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Species composition of fish and some ecological factors in Haji Ali drainage Al-Hilla/Iraq

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Abstract: The present study included species composition of fish and some ecological factors in haji Ali drainage in the Babylon province. Three stations were chosen for the purpose of the study, the station of first is placed at the beginning of the drain(St1), the second in the middle(St2) and the third at the end(St3), monthly samples were selected from June 2019 to May 2020. Water temperature showed slight changes to the stations were recorded between(11.8C°-28.9C°).Salinity ranged between 0.12gm/l -2.55 gm/l. pH values tended in some months of study to the acidic side and in other months to the basic side has recorded from (6.4-9.3). Dissolved oxygen values ranged from (1.71-.86)mg/l.Biological oxygen demand values ranged between (0.04-4.59) mg/l.Throughout 8 fish were obtained, belonging to 14 species 793of 5 the period mentioned above, a total and 7 families, 11 species of them were native species whereas 3 of them were alien species. The most abundant species was Carassius auratus constituted 31.28% of the total caught of the first station, the value of the dominance index (D3) in first station was 78.53%. The most abundant species in second station was C. auratus constituted 31.46% of the total caught, the value of the dominance index (D3) in the second station was 70.03%. The most abundant species in third station was Planiliza abu constituted 28.08% of the total caught, the index of dominance value (D3) in the third station was 75.68%. Richness index (D) was ranged between (0.66-1.92) and diversity index (H) recorded (1.07-2.01),while evenness index (J) ranged (0.55-0.70).

Keywords: Fish composition, Haji Ali drainage, Ecological factors, Aquatic organisms, Biodiversity, Al-Hilla /Iraq.

1. INTRODUCTION

Studies on the diversity of the fish composition are of great importance for drawing a clear picture of the nature structure of the fish composition (Korsbrekke *et al*., 2001), as well as providing good information on commercial and non-commercial species of fish and their spread, as well as nutritional relations and the nature of breeding and seasons (Al-Naely, et at, 2018a; Al-Naely, et al., 2018b; Pennington *et al*., 2002).

To understand the intervention of human impacts in the environments as well as to find ways to minimize such damage and protect biodiversity by investigating and measuring environmental indices of biodiversity that in turn gives an accurate depiction of the state of biodiversity of the fish composition (Christian, 2006 and Sarkar *et al*., 2013).

Most of the previous studies focused on Iraqi surface waters, while the studies were about drainage Al-Iraqi is rare, and many of the drains have turned into a waterway in which

heavy water is discharged to many cities and residential communities near to them (Abdulraheem, et al., 2020; Al-Marri, et al., 2020), in addition to waste, thus losing its basic function and turning into a source of danger to agriculture and human and animal life alike. The continuous increase in population growth has made the specialists and those concerned with water resources stand on the possibility of benefiting from the drain in different ways, whether in agriculture or in the development of fish wealth in particular, and that these drains contain good types of fish, and a number of researchers have done environmental studies on some Iraqi trenches, such as the study of the reality on the Baghdad-Karbala road (Jbr, 2003), the study of the drainage water of the Saqlawiya drainage (Muhammad, 1978,).

Through the literature review, we find that the drainages in Babylon province were not sufficiently studied, and from this came the idea of a study fish composition in Haji Ali drainage in the Babylon province and predict some ecological parameters and their impacts on fish composition.

2. METHODS AND MATERIAL

Sample collection

Fish specimens were taken from the three different places (stations) monthly throughout the second week of each month, were caught using gill nets and electro- fishing.Taking into consideration the stability of the fishing time, which is two hours throughout the study period .The fish caught are placed in boxes contain the ice for purpose of transporting them to the laboratory and they were classified on the same day depending on (Coad ,2010) until the necessary studies were conducted on them. Water samples were selected in Winkler's bottle 250 ml size for the purpose of stabilizing field-soluble oxygen and estimating the biological oxygen demand BOD.

Physical and chemical properties

Water temperature

Water temperature was measured directly at the sampling sites by a multi- meter.

Salinity

The salinity values were calculated from the electrical conductivity values that were measured using a multi- meter device, according to (Mackereth *et al*.1978) and apply the following equation:-

$$Salinity(gm/l)‰ = \frac{electrical\ conductivity(\mu s/cm) * 0.64}{1000}$$

PH

pH of water was measured using device a Multi-meter (HANNA Model)after being calibrated with standard solutions (4,7,9).

