International Journal of Applied Sciences: Current and Future Research Trends
(IJASCFRT)
ISSN: 2790-3990
https://ijascfrtjournal.isrra.org/index.php/Applied_Sciences_Journal

Seasonal Variations for Petroleum Hydrocarbons in the Tissues of Fishes from Shatt Al-Arab River and Southern Iraqi Marshes (2020)

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Abstract

Petroleum hydrocarbons were investigated in the tissues of five fish species: (1) Carrasius auratus, (2) Coptodon zillis, (3) Oreochromis auratus, (4) Oreochromis niloticus, and (5) Tenualosa ilisha, caught at three stations : 1) El-Manthory within Al-Hammar marshland, and 2) Sinbad Island, and 3) Basrah station along Shatt Al-Arab River during the year 2020. Fishes were caught by net , kept in cool box on the board of fishing boat, then transferred to the labs of Marine Science Centre / Basrah University, cleaned and frozen at – 20^{o}C prior to analysis. In the lab fishes were thawed and cut from their sides. Tissues were freeze dried by Edwards freeze drier type Modulyo, homogenized and 10 grams were weighted from each fish, petroleum hydrocarbons were extracted in hot soxhelet by using 40 ml n- hexane solvent for 4 hours . Extracts were reduced to 10 ml each by rotary evaporator. Finally concentrations of petroleum hydrocarbons in each sample were estimated spectrofluorometricaly by UV spectrofluorometry type Shimadzu RF-530IPC at excitation wavelength 310 nm and emission wavelength 360 nm. Higher levels were recorded during winter and spring in fishes caught at Shatt Al-Arab River, Stations 2 and 3, while lower levels were recorded in Tenualosa ilisha caught at all stations during spring, increased during summer, then autumn and winter . levels recorded in µg/g dry weight were in the trend ND < 2.15 < 5.33 ≈ 4.51 respectively at Sinbad Island site No. 2, ND < 3.09 < 9.18 < 11.64 respectively at Basrah site No 3, and ND < 1.14 < 6.73 < 8.46 respectively at Manthory site No. 1. These levels were comparable to levels reported in fishes studies at nearby areas.

Keywords: Petroleum Hydrocarbons; Fish Tissues; Shatt Al-Arab; Southern Marshland; Pollution. Fluorescence Spectroscopy; Soxhlete Extraction.

Received: 9/6/2023
Accepted: 10/11/2023
Published: 10/23/2023

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1.Introduction

Shatt Al-Arab River at Southern Iraq is formed from the confluence of Tigris and Euphrates rivers at Qurnah City and receives its water from those rivers directed towards the south. During it's inflow it receives water from Al-Hwaizah marsh via Al-Swaib river, and from Al-Hammar Marsh via Shafy River and Garmat Ali River. Then within Basrah City and further down to the south it's water deteriorate by waste waters from the city of Basrah via Al-Jubailah, Al-Muftiah, Al-Rubat, Al-Khandak, Al-Ashar, Al-Khorah …etc tributaries and Karun River from the Iranian territories

