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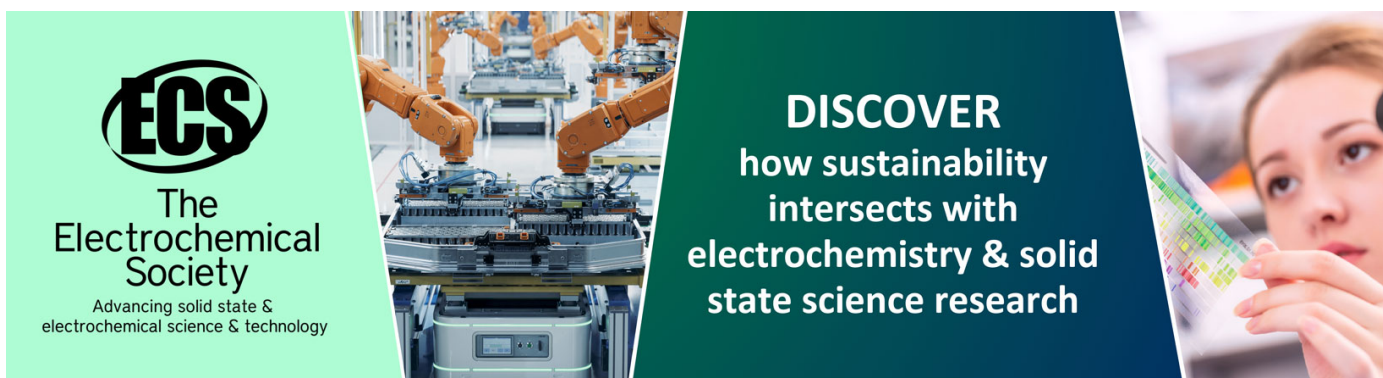
A study of the Composition of Chondrichthyes Fishes in the Shatt Al-Arab Estuary and Iraqi Marine Waters

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A study of the Composition of Chondrichthyes Fishes in the Shatt Al-Arab Estuary and Iraqi Marine Waters

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Abstract. Thirteen Chondrichthyes fish were caught in the current study, belonging to 12 genera and (6) orders and representing (8) families from January 2018 to December 2018. The Dasyatidae family represented the highest number of species, represented by five species: Dasyatidae, Carcharhinidae, and Hemiscylliidae, forming 74.74% of the total number of individuals. The results of the relative abundance showed that three species, *Brevitrygon walga*, *Brevitrygon imbricata*, and *Pastinachus sephen*, constituted 34.34% of the total number of individuals, and one resident species *Carcharhinus leucas* (9-12 month) appeared in the second station. No other resident species appeared in the first and third stations.

Keywords Chondrichthyes fish, Iraqi marine water, Fish assemblages, Arabian Gulf.

1. Introduction

The importance of the Iraqi marine water is highlighted as it is a nursery, breeding, and feeding area for many marine and estuarine fish. Its high primary productivity also characterizes it as a result of the freshwater from the Shatt al-Arab[1]. The seas are also an essential source of protein food, including fish, as they provide an amount of 20% Approximately of the world population's consumption of it [2].many studies have been published on Osteichthyes and Chondrichthyes fish in Iraqi marine waters, including [3].on fish assemblages in the North of Khor Abdullah, as 35 species were obtained of the bony fish belonging to (32) genera, representing (24) families and (6) species of Chondrichthyes fish belonging to five families, and [4], study on Khor Al-Zubair, where (40) species were recorded, (38) species belong to the Osteichthyes class and two species belong to the Chondrichthyes class: *Actobatus narinari* and *Chiloscyllium griseum*. [5], study on the fish composition in the marine seas of Iraq found that rays made up 5% of the population while sharks made up 7.6%, as [6], studied the nature of the fish population in the Northwest Arabian Gulf during the period 1995-1999 and recorded 125 species belonging to 58 families, including 16 species of Chondrichthyes fish, and the study of [7], on the breeding strategy of two species of Chondrichthyes fish, namely, *Chiloscyllium arabicum* and *H. randalli*. as 365 individuals were obtained from the first species and 321 individuals from the second, and [8] documented 111 species from 50 families, together with three species of fish from the genus Chondrichthyes when researching the Shatt al-Arab estuary's fish community's structure and distribution, prepared by [9] A list of the species recorded in the Iraqi marine waters for the period from 1874 until mid-2018, it was found that 322 species were recorded, belonging to 26 orders and 94 families and belonging to 193 genera, sharks represented in three orders and eight families, and rays in



four orders and seven families. The present study aims to know the cartilaginous fish populations and their distribution in Iraqi marine waters.