Dissolved oxygen (DO)

Dissolved oxygen was measured using the DO-meter device and the factory is from company Oakton expressed results in units (mg/l).

Biological oxygen demand (BOD)

Biological oxygen demand was measured by measuring the variance in the magnitude of dissolved oxygen in water when collecting samples and after the incubation period (5 days) and expressed results in units (mg/l) (Nollet, 2007).

Biological-oxygen demand (mg\L)=Dissolved oxygen first(Before incubation)-Dissolved oxygen second (after incubation)

Relative abundance

Calculated the relative abundance based on (Odum,1970), By applying the equation:

Relative abundance (%) = (ni/N) x 100

ni: Individuals number in the monthly specimen.

N: Total Individuals number in monthly specimen.

Dominance (D3)

The next formula (Kwak and Peterson, 2007) has been utilized:

D3=[Σpi3i=1.] 100

Pi= weight or number's ratio for 3 species with greatest abundance to total people.

Biological indices

Diversity index (H)

The numerical and weight diversity value was determined depending on the equation (Shannon and weaver, 1949):

H=-∑pi lnpi

H: Index of Variety.

Pi: The ratio of the number of each species in the catch sample to the total number.

Richness index (D)

The numerical and weight richness index was determined using the following formula (Margalef, 1951):

D=S-1/Ln N

D: index of Richness.

S: The species' number.

N: The total individuals' number.

Evenness index (J)

The numerical and weighted Evenness index was determined from the following formula (Pielou, 1977):

J=H/Ln S

J: Index of Evenness.

H: Index of Variety.

S: The total species' number.