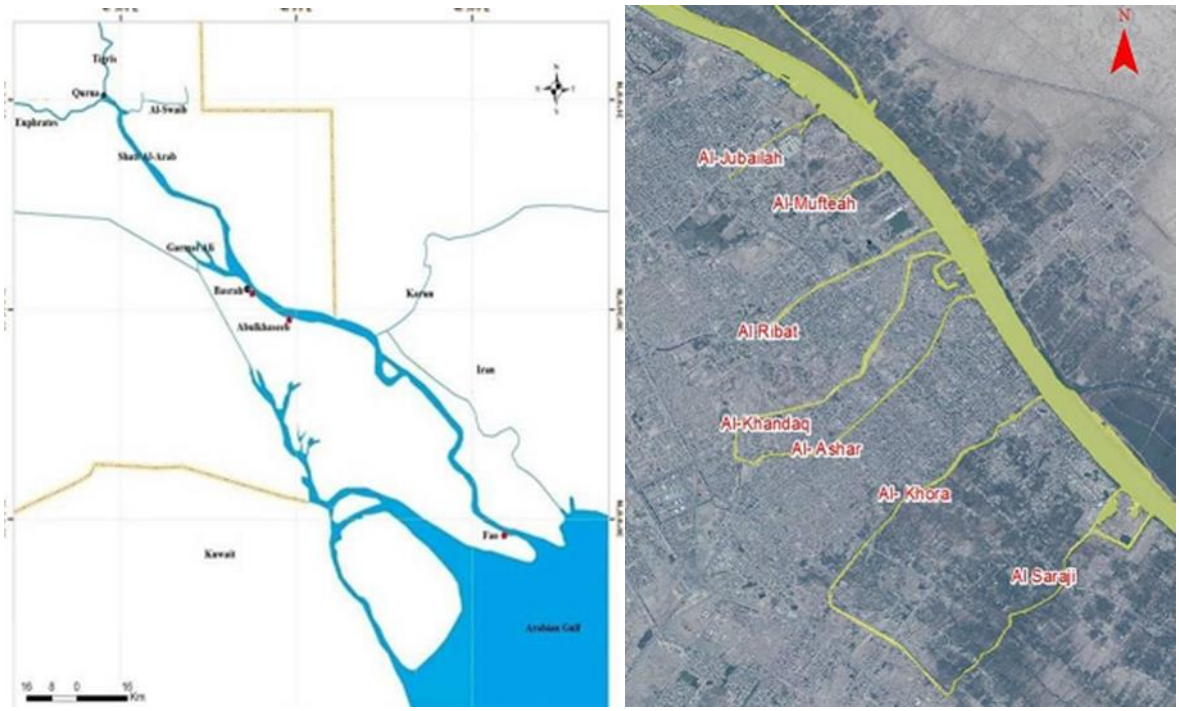

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Figure 1: (A) Shatt Al-Arab river and its tributaries from Qurnah to Fao, and (B) Part of Shatt Al-Arab river within Basra city showing its tributaries.

Shatt Al-Arab River is liable to pollution by petroleum hydrocarbons since the discovery of crude oil around the river [1]. Moreover Shatt Al-Arab river receives petroleum hydrocarbons which released from refinery facilities around it, Al-Shuaaibah at Basrah /Iraq, and Abadan oil refineries at Iran in which these pollutants are accumulated in the estuary of Shatt Al-Arab then discharges to North West Arabian Gulf [2].

Shatt Al-Arab river is the main river in southern Iraq used for supplying people in this area with water for different uses, drinking, irrigation, domestic, recreation, and fishing. For the last few decades, the Shatt Al-Arab river faced many problems of pollution, decrease in fresh water discharge, and increase in wastewater discharge by the river, in addition to industrial, municipal, and irrigation activities, as well as agricultural wastes leading to contaminating the river water. Due to increased activities of oil production in Basrah province, it is expected that the water of the Shatt Al-Arab river is deteriorate with oil and oil derivatives that enter into the river from

different sources. Moreover, Shatt Al-Arab river faced many threats from oil pollution, transportation, and sinking vessels during the wars. The levels of petroleum hydrocarbons in the water, sediments, and biota from the Shatt Al-Arab river were recorded since 1984 [3] and during the 1990s [4, 5],and extended through the 2000 years [6]. Studies conducted by scientists from the Marine Science Centre of Basrah University revealed increased contamination in the water, sediments, and biota of the Shatt Al-Arab river with petroleum hydrocarbons [7], as well as heavy chemical elements [8].

Petroleum hydrocarbons in the water of Shatt Al-Arab river transfers either dissolved or particulates. Those in the particulate phase are deposited in the bottom of the river and became a part of the sediments and accumulated in the core with time [9], while those within the dissolved phase could be accumulated by fishes and biota [10].

2.Study area

The study area represented by three stations of water ways within Basrah city: 1) Manthory at Al-Hammar marsh, 2) Sinbad Island, and 3) Basrah sites along Shatt Al-Arab River, as shown in Fig. 2.

Studied fishes were,1) Carassius auratus, 2) Coptodon zillii, 3) Oreochromis aureus, 4) : Oreochromis niloticus, and 5) Tenualosa ilisha.