2. Materials and Methods

Three stations were selected in the Shatt al-Arab estuary and Northwest of the Arabian Gulf. Regular field trips were conducted to collect water and fish samples monthly from January 2018 to December 2018. (Fig.1), the map was made using the program GIS V.10.1.

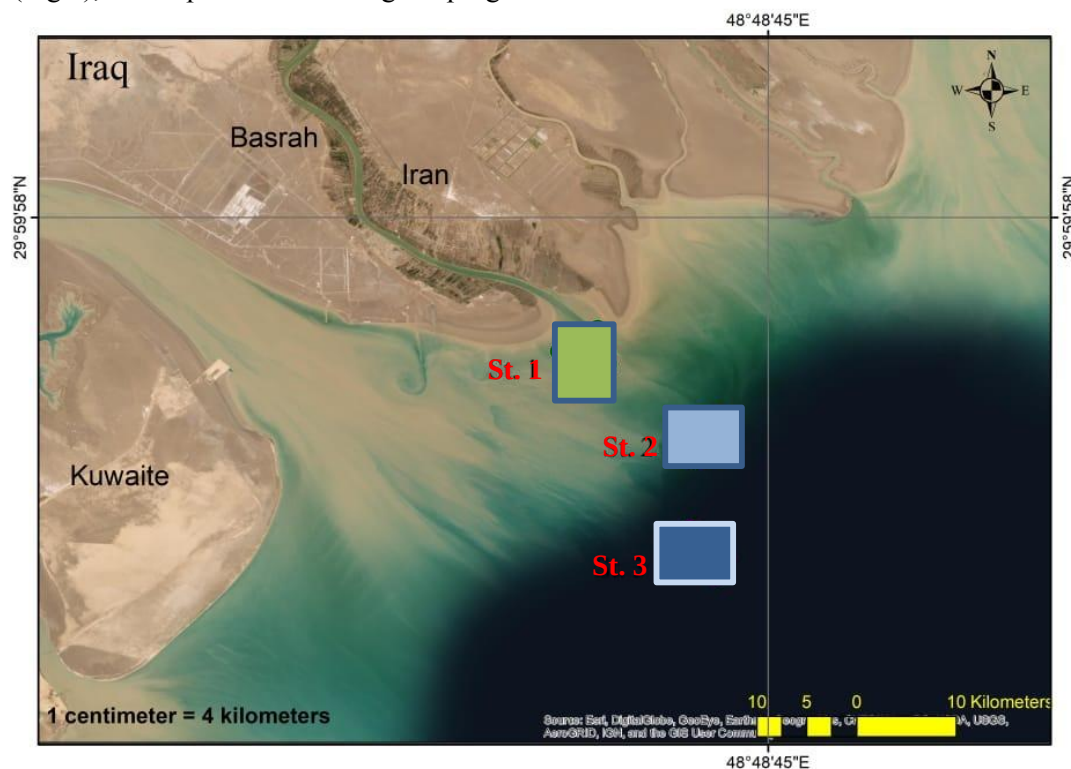


Figure 1. Shows where the study stations are located in the Shatt al-Arab estuary and Iraqi marine waters.