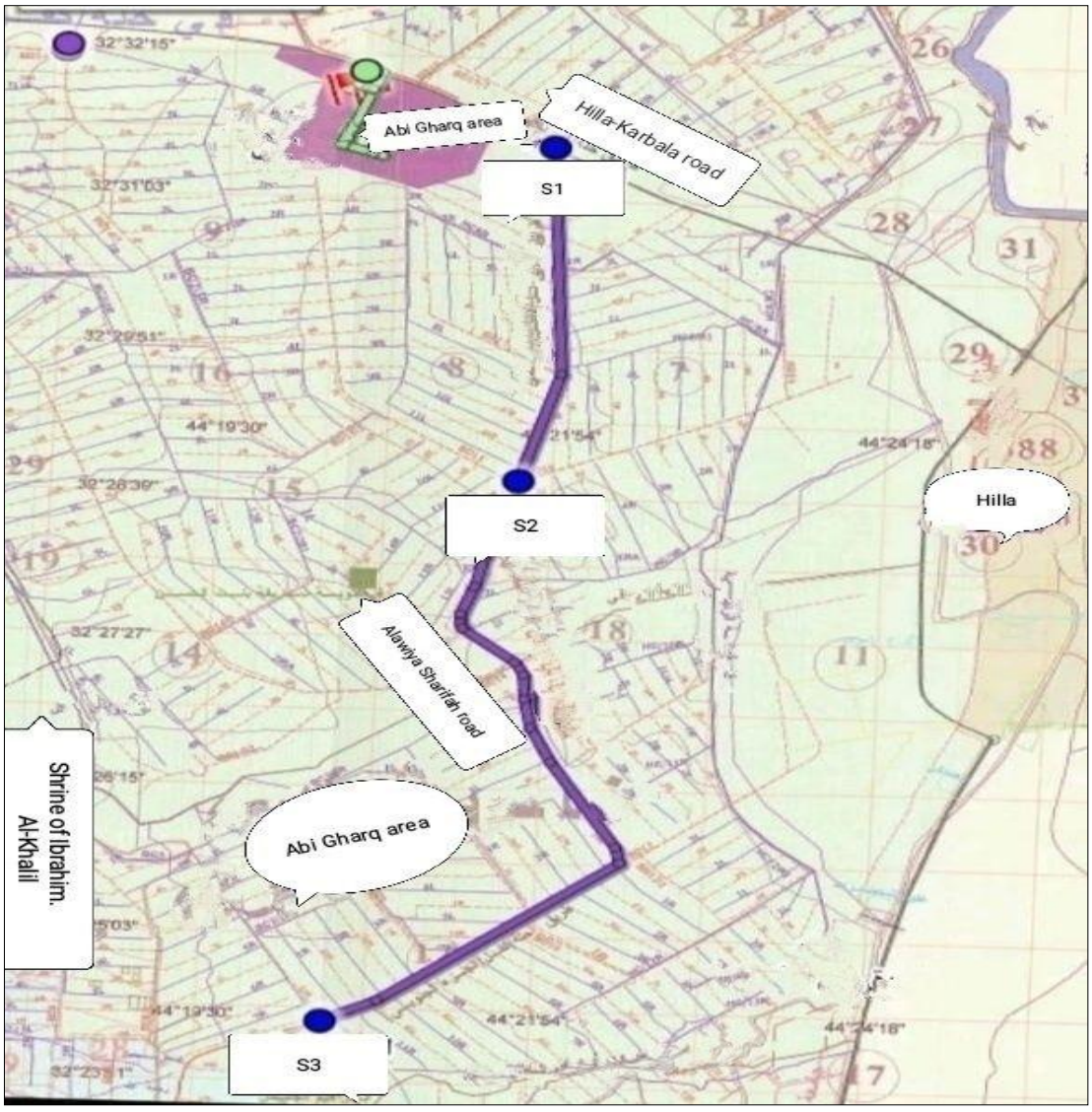

Figure (1) Map of the Haji Ali drainage with locations of study sites.

3. RESULTS

Environmental factors

Water temperature

Water temperature values show slight changes throughout different months and at all stations (Figure2).The highest temperatures recorded 28.9C° in July at third station, while the lowest value was recorded in February constituted 11.8 C° in the first station. The results of the statistical analysis showed a negative correlation between temperature and pH in all stations at level (p= 0.01), and BOD at level (p= 0.05).

pH

Figure (3) show the monthly variations of pH values at the study stations and the results nearly similar between stations, high value was recorded 9.3 in January in the first station, while the lowest value in June reached 6.4 in the first station. The results of the statistical analysis showed a negative correlation between pH and temperature in all stations at level (p= 0.01).

Salinity

Figure (4) show the monthly variations in salinity concentration in the study stations, the highest values was recorded in the first station 2.55 gm/l throughout June while the lowest value recorded 0.12 gm/l in August in the same station.

Dissolved oxygen (DO)

Figure (5) show the monthly differences of dissolved oxygen throughout the study stations, the highest values were recorded 8.86 mg/l in June at the second station, the lowest magnitudes of dissolved oxygen was 1.71 mg/l in July at the first station. The results of the statistical analysis showed correlation between DO and BOD at level (p= 0.05) at the first station.

Biological oxygen demand (BOD)

Figure (6) explain the monthly variations biological oxygen demand in the study stations, the highest value was recorded 4.59 mg/l in January in the first station while 0.04 mg/l was recorded in the third station throughout August. The results of the statistical analysis showed a positively correlation between BOD and DO in the first station and temperature in second stations at level (p= 0.01).

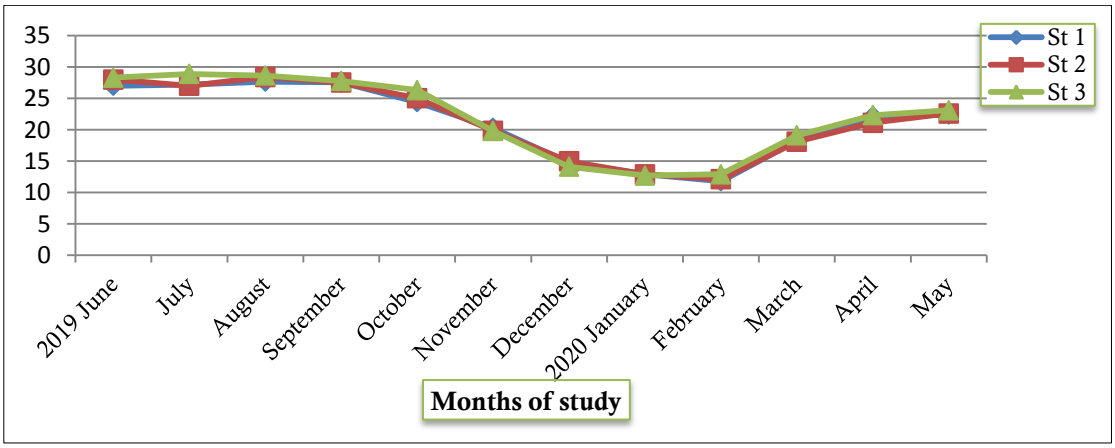

Figure (2) Monthly variations in water temperature in Haji Ali drainage throughout study period.