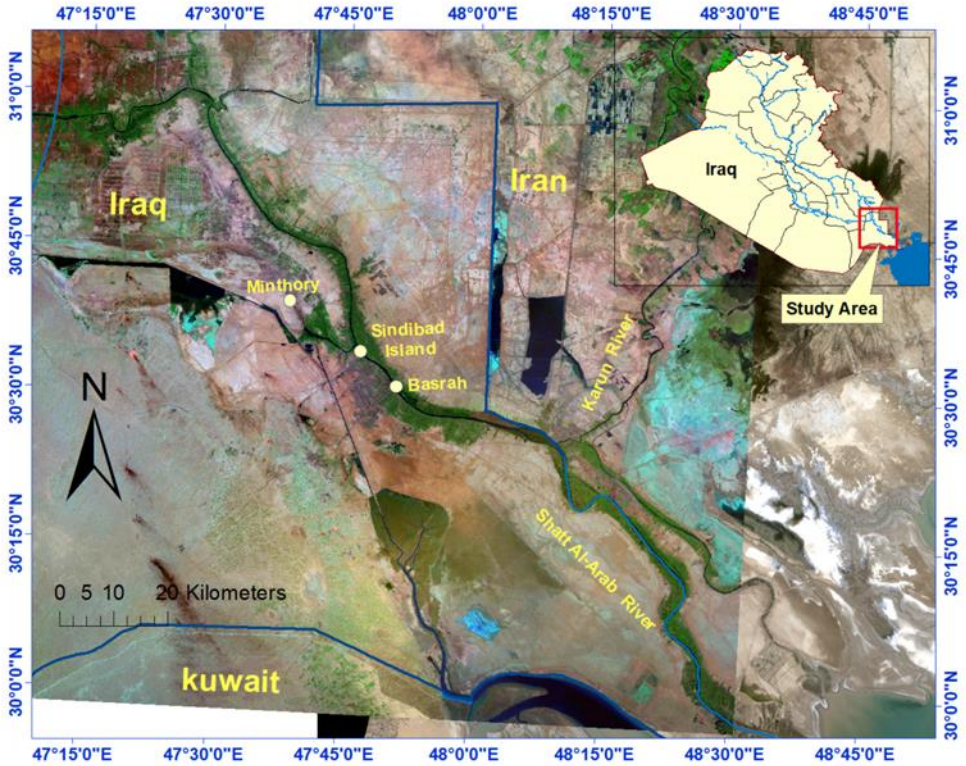


Figure 2: Map of southern Iraq showing the sites of fish collection.

3.Sampling

Fishes were caught by net and kept in cool box on the board of fishing boat then transfer to the labs of Marine Science Centre / Basrah University and store in freezer at -20^{o}C prior to analysis. In the lab fishes were thawed and cut from sides and freez dried, and petroleum hydrocarbons were extracted by hot soxhelate using hexane as a solvent.

4. Extraction Method

Petroleum hydrocarbons in the edible tissues of selected fishes were extracted by soxhelate system according to the method described by DouAbul and his colleagues [11]. 5 gm dried fish tissue was placed in a cellulose extraction thimble and extracted with 50 ml n-hexane for 4 hours, then each extract was evaporated to approximately 10 ml [12]. The total petroleum hydrocarbons in each sample were determined by UV Spectrofluorometry using the Fluorescence spectrophotometer type Shimadzu RF – 530IPC at excitation wavelength 310 nm and emission wavelength 360 nm [13].

5.Results

Table 1: Seasonal variations in the levels of petroleum hydrocarbons (µg/g) in tissues of fishes caught at southern Iraqi waterways,2020.

Stations	Fishes	Winter	Spring	Summer	Autumn
1).Manthory	Carassius auratus	20.5	9.11	1.31	2.17
	Coptodon zillii	6.27	1.01	3.16	3.88
	Oreochromis aureus	5.7	0.81	2.14	3.13
	Oreochromis niloticus	19.67	0.9	4.2	11.04
	Tenualosa ilisha	8.46	ND	1.14	6.73
2).Sinbad	Carassius auratus	4.78	5.8	0.99	1.14
	Coptodon zillii	5.34	6.82	1.01	3.18
	Oreochromis aureus	5.82	7.33	1.39	2.17
	Oreochromis niloticus	8.15	9.11	1.44	4.07
	Tenualosa ilisha	4.51	ND	2.15	5.33
3).Basrah	Carassius auratus	.53	7.20	0.86	1.38
	Coptodon zillii	13.41	16.7	2.11	6.34
	Oreochromis aureus	7.39	11.25	3.21	5.55
	Oreochromis niloticus	12.58	14.81	3.12	5.14
	Tenualosa ilisha	11.64	ND	3.09	9.18

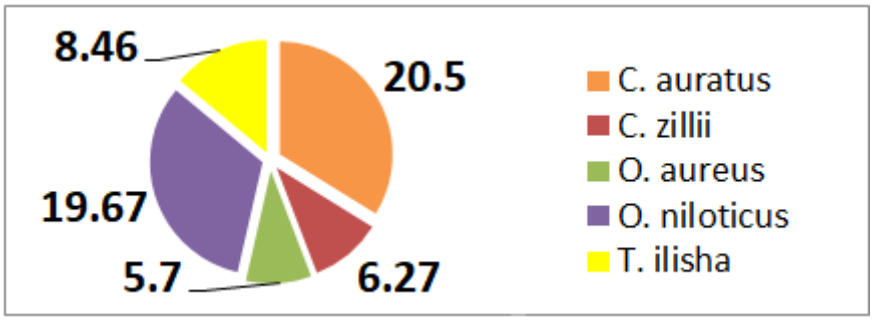
6.Discussion

The Northern area of Arabian Gulf is represented as the most heavily contaminated area by petroleum hydrocarbons due to exploration, transportation, burning, and refinery of crude oil [14].

There are a great interest in the inner water ways environments of Southern Iraq represented by Shatt Al-Arab River and Marshes. Existence of petroleum hydrocarbons in the water column of Shatt Al-Arab river are mostly deposited in the bottom of the river by adsorption on particulates [15], they became a source of pollution in the aquatic medium specially to living organisms the fishes, Fishes are the most sensitive living organisms in the

aquatic environment to trace pollutants among which are petroleum hydrocarbons, pesticides, and chemical elements [16].

