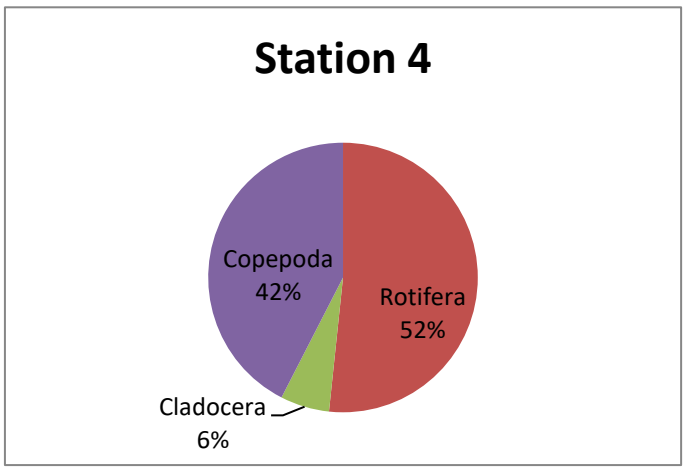


	Apr.2022	Feb.	Dec.	Oct.	Aug.	Jun-21
S1	3440	3762	2772	2615	2299	2844
S2	3766	3760	3688	3161	3388	4120
S3	3567	3995	3866	2301	2990	2930
S4	3547	3720	3720	2286	2428	2898









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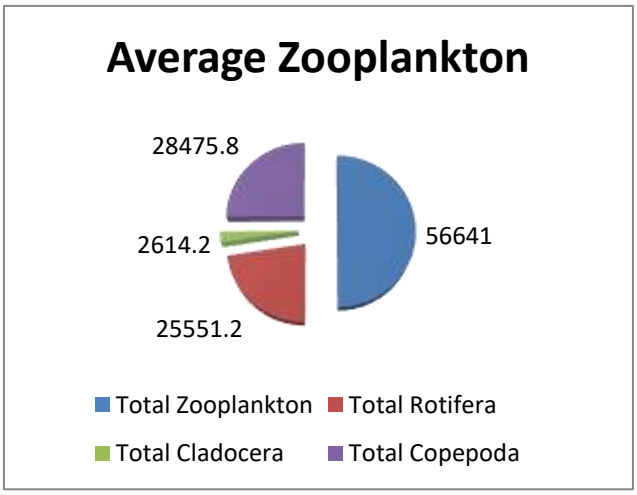
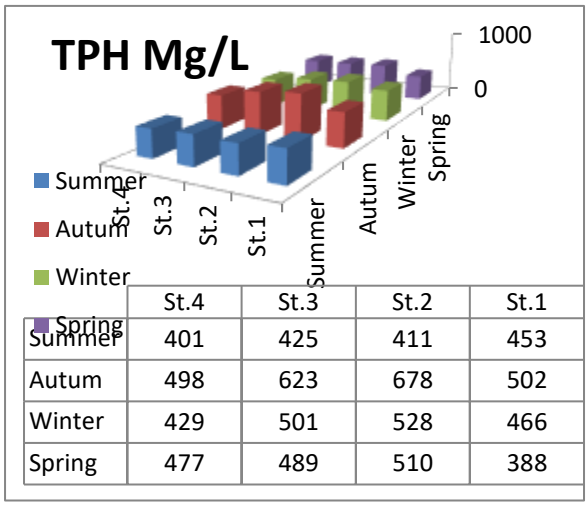
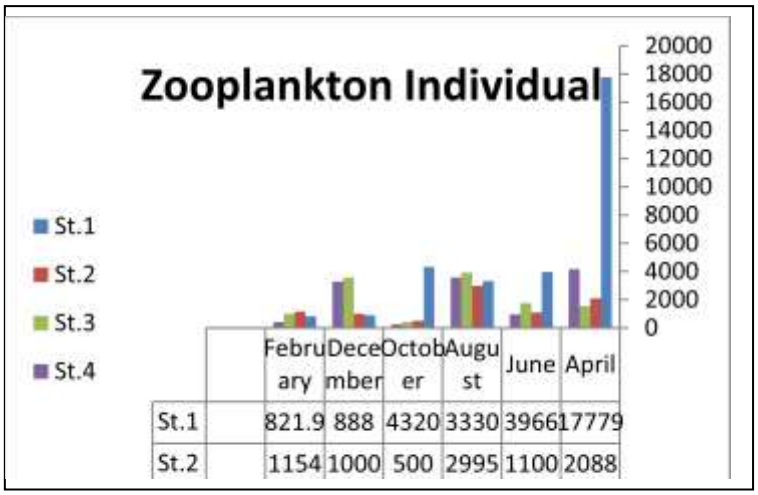