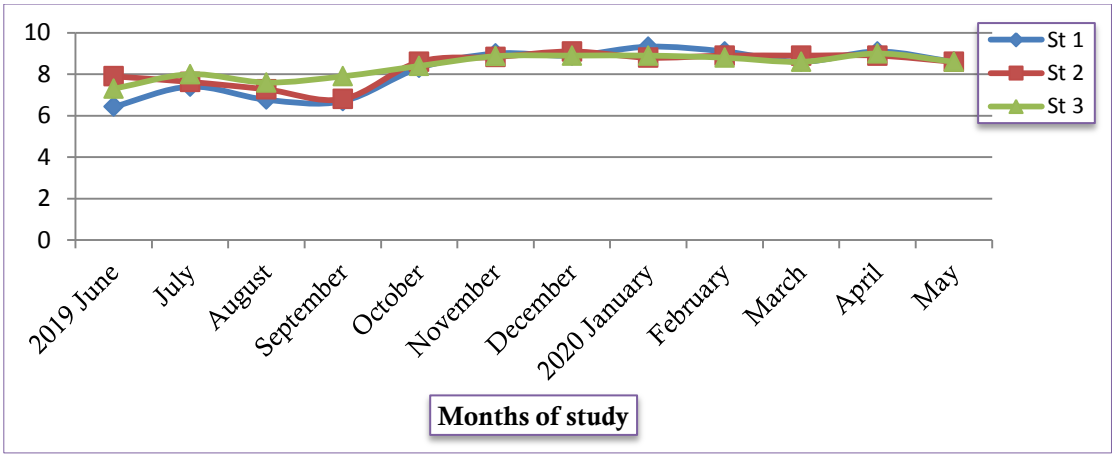

Figure (3) Monthly variations in pH in Haji Ali drainage throughout study period.

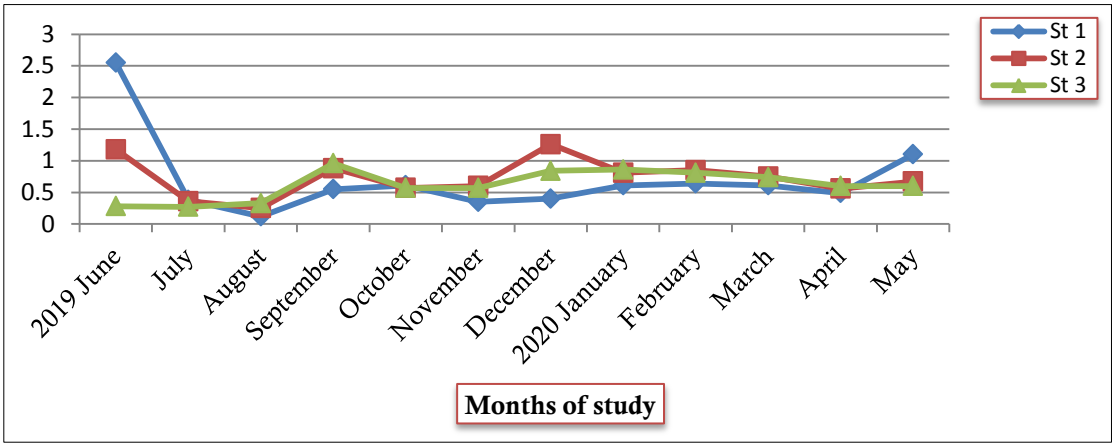

Figure (4) Monthly variation in salinity in Haji Ali drainage throughout study period.