The concentrations of petroleum hydrocarbons measured in the tissues of studied fishes coughed at stations 1, 2, and 3 are shown in figures 3, 4, and 5 respectively during winter, spring, summer, and autumn seasons of the year 2020. In station 1 the higher concentration was measured in the tissues of Carassius auratus to be (20.5) µg/g and the lower was recorded in Oreochromis aureus to be 5.7 µg/g ، while other concentrations were graduated as 6.27, 8.46, and 19.67 µg/g in the tissues of Coptodon zillii ،Tenualosa ilisha and Oreochromis niloticus respectively as shown in fig. 3. Results showed a significant differences (P>0.05) between the fishes Carassius auratus and Oreochromis niloticus from one side and other fishes from other side for the same probability. During Spring the higher concentration was recorded to be 9.11 µg/g in Carassius auratus and lower ND in the tissues of. T. Ilisha while other concentrations were 1.1, 0.81, and 0.9 µg/g in the tissues of C. zillii ، O. aureus ، and O. niloticus fishes respectively, as shown in fig, 3. Results showed significant differences (P>0.05) at the same probability between C auratus from one side and other fishes from the other side. Levels of petroleum hydrocarbons recorded in the tissues of studied fishes during summer season at station 1 were 1.13, 3.16, 2.14, 4.2 and 1.14 ug/g in the fishes C. auratus ، C. zillii ، O. aureus ، O. niloticus and T. ilisha. respectively, as shown in fig. 3. Results showed non-significants differences (p<0.05)at the same probability among all fishes.



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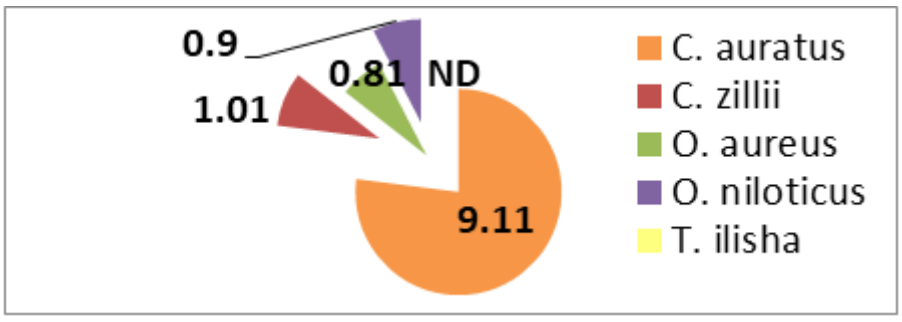

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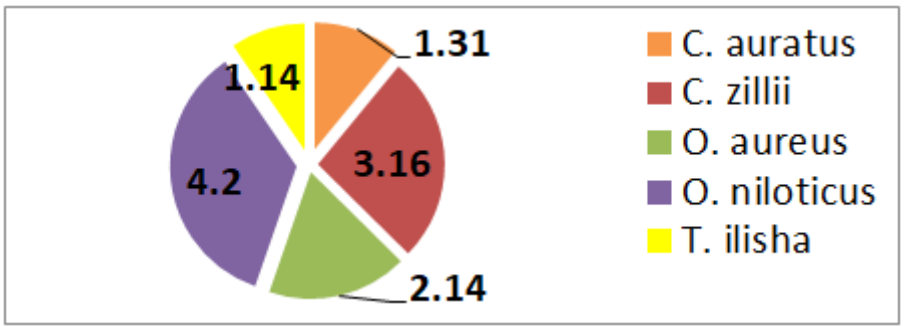

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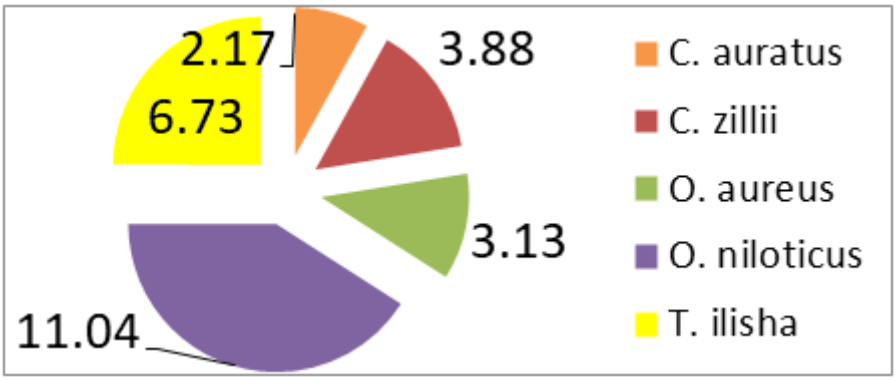


D

Figure 3: Concentrations of petroleum hydrocarbons (µg/g)in the fish tissues caught in station 1, during 2020, A)Winter, B) Spring, C) Summer, and D) Autumn.