	St.4	St.3	St.2	St.1
Summer	401	425	411	453
Autum	498	623	678	502
Winter	429	501	528	466
Spring	477	489	510	388



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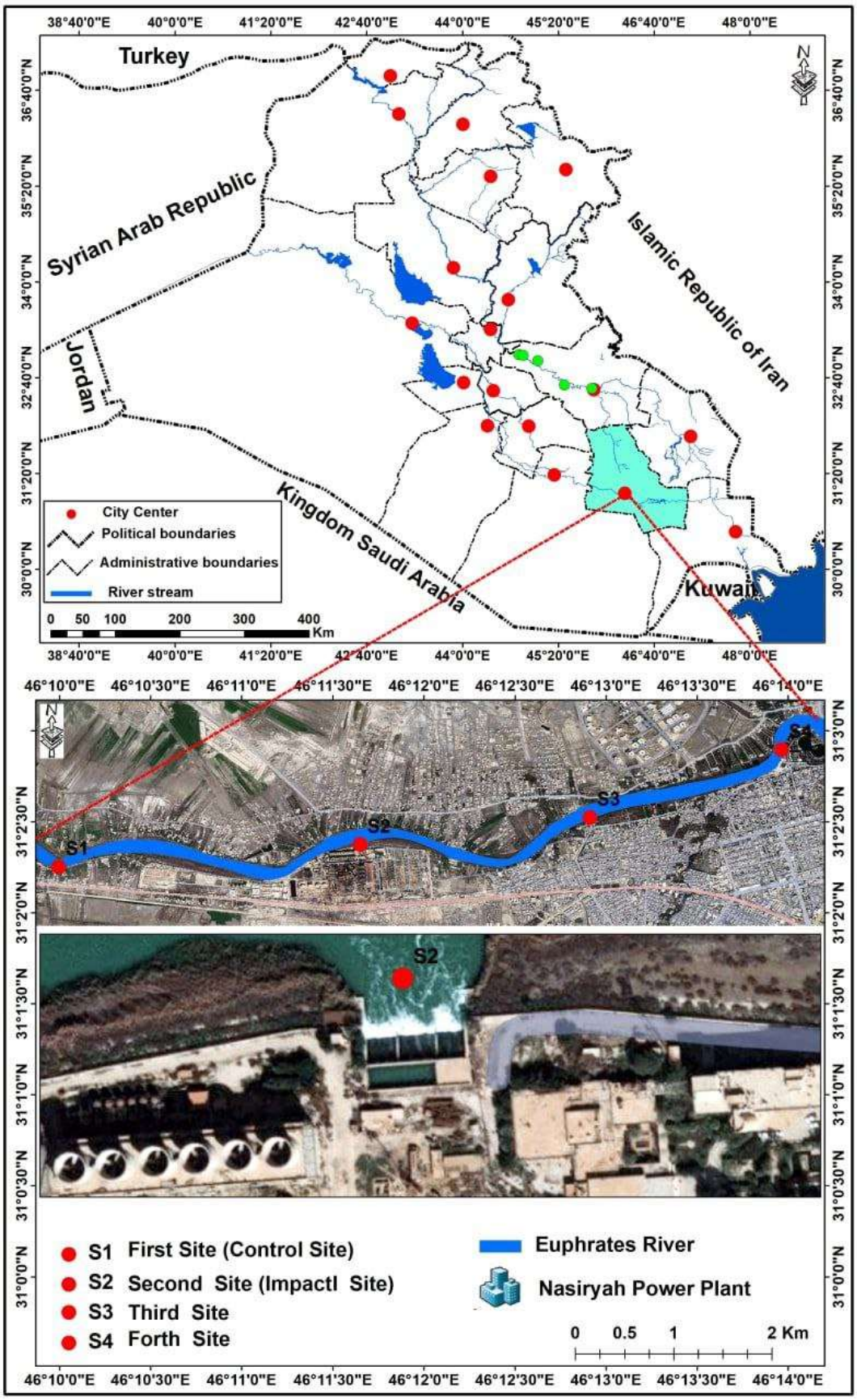

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