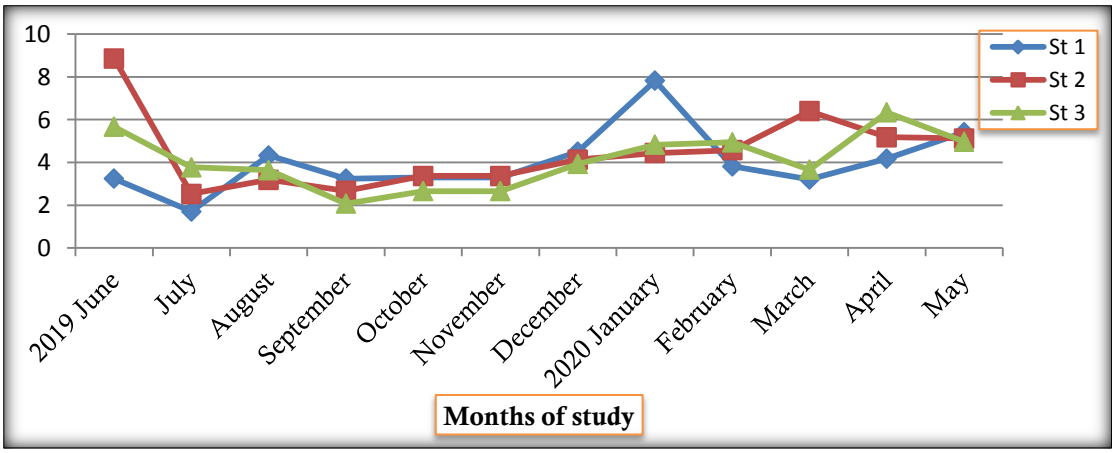

Figure (5) Monthly variations in dissolved oxygen in Haji Ali drainage throughout study period.

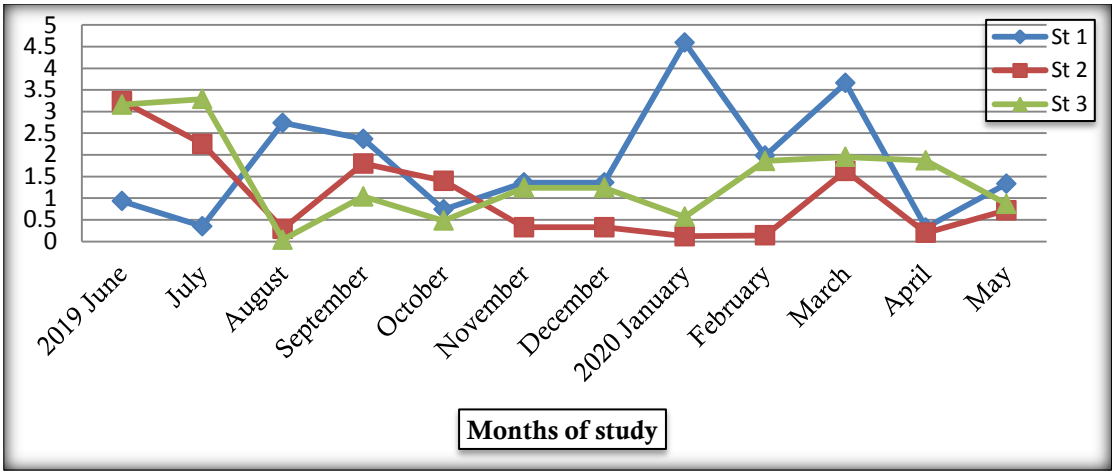

Figure (6) Monthly variations in biological oxygen demand in Haji Ali drainage throughout study period.

Fish composition

Cyprinidae family represented by 6 species are *Carassius auratus*, *Cyprinus carpio*, *Carasobarbus luteus* (appeared in all stations), *Arabibarbus grypus*, *Luciobarbus xanthopterus* (appeared at the first station only), *Cyprinion kais* (appeared at the third station only). Leuciscidae family represented by three species are *Alburnus caeruleus* (appeared at all stations), *Alburnus sellal* (appeared at the first station only), *Leuciscus vorax* (appeared at the second and third station). Cichlidae, Mugilidae, Siluridae , Bagridae and Mastacembelidae families represented by one species for each of them are *Oreochromis aureus*, *Planiliza abu*, *Silurus triostegus* (appeared at the all stations), *Mystus pelusius* (appeared at the first station only), *Mastacembelus mastacembelus* (appeared at the first and second station) respectively. Table(1).