The concentrations of petroleum hydrocarbons measured in the tissues of fishes caught at station 2 are shown in figure 4, The highest concentration (8.15 µg/g)was measured in O. niloticus and the lowest concentration 4.51 µg/g in T. ilisha ،during winter season, while other values were recorded as 4.78, 5.34, and 5.82 µg/g in C. auratus, C. zillii , and, O. aureus respectively. Statistical analysis did not show any significant differences (P>0.05). During spring season higher concentration of petroleum hydrocarbon (9.11 µg/g) was measured in the tissues of O. niloticus and the lowest was ND in T. ilisha, while other concentrations recorded were 5.8, 6.82, and 7.33 µg/g in C. auratus, C.zilii, and O. aureus respectively. Statistically, there was a significant differences (P<0.05)between T. ilisha and other fishes at the same level of probability. During summer season levels of petroleum hydrocarbons recorded were, 0.99, 1.01, 1.39. 1.44, and 2.15 µg/g in C. auratus ،C. zillii ،O. aureus, O. niloticus ، and T. ilisha respectively. Results did not show any significant differtences (P<0.05) among all fishes. During autumn, the highest and lowest levels of petroleum hydrocarbons recorded as 5.33 and 1.14 µg/g in T. ilisha and C. auratus respectively, while other values recorded were 3.18, 2.17, and 4.07 µg/g in ،C. zillii ، O. aureus ، and O. niloticus. Results did not show any significant differtences (P<0.05) among all fishes..