Three stations were selected for the study, representing the one station at the Shatt al-Arab estuary (29°54'15.93"N; 48°41'15.62"E), (29°54'15.84"N; 48°37'24.24"E), (29°50'44.04"N; 48°41'15.51"E) and (29°50'44.12"N; 48°37'24.38"E). This station is considered the most affected by the waters of the Shatt al-Arab River, through which the marine channel entering the Shatt al-Arab passes, while the second station represents the part between the impact of the Shatt al-Arab and the open sea waters (29°50'17.98"N; 48°43'53.28"E), (29°50'17.86"N; 48°49'43.87"E), (29°46'48.85"N; 48°43'53.16"E) and (29°46'48.99"N; 48°49'43.90"E) This area is characterized by its steadily increasing depths from 4m to 10m and the presence of some grooves at the bottom reaching a depth of 20m m, and the third station represents marine waters (29°43'33.41"N; 48°43'43.46"E), (29°43'33.38"N; 48°49'34.85"E), (29°40'04.13"N; 48°43'43.39"E) and (29°40'04.02"N; 48°49'34.96"E) This station is characterized by great depths ranging from 10-20 meters as well as the presence of medium fishing boats (Lengats) and merchant ships Large size, as well as oil tankers, and the presence of some grooves with rocky bottoms.

The fish were collected through regular monthly cruises on board the fishing boat (Anwar 2), which is 16 m long, 3.5 m wide, 150 hp horsepower, 2.5 knots when fishing, equipped with a bottom trawl net whose anchor rope length is 16 m and the ground rope is 18 m, the size of the net holes in The sides are 5 x 5 cm and at the bag 3 x 3) cm. The length of the rope to pull the net varies between 75-100 m. pulling the net into the water takes three hours, and each cruise takes 4-6 days. Cartilaginous fish were classified according to their types, based on: [10-13].

Fish were divided according to the frequency of their presence in monthly samples based on [14]. Using an equation created by [15]. The relative numerical abundance of each fish species was determined as follows:

$$\text{Relative abundance (\%)} = (n_i/N) \times 100$$

Where:

n_i = is the total number of individuals of the species included in the monthly sample.

N = total number of individuals in the monthly sample

3. Results

Catch (13) species of "Chondrichthyes" belonging to (6) orders and representing (8) families and (12) genera" during the research phase (Table 1). The family Dasyatidae represented the largest number of species with five species, followed by the Carcharhinidae family with two species, and the rest represented only one species. The number of recorded species reached (12) both in the first and second stations, and (13) in the third station, where the *Torpedo panther* was recorded in the third but not in the first and second stations. The highest number of species (6) was recorded in July and August, December in the station one, (9) species in December in the station two, and (7) species in March, July, and October in the third station (Fig. 2).

198 Chondrichthyes fish were collected, there were 34 fish in the first station, 80 in the second station, and 84 in the third station. The largest number of Chondrichthyes fish was obtained in March (26) fish, equivalent to 13.13% of the total number of fish caught, while the lowest number of fish was recorded (9) in September, equivalent to 4.54% of the total number of fish caught (Fig. 2).

Table 1. Represents a list of the orders, families, and species of Chondrichthyes fish caught during the period from January 2018-December 2018.

Order	Family	Species
Myliobatiformes	Dasyatidae	<i>Brevitrygon walga</i>
		<i>Brevitrygon imbricata</i>
		<i>Pastinachus sephen</i>
		<i>Maculabatis gerradi</i>
		<i>Himantura uarnak</i>
Carcharhiniformes	Sphyrnidae	<i>Sphyrna mokarran</i>
	Carcharhinidae	<i>Rhizoprionodon acutus</i>
		<i>Carcharhinus leucas</i>
Myliobatiformes	Myliobatidae	<i>Aetobatus flagellum</i>
	Gymnuridae	<i>Gymnura poecilura</i>
Orectolobiformes	Hemiscyllidae	<i>Chiloscyllium arabicum</i>
Rhinopristiformes	Rhinobatidae	<i>Glaucostegus granulatus</i>
Torpediniformes	Torpedinidae	<i>Torpedo panther</i>

3.1. Numerical and Relative Abundance of Families

The numerical abundance results showed that three families constituted 74.74% sorted by the quantity of Chondrichthyes fish caught overall:

The family Dasyatidae catches (92) fish, representing 46.46% of the total number of Chondrichthyes fish caught. The highest appearance of the family (8) was in June and August in the two and three stations. as well as 4% of the total number of fish in the genus Chondrichthyes were caught.. The family Carcharhinidae (44) fish with a rate of 22.22% and the highest appearance of the family (17) was recorded in July in the second station with a rate of 8.5%, while the family Hemiscylliidae (22) fish accounted for 11.11% from the overall catch of Chondrichthyes fish. The highest appearance was in July in the third station (4), and 2% of the total number of Chondrichthyes fish catch were from this species.