Table (1)The scientific name and family name of the fish species caught in Haji Ali drainage throughout study period (St1:First station, St2:Second station, St3:Third station).

No.	Scientific name	Family	Station occurrences
1	*Carassius auratus*	Cyprinidae	St1,St2,St3
2	*Cyprinus carpio*	Cyprinidae	St1,St2,St3
3	*Carasobarbus luteus*	Cyprinidae	St1,St2,St3
4	*Arabibarbus grypus*	Cyprinidae	St1
5	*Luciobarbus xanthopterus*	Cyprinidae	St1
6	*Cyprinion kais*	Cyprinidae	St3
7	*Alburnus caeruleus*	Leuciscidae	St1,St2,St3
8	*Alburnus sellal*	Leuciscidae	St1
9	*Leuciscus vorax*	Leuciscidae	St2,St3
10	*Oreochromis aureus*	Cichlidae	St1,St2,St3
11	*Planiliza abu*	Mugilidae	St1,St2,St3
12	*Silurus triostegus*	Siluridae	St1,St2,St3
13	*Mystus pelusius*	Bagridae	St1
14	*Mastacembelus mastacembelus*	Mastacembelidae	St1,St2

*Alien species

Table (2) demonstrated the monthly differences in the persons number and species of fishes in hajji Ali drainage throughout study period, a total of 5793 fish were taken

throughout the investigation time, involving 11 native species and 3 alien species.The total number of 5793 individuals for all stations, the highest number ranged between 806 individuals in August, and the lowest number of individuals 232 was obtained in March. The total species' number was 14 species for all stations and ranged between 9 species in June, July and August and 7 in November, January and April. According to stations 12 species was recorded in the first station, its ranged from 8 species in July and 5 species in May, the second station was recorded 9 species ranged between 8 species in February and March, and 5 species in June and July, . while the third station recorded 9 species ranged between 9 species in June and 4 species in July and December.

The total number of individuals reached 1691 individuals in the first station ranged between 247 individuals in October and 38 individuals in April, a total of 1869 fish individuals were recorded at the second station ranged between 299 individuals in August and 67 individuals in November, while the third station recorded 2233 individuals, it ranged between 392 individuals in September and 53 individuals in March. Also (Table 2) show diversity indices in Haji Ali drainage throughout study period, the heights value of richness index (D) ranged between 1.92 in June and the lowest value ranged 0.66 in December throughout third station. The heights value of diversity index (H) ranged 2.01 in June in the third station and the lowest magnitude was 1.07 in August in the first station. Evenness index (J) ranged between 0.55 in August in the first station and 1.70 in April in the second station.
Table (2)The species number and individuals and diversity indices in Haji Ali drainage throughout study period (St1:First station, St2:Second station, St3:Third station).

Months	Station	Species number	Species number monthly	Number of individuals	Number of individuals monthly
June	St1	7	9	189	427
	St2	5		130	
	St3	9		108	
July	St1	8	9	125	335
	St2	5		120	
	St3	4		90	
August	St1	7	9	208	806
	St2	6		299	
	St3	6		299	
September	St1	6	8	204	743
	St2	6		147	
	St3	7		392	
October	St1	7	8	247	723
	St2	6		102	
	St3	6		374	
November	St1	7	7	180	332
	St2	6		67	
	St3	6		85	
December	St1	7	8	139	473
	St2	7		242	
	St3	4		92	
January	St1	7	7	60	377
	St2	6		130	
	St3	6		187	

February	St1	7	8	154	695
	St2	8		284	
	St3	6		257	
March	St1	7	8	105	232
	St2	8		74	
	St3	6		53	
April	St1	7	7	38	243
	St2	6		98	
	St3	6		107	
May	St1	5	8	42	407
	St2	7		176	
	St3	6		189	
Diversity index (H)	St1	1.07-1.75	-	-	-
	St2	1.25-1.59		-	
	St3	1.15-2.01		-	
Richness index (D)	St1	0.94-1.65	-	-	-
	St2	0.82-1.63		-	
	St3	0.66-1.92		-	
Evenness index (J)	St1	0.55-0.90	-	-	-
	St2	0.66-1.70		-	
	St3	0.64-0.94		-	