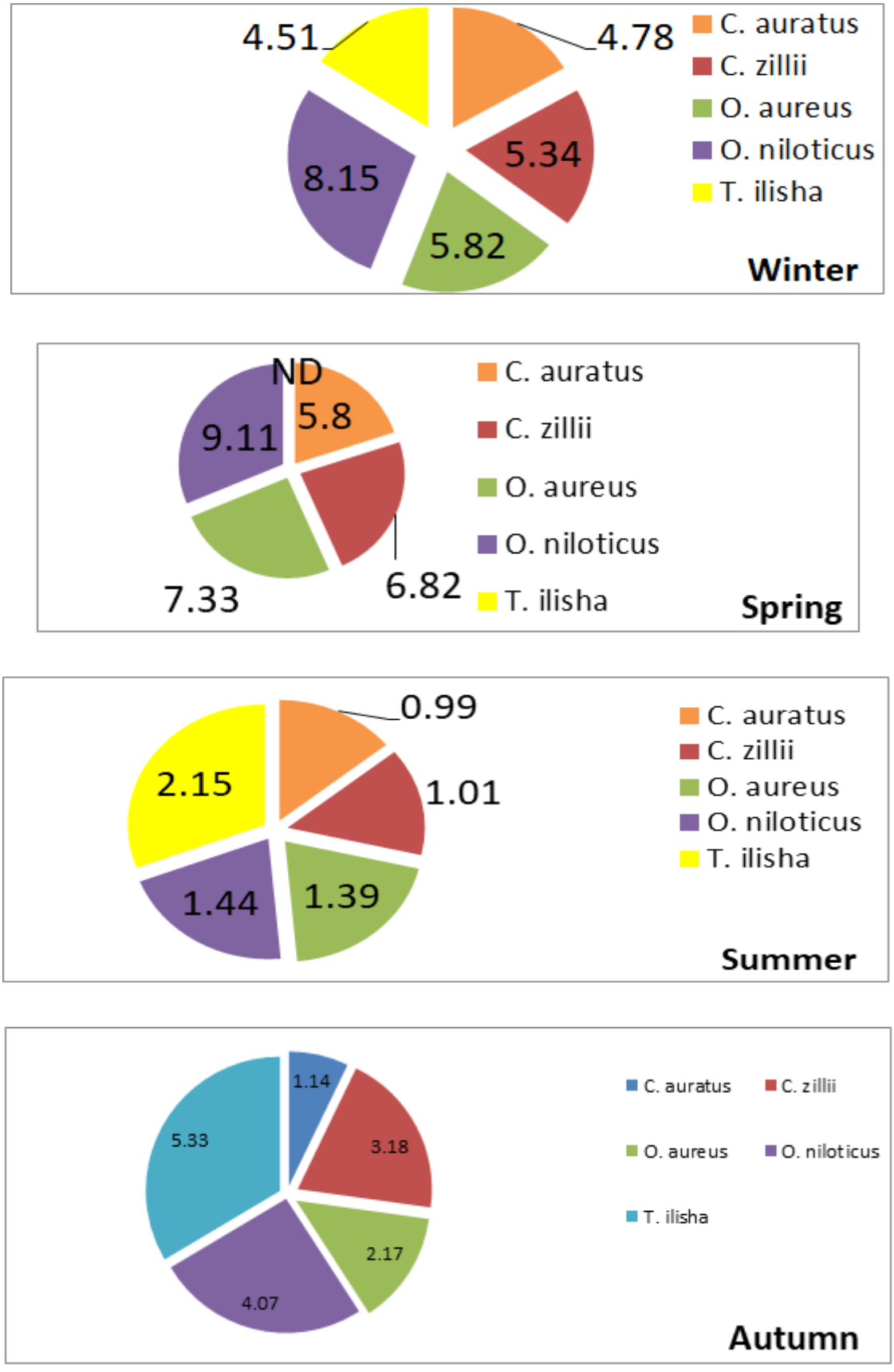
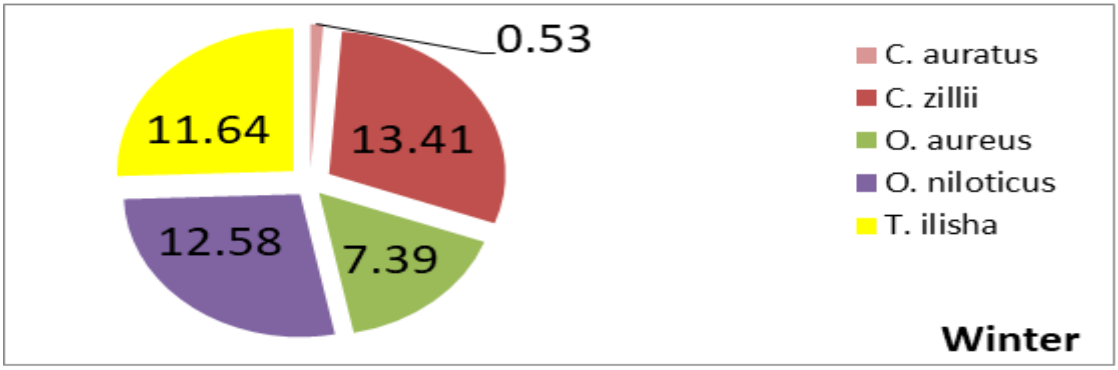
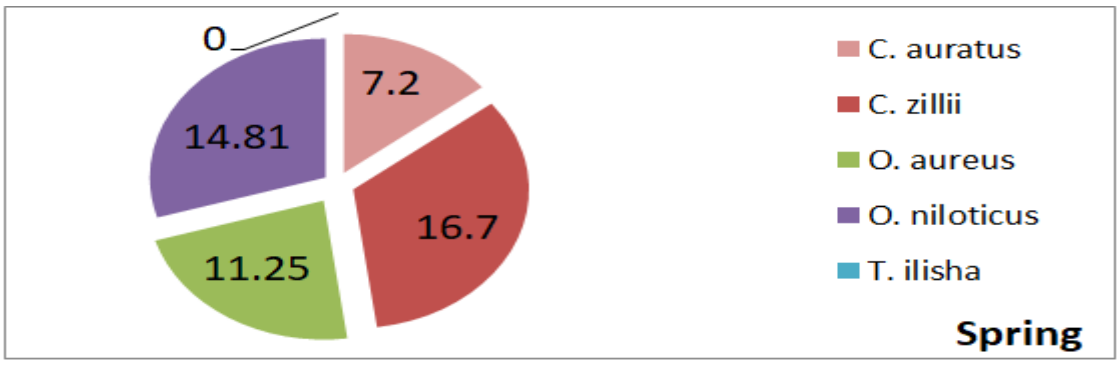
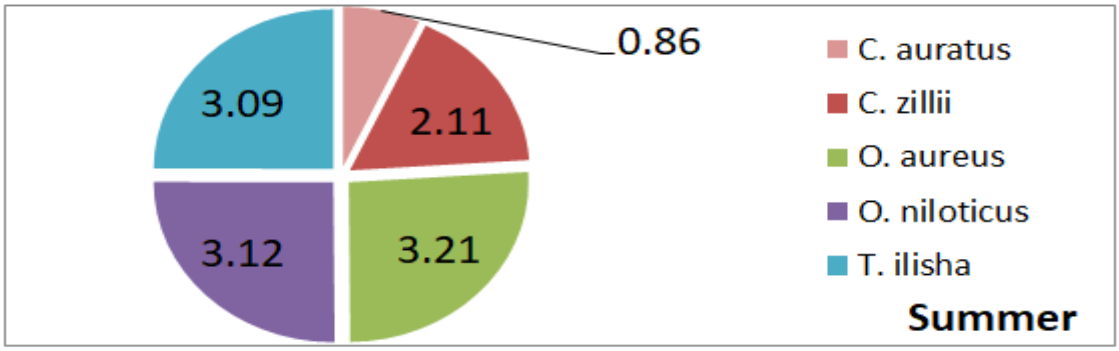


Figure 4: Concentrations of petroleum hydrocarbons (µg/g)in the fish tissues caught in station 2, during 2020.