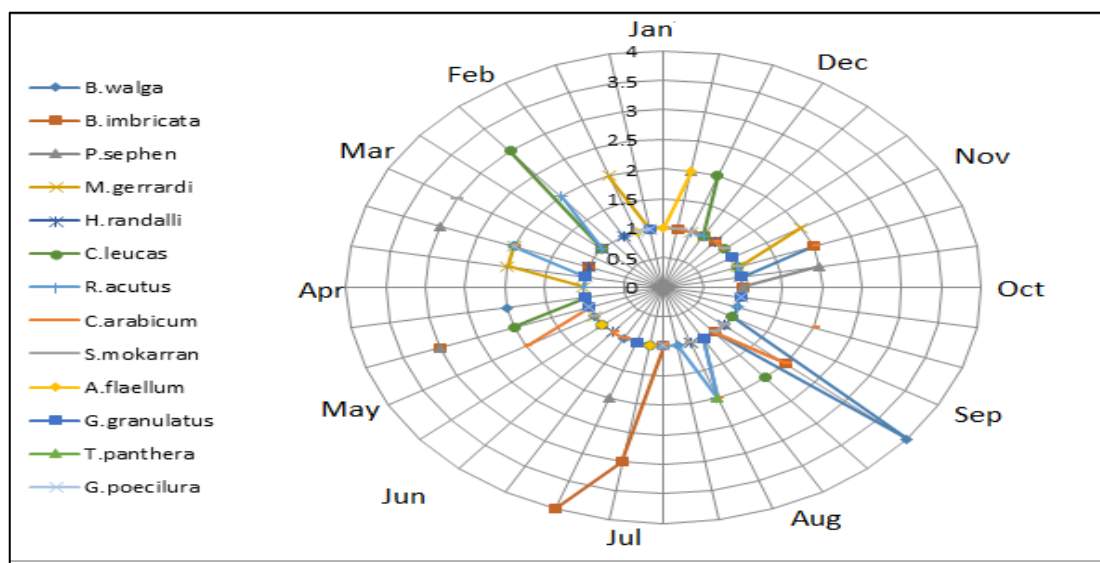


Figure 2. Monthly changes of Chondrichthyes fish species caught in study stations.

Three families accounted for 82.35% Among all the Chondrichthyes fish catch at the first station: The highest appearance of the family (2) occurred in February, May, July, and October and November, with percentages of (100, 66.6, 50, 100, and 66.6%) of the total number of Chondrichthyes fish caught in those months, respectively. Half of the fish taken at the first station—17 fish—belong to the family Dasyatidae. Additionally, the family Hemiscylliidae (consisting of five fish) represented 14.7% of the total number of Chondrichthyes fish obtained in the first station, and it had its strongest showing in March (3), accounting for 100% of the fish caught in that month.. The family Carcharhinidae (six individuals) had a rate of 17.6%, and its highest appearance was in January (2) by 40%..

Three families accounted for 81.5% Among all the Chondrichthyes fish catch at the second station, they are as follows: The family Dasyatidae caught (32) fish and 40% of the overall catch at the second station's fishery, and its highest appearance was in March (7) and by 46.6% of the total number of fish caught in that month, while the family Carcharhinidae accounted for (26) fish with a percentage of 32.5%, and the highest appearance was recorded in February (5) fish with a percentage of 100%, and the family Hemiscylliidae at a rate of 8.7% of the total fish caught in the second station, caught (7) fish., the highest occurrence of which was in March and September (2) fish, and at a rate of 13.3 and 50% of the total number of fish caught in those months, respectively.