4. DISCUSSION

Environmental factors

Temperature is one of the most important environmental parameters in controlling the distribution and abundance of living organisms and their activities, as they possess several direct overlapping effects on the presence and distribution of organisms (Moheseni and Stefan, 1999). The changes in water temperature and its fluctuation throughout the months of the study are related to the nature of the climate of Iraq, as its geographical location imposed on it a climate characterized by elevated Summer temperatures and Winter with low temperatures. The results showed a negative correlation between temperature and pH, due to the lower temperatures in Winter season, where the presence of aquatic plants and the increase in photosynthesis, then leads to the consumption of CO2, which leads to an increase in the pH values, due to high temperatures in Summer that lead to an increase in the decomposition of organic compounds and aquatic plants, which leads to a decrease in the amount of O2 and an increase in CO2 and thus leads to a reduce in the pH magnitudes (Ayenimo *et al*., 2005).

Differences in salinity concentrations, which indicate their high values in the hot months and early Autumns and their decrease in the cold and Spring, due to the high temperature that leads to the evaporation of water and thus an increase in salt concentrations, and an increase in the decomposition of organic matter (Horowitz, 1999),the disposal of wastewater and the impact of the drainage on agricultural activity led to raising salinity values (Al-Nimrawi, 2005 and Al-Fenhrawi, 2010), while the rains reduce the negative ions causing salinity (Hussein *et al*., 1991), as well as the high water level in Spring, which leads to reducing the salinity of water, (Reid, 1961). Dissolved oxygen is one of the most significant environmental parameters that control the aquatic life abundance, due to its importance in metabolic

processes in aquatic organisms (Wetzel, 2001), oxygen concentration is influenced by various factors, including temperature, respiration and photosynthesis (Green *et al*., 2000). The values were low in most months of the stations, and this decrease may be due to the high salinity of drainage water, it may be due to reduce in the water level and an increase in the release of organic compounds (Al-Saadi *et al*., 1998), it increased in some months, and this increase is due to the high water level in these months, the speed of water movement and increase in the density of phytoplankton (Al-Azzawi, 2004).

BOD is a calculate of the amount of organic matter oxidized by microorganisms (Best and Ross, 1977). Low BOD values were recorded in months where the temperature was low while dissolved oxygen was high concentrated, higher BOD values were recorded in hot months in which dissolved oxygen concentration was low and may be due to the flow of organic materials delivered into the river directly, the analysis of which requires the consumption of large quantities of dissolved oxygen (Al-Fanharawi, 2010).

Fish composition and diversity indices

The nature of the composition of the fish identified by the experience of the variations in the environment in that culture, variations in the condition of the water have a direct impact on the abundance of the fish in the flow. Primary production, global warming, quality of food are main factors in the structure of fish composition. Furthermore, biological parameters, the association between organisms and other organisms (Mondal *et al*., 2010).

The present research is the first investigation of species composition in Haji Ali drainage in the Babylon province.

The present study was differ with species number with (Abdullah *et al*., 2018) in the Southern Sector of Main Outfall Drains, represented 21 fish species, six species were freshwaters fishes, four were alien species and 15 marine species. The most abundant three species were *Poecillia latipinna*, *Planiliza subviridis* and *Thryssa whiteheadi* formed 26.68%, 25.00% and 17.58%, respectively of the total number of samples. The species' number in this research was higher than that reported by (Salman, 2012) in his investigation of the fish composition of Sulaibiat marsh in Al-Samawa Region, when 13 species were reported, where P. abu dominated by 45.75 percent, C.auratus second by 25.02 percent, and C. Luteus was sixth, accounting for 22.64 percent of the overall catch..

Abbas et al., (2015) documented 8 species at Kut dam on the Tigris River, which is lesser than the one recorded in this research. It seems that the explanation for this is the different fishing means as they utilized multiple sizes of gillnets and driftnets and pointed to the predominance of P.abu by 31.3 percent, and Barbus luteus (= Carassobarbus luteus) second with 15.4 percent and third Barbus belayewi (= Capoeta damascina). The current investigation has been lower than reported (Attee and Lazem, 2016) described 19 species belonging to 7 families. 23.6 per cent grypus, 20.07 per cent C.auratus and C. In Himreen dam Lake, carpio 11.39 per cent were dominant species.