For station No. 3, recorded levels of petroleum hydrocarbons are shown in figure 5, during winter season, higher level was measured as 13.41 µg/g in C. zilii and and lower as 0.53 µg/g in C. auratus, other concentrations recorded were, 7.39, 12.58, and 11.64 µg/g in O. aureus, O. niloticus, and T. ilisha respectively. Results showed significant differences with P<0.05 between C. aureus and other fishes at the same level of probability. During spring season the concentrations of petroleum hydrocarbons recorded from higher to lower values as 16.7, 14.81, 11.25, 7.2, and ND µg/g in fishes, C.zilii, O. niloticus, O. aureus, C. auratus, and T. ilisha respectively. Results showed significant differences (P<0.05) between T.ilish and other fishes at the same level of probability. During summer season the levels of petroleum hydrocarbons recorded in the tissues of studied fishes and rangedfrom lower to higher as: 0.86, 2.11, 3.09, 3.12, and 3.21 µg/g in C.auratus, C. zilii, T.ilsha, O.niloticus, and O. auratus respectively. Results showed significant differences (P<0.05) between C. auratus and other fishes. During autumn levels of petroleum hydrocarbons recorded the highest and lowest as 9.8 and 1.33 µg/g in T.ilisha, and C. auratus respectively, while for other fishes levels recorded were6.34, 5.55, and 5.14 µg/g in C. zilii, O.aureus, and O. niloticus respectively. Results showed significant differences (P<0.05) between T.ilisha and C.auratus as well as other fishes at the samelevel of probability.







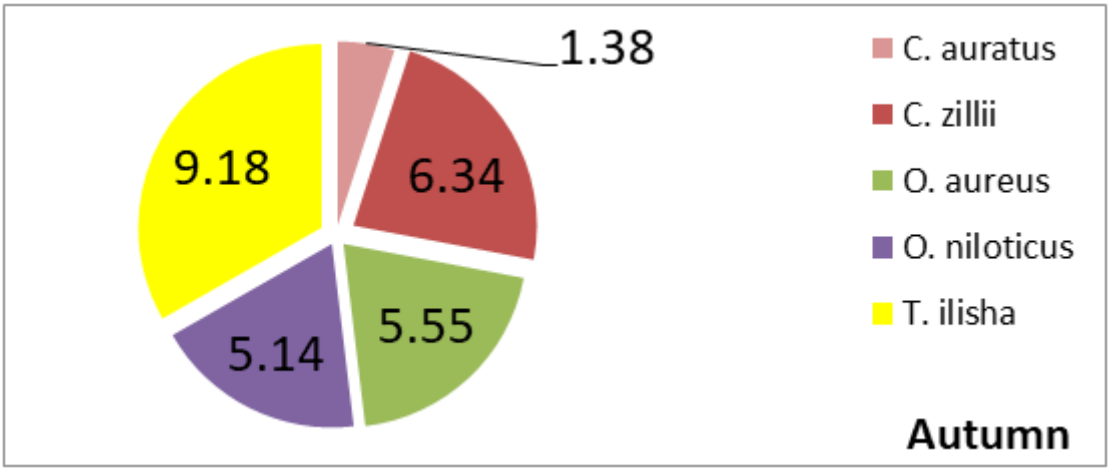


Figure 5: Concentrations of petroleum hydrocarbons (µg/g)in the fish tissues caught in station 3, during 2020.

Concentrations of petroleum hydrocarbons in the tissues of studied fishes caught at stations 1,2, and 3 during all seasons of the year 2020 are shown in table 2. Highest concentration recorded was 60.6 µg/g in station No. 1(El-Manthory) during winter while the lowest was 6.98 µg/g in station No. 2 (Sinbad) during summer. Statistical analysis showed significang differences($P<0.05$) between summer and winter while there was none significant differences among stations at the same level of probability Whitin stations the concentrations of petroleum hydrocarbons as shown in table 7,recorded higher and lower values of 38.56, and 9.97 µg/g in fishis C.zilii, and C. auratus respectively. Statistical analysis showed significant differences ($P<0.05$)between stations 3 and 2.and significant differences were found at the same probability between O.niloticus and other fishes.

The concentrations of petroleum hydrocarbons in the tissues of all fishes during winter season at all stations are shown in table 3. the higher and lower values recorded in C.auratus to be 25.5 and 0.53 µg/g at stations 1 and 3 respectively. Statistical analysis showed a significant differences at the same level of probability between O. niloticus and all other fishes.

Table 2: Concentrations of petroleum hydrocarbons in the tissues of studied fishes caught at stations 1,2, and 3 during all seasons of the year 2020.

Stations	*Winter*	*Spring*	*Summer*	*Autumn*
1)Manthory	60.6	11.83	11.95	26.95
2)Sinbad	28.6	29.06	6.98	15.89
3)Basrah	45.55	49.96	12.39	27.59

Table 3: Total concentrations of petroleum hydrocarbons in the tissues of studied fishes caught at the three station of study 1, 2 , and 3.