Three families accounted for 77.3% of the overall catch at the third station's fishery, they are as follows: In the third station, the family Dasyatidae caught 43 fish and 51.1% of all the chondrichthyes fish caught; its peak appearance was in August, when it caught 8 fish at a rate of 72.7% of all chondrichthyes fish caught in that month., while the catch of the family Carcharhinidae (12) fish at a rate of 14.2%, and the highest appearance was recorded in February, April, June, July, and October (2) fish with a percentage of (40,18.1,28.5,18.1,20)%, respectively, and the family Hemiscylliidae (10) fish and at a rate of 11.9% of the total number of Chondrichthyes fish captured at station three, and the highest appearance was recorded in July, August and October (2) fish, and at a rate of (18.1,18.1, 20)% of the total number of Chondrichthyes fish caught in those months, respectively (Table 2).

Table 2. Numbers and percentages of cartilaginous fish families in the three study stations during the period of sample collection from January 2018 - December 2018.

Family	Station1		Station 2		Station 3		%	Total
	%	No.	%	No.	%	No.		
Dasyatidae	50	17	40	32	51.1	43	46.46	92
Carcharhinidae	17.6	6	32.5	26	14.2	12	22.22	44
Hemiscylliidae	14.7	5	8.7	7	11.9	10	11.11	22
Sphyrnidae	5.8	2	5	4	5.9	5	5.55	11
Myliobatidae	2.9	1	3.7	3	7.1	6	5.05	10
Rhinobatidae	5.8	2	5	4	3.5	3	4.54	9
Gymnuridae	2.9	1	5	4	3.5	3	4.04	8
Torpedinidae	-	-	-	-	2.3	2	1.01	2
ToTal		34		80		84		198

3.2. Numerical and Relative Abundance of Species

The results of the numerical abundance of Chondrichthyes species showed that three species constituted 34.34% of the total number of Chondrichthyes fish caught: species *B. walga* caught (23) fish and accounted for 11.6% of the overall catch of Chondrichthyes fish, the highest occurrence of the species in the third station in August (4) fish with a percentage of 36.3% of the total number of fish caught in that month, and species *B. imbricata* (23) fish, at an 11.6% rate. The second station in June (4) fish at a rate of 50% recorded the highest incidence of the species. Additionally, 22 fish of the species *P. sephen*, or 11.1% of all the Chondrichthyes fish caught, were caught, and the species made its highest presence in the second and third stations in March and April (3), when it appeared in those stations at a rate of (20, 27.2%, respectively) of the total number of Chondrichthyes fish taken in those months..

Accordingly, two species of chondrichthyes fish made up 29.4% of all chondrichthyes fish caught at the first station.: The first station had five *M. gerrardi* fish, representing 14.7% of the total number of Chondrichthyes fish taken there. November saw the largest concentration of this species (2) The species was most prevalent in May, when there were two fish caught, accounting for 40% of all Chondrichthyes fish caught that month. This fish made up 66.6% of the overall number of fish taken in that month, and the first station's *C. arabicum* fish made up 14.7% of the total number of Chondrichthyes fish caught.

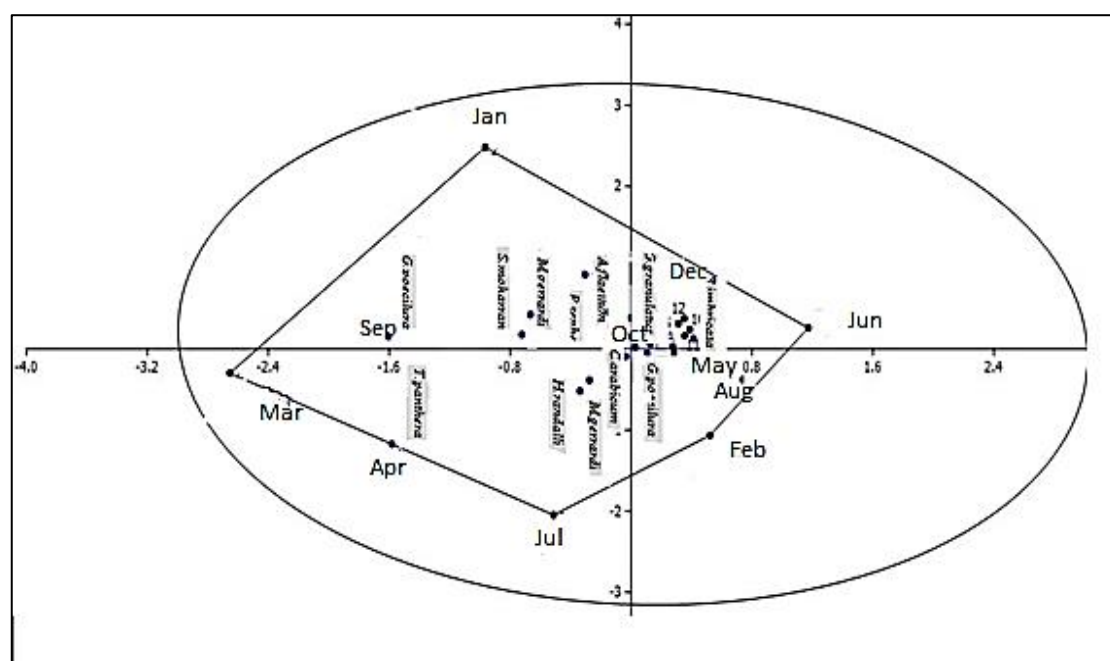
C. leucas (15) fish and 18.75% of the total Chondrichthyes fish caught in the second station made up two species, accounting for 41.25% of the total caught., the highest occurrence of this species was recorded in February (3) fish, with a percentage of 60% of the total number of Chondrichthyes fish caught in that month. The species (2) fish was most frequently observed in January, February, and March, when it appeared at rates of (22.2, 40, and 13.3%) of the total number of Chondrichthyes fish caught in those months, respectively. The species *R. acutus* (11) fish accounted for 13.7% of the total number of Chondrichthyes fish caught in the second station...

Two species, each accounting for 26.19% of the total number of Chondrichthyes fish caught at the third station: Located in station three, there were 12 fish of the species *B. imbricata* and 14.2% of all the fish in the genus Chondrichthyes., the highest appearance of the species in April and June (3)) fish with a percentage of (27.2, 42.8%) of the total number of fish caught in those months, and the species *B. walga* (10) fish with a rate of 11.9% of the total number of fish caught in the third station, and the highest occurrence of the species was recorded in August (4) at a rate of 36.3% from the total number of Chondrichthyes fish caught in that month (Table 3).

Table 3. Number of species and their percentages in study stations during the period of sampling collection from January 2018 - December 2018.

Species	Station 1		Station 2		Station 3		Total	
	No.	%	No.	%	No.	%	No.	%
<i>B.walga</i>	4	11.7	9	11.2	10	11.9	23	11.61
<i>B.imbricata</i>	3	8.8	8	10	12	14.2	23	11.61
<i>P.sephen</i>	4	11.7	9	11.5	9	10.7	22	11.11
<i>C.leucas</i>	2	5.8	15	18.7	5	5.9	22	11.11
<i>C.arabicum</i>	5	14.7	7	8.7	10	11.9	22	11.11
<i>R.acutus</i>	4	11.7	11	13.7	6	7.1	21	10.60
<i>M.gerradii</i>	5	14.7	4	5	7	8.3	16	8.08
<i>S.mokarran</i>	2	5.8	4	5	5	5.9	11	5.55
<i>A.flagellum</i>	1	2.9	3	3.7	6	7.1	10	5.05
<i>H.uarnak</i>	1	2.9	2	2.5	6	7.1	9	4.5
<i>G.granulatus</i>	2	5.8	4	5	3	3.5	9	4.54
<i>G.poecilure</i>	1	2.9	4	5	3	3.5	8	4.04
<i>T.panthera</i>	0	0	0	0	2	2.3	2	1.01
	34		80		84		198	

Figure (3) shows the Principal Components Analysis (PCA) analysis between species caught and the study period. The species *M.gerradii*, *S.mokarran*, *A.flagellum*, *P.sephen*, and *G.poecilure* directly correlated with January at the level. 3%, while the species *G.granulatus*, *B.imbricata* showed a weak direct correlation with December and amounted to 0.8%, while it was a weak correlation of *G.poecilure* with February, May, and August at the level of 0.10%, while it is noted that the species *M.gerradii*, *H.uarnak*, *C.arabicum*, and *T.panthera* showed a "negative" correlation with March and July at a correlation of -2.4%.

**Figure 3.** Principal Components Analysis (PCA) analysis between species caught and the study period.

3.3. Occurrence

Only one species, *C. leucas*, emerged at the second station out of the nine to twelve resident species, and none at all emerged in the first or third stations, while the two species, *B.imbricata* and *B.walga*, appeared in the second and third stations as seasonal species (6-8) months, while the species *R.acutus*

appeared in the second station and the two species *H.uarnak* and *B.imbricata* appeared in the third station, while no seasonal species appeared in the first station, while the number of rare species (1-5) months in the three study stations reaches (12,9,9) respectively, while *T.panthera* appeared in the third station only (Table 4).

Table 4. Distribution of Chondrichthyes fish according to their monthly occurrence as resident, seasonal and rare species.

Species	Station1	Station 2	Station3
Resident species (9-12) months	-	<i>C.leucas</i>	-
Seasonal species (6-8) months	-	<i>B.walga</i> , <i>R.acutus</i> , <i>C.arabicum</i>	<i>B.walga</i> , <i>B.imbricata</i> , <i>H.uarnak</i> , <i>C.arabicum</i>
Rare species (1-5) months	<i>B.walga</i> , <i>A.flagellum</i> , <i>B.imbricata</i> , <i>P.sephen</i> , <i>M.gerradii</i> , <i>H.uarnak</i> , <i>R.acutus</i> , <i>C.leucas</i> , <i>C.arabicum</i> , <i>S.mokarran</i> , <i>G.granulatus</i> , <i>G.poecilure</i>	<i>A.flagellum</i> , <i>B.imbricata</i> , <i>G.granulatus</i> , <i>G.poecilure</i> , <i>H.uarnak</i> , <i>M.gerradii</i> , <i>P.sephen</i> , <i>S.mokarran</i>	<i>A.flagellum</i> , <i>C.leucas</i> , <i>G.granulatus</i> , <i>G.poecilure</i> , <i>M.gerradii</i> , <i>P.sephen</i> , <i>R.acutus</i> , <i>S.mokarran</i> , <i>T.panthera</i>

4. Discussion

Eight hundred fifty species of Chondrichthyes fish spread in all the world's marine and fresh waters, and the Arabian Gulf includes 50 species of them (source). The results of the current study showed the registration of 13 species of Chondrichthyes fish, including nine rays and four sharks, and previous studies confirmed that the Iraqi marine waters are abundant in Chondrichthyes fish species [5,16,17] during their study on Iraqi marine waters.

The results of the present study indicate that the highest appearance of individuals was in the temperate and hot months for the three study stations, and its lowest presence was in the cold months, and this is possibly due to the fish migration to deep areas to stay away from low temperatures and in the temperate months, it is noted that they graze in a lower layer than the surface of the water to search for food. According to several studies, including [17], Chondrichthyes fish during fishing is subject to seasonal changes [18]. Perhaps the presence of Chondrichthyes fish in the three study stations is due to the availability of food, which is consistent with what [5] found 12 species of Chondrichthyes fish during their study on the third River and its effect on the fish of Iraqi marine waters, 13 species were discovered during studies on Khor Al-Zubair by and [19]. They connected the high salinity, rising temperature, and marine productivity of the research to the presence of these species. it was recorded in the current study that the highest presence of Chondrichthyes fish was in July, as 38 fish were recorded. It seems that Chondrichthyes fish increase in the summer months with an increase in the catch of Osteichthyes and an increase in food and appropriate temperature. This is consistent with the study of [20] during the evaluation of Iraqi marine waters from 1995 -1999. On the one hand, the presence of Chondrichthyes fish increases in the summer months and the presence of five species in the first station (the Shatt al-Arab estuary), and this is consistent with the study of [21] during his study on the Shatt al-Arab estuary and Iraqi marine waters, where he recorded seven species while both [6,22] recorded 16 and 11 species "respectively, during their study on the Shatt al-Arab estuary and in the study of [7] on the reproductive strategy of two