The present study was differ with species number with (Al-Thahaibawi *et al*., 2019) in Al-Huwaizah marsh southern of Iraq, 19 species fish belonging to 9 families were selected, 11 of them of native species and 8 of alien species, included *Planiliza abu* 38.2% *Coptodon zilli* 29.41% and *Carassius auratus* 6.65%.

Roberts, (1975) explain Cyprinidae are dominant fish in highland rivers and lakes of Ethiopia and East Africa waters, this was similar to the results of the present investigation.

The species number was differ in the present study with (Brown, 1998) in Lower San Joaquin River Drainage, California, recorded 31 species of fish captured throughout the investigation, only 10 taxa were native to the drainage. Golubtsov and Mina, (2003) recorded 31 species in the Wabi Shebele-Juba drainage, it is higher recorded than in the current investigation.

Rosso and Quirós, (2010) studied Patterns in fish species composition and composition structure in the upper Salado River lakes, Pampa Plain, Argentina, 17 species and 11 families were selected throughout the surveys, and this investigation was higher than recorded in the current investigation. The current investigation was differ with (Jindal *et al*., 2014) recorded 28 fish species from Pong Dam reservoir, and Cyprinidae family was dominated.

The species' number was conforms with (Yousefi *et al*., 2018) recognized 14 species, belonging to 2 families of bony fishes in the Seymare dam which Cyprinidae family had the highest rate with 97.85% and *Cyprinion macrostomuman*d *C. gibeliohad* the most abundant. Cyprinidae are dominant fish in in Andassa River (Aynalem, 2018), this was agree to the results of the current investigation, but it differ in species number where recorded eight species in the same river.

The species' number in the current investigation less than recorded of (Paller, 2018), 67 species in Savannah River Site (SRS) streams. The species' number in current investigation was higher than recorded of (Paighambar *et al*., 2020) in Doroudzan Dam which obtained 8 species belong 2 families, *C. carpio* and *P. abu* with 34% and 23.67% specimens had the most abundance.

It shows the domination of alien organisms and distributes them in the bodies of freshwater water. The ability to withstand change and climate changes, and C's possessions. Auratus of a large variety of food, and O. Aureus has proliferative activity during the year as well as tolerance to poor environmental conditions such as salinity , temperature and low dissolved oxygen levels (Altun *et al*., 2006), and also high numbers due to its ability to feed on various food sources, in addition to its competitiveness with endemic species (Hussain *et al*., 2006).The current investigation demonstrated reducing of local economic fishes, like *L. xanthopterus*, *L. vorax*, *C. luteus* and *A. grypus*, and the absence of others, for instance *M. sharpeyi* and *L. kersin*. Some previous studies indicated decreasing in the number of native fishes and the emergence of a clear rule for alien species, involving the investigation of Roberts (1975), Salman, (2012), (Jindal *et al*., 2014), Abbas *et al*., (2015), Attee and Lazem, (2016), Aynalem, (2018)

The diversity and richness index in the present investigation was recorded highest value in Summer (June) maybe related to species number and individuals respectively. Water temperature has positive correlation with diversity index due to increase natural food, activity and movement of fishes(Al-sodani *et al*.,2007;Kamaruddin *et al*.,2011), Harris (1995) pointed, the biodiversity of fishes in any water body close related to abundance of food, place of reproduction and physical chemical properties of water (Al-khafaji, et al., 2018).

The diversity and richness index increase slightly in (site 1), (site 2) and (site 3) due to increase species number may be to a viability of important food and suitable abiotic factors. Zakaria *et al*., (1999) mention that species richness, species diversity and species survival in aquatic habitat were influenced by many environmental factors such as physicochemical of water, topographical, hydrological properies and habitat destruction. The highest value of evenness was recorded in July and lowest value in August in all stations, the evenness index depended on the diversity index, the absence of high individuals' number of some species when compared with the individuals' number of each species in the catches of same month led to increase the value of evenness index (IUCN, 2001).

5. CONCLUSION

To sum up, aquatic environment of Haji Ali drainage in the Babylon province was various from other river's sectors, that resulted from a low levels of dissolved oxygen. The fish composition was various from other river's sectors in a species number and its dominance and abundance. It is clearly that the dominance of alien species (*C.auratus* and *O.aureus*). In addition, there was a low abundance of economic native species like *A. grypus and L. xanthopterus, C. kais* fish, *L. vorax and A. sellal.*

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