	1)Manthory	2)Sinbad	3)Basrah
C. auratus	33.09	12.71	9.97
C. zillii	14.32	16.35	38.56
O. aureus	11.78	16.71	27.4
O. niloticus	35.81	22.77	35.65
T. ilisha	16.33	11.99	23.91

7.Conclusion

Petroleum hydrocarbons varied seasonally at Northern[6] and Southern[18] parts of Shatt Al-Arab river due to climate changes in which higher levels were recorded at winter, and lower levels were recorded at summer. During summer petroleum hydrocarbons in the aquatic environment undergoes degradation by temperature and biodegradation by existing bacteria [19]. Those variations are reflected upon levels of petroleum hydrocarbons in the edible tissues of living organisms mainly fishes. Climate changes are the main reason for variations in the concentrations of petroleum hydrocarbons in each of water body of Shatt Al-Arab river and their reflection upon there levels in the tissues of living organisms. Fishes caught at Shatt Al-Arab river and Southern marshes of Iraq contains a certain levels of petroleum hydrocarbons in their tissues and showed seasonal variations being higher during Winter and lower during Summer, moreover studied fishes showed slight differences in concentrations of petroleum hydrocarbons may be due to differences of fat contains in their tissues.

Within this study levels of petroleum hydrocarbons were recorded in the tissues of the studied fishes during the four seasons of the year 2020. Higher levels were reported during winter and spring for fishes caught at sites 2)Sindnad and 3) Basrah. Lower levels of petroleum hydrocarbons were recorded in the tissue of Tenualosa ilisha from all studied sites during spring season, increased during summer then autumn, and winter, levels reported in μg/g dry weight were in the trend ND < 2.15 < 5.33 ≈ 4.51 respectively at Sinbad site, and ND < 3.09 < 9.18 < 11.64 respectively at Basrah site, and ND < 1.14 < 6.73 < 8.46 respectively at Manthory site. These levels were comparable with other studies at nearby area, Al-Ali and his colleagues [17] reported levels of 2.45 – 7.65 μg/g in tissues of fish from North West Arabian Gulf .

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Biography of author(s)

Figure 6: Experience Prof. Dr. Faris J. M. Al-Imarah.

Department of Marine Chemistry and Environmental Pollution, Marine Science Centre, Basrah University, Basrah –Iraq.

Born on 4th of September 1951 in Basrah Governorate of Iraq, studied for primary(1963), secondary(1966) and higher preparatory (1969) schools at Basrah province, then he obtained his B.Sc. in Chemistry at Basrah University 1973, M.Sc. in Physical Chemistry at Baghdad University 1976, and finally received his D. Phil. As a laser spectroscopic at Sussex University/The United Kingdom 1984, Back to Basrah joined the staff of Basrah University as a lecturer. Dr. Imarah received his first promotion to Ass. Prof. at Marine Science Centre/Basrah University during 1990, then he received his second promotion to Prof. during 1995 at the same Centre. Prof Imarah supervised 20 students as M.Sc. and Ph. D. and he involved in different fields of research mainly Chemistry, and Environment and Pollution of different media, air, water, soil, sediments, and biota of Southern Iraqi Marshlands, Southern Iraqi waterways, and Northern West Arabian Gulf. He has 190 research papers published in local, national and international journals.

Prof. Imarah received his title as experience prof. from Basrah University at 2022.

Figure 7: Ghassan A. Al-Najar.

Department of Marine Invertebrate, Marine Science Centre, Basrah University, Basrah, Iraq. Born on 7th February, 1977 in Baghdad, Republic of Iraq. He is an Assistant Professor of Environment and Pollution. He received his Bachelor's degree from the Department of Fish and Marine Resources /Agriculture College/ University of Basra at 2000, then a master's degree from the University of Basra in 2009, a doctorate from the same university in 2020. He was appointed to the Marine Sciences Center, then promoted to a teacher in 2012 and got On the title of Professor except for the year 2016. He participated in various research fields, including the environment, water pollution, sediment and live plants in southern Iraq and the northwest of the Arabian Gulf. His has 30 research papers in the national and international journals.

Figure 8: Amir .A. Jabir.

Department of Marine Vertebrates/ Marine Sciences Center/ University of Basra

He was born on 7th July 1965 in Dhi Qar, Republic of Iraq, He is professor aquaculture .He obtained B.Sc Re.C. Degree from the Department of Fish and Marin Resources from the University of Basra in 1989 a master. M.Sc at University of Basra in 2000. Ph.D at University of Basra in2006.then the second promotion to prof.2018.he is involved in different fields of research. He has 38 research paper in the national and international journals.

Figure 9: Kadhim H. Younis.

He was born on 10th September, 1963 in Basrah, Republic of Iraq. He is a professor of Fish Ecology. He obtained B.Sc. in fishes and water resources at Basrah University 1985, M. Sc in Marine Science at Basrah University 1991 and Ph. D. in Basrah University at 2005. He joined the staff of Basrah University as a Asst. lecturer 1991 at Marine Science Center, received second promotion to Asst. Prof. 1999, then the third promotion to Prof. at 2005. He is involved in different fields of research among which are Environment assessment, fish

ecology and fish biology in Shatt Al-Arab River and Iraqi Marine water. He has 53 research papers in the national and international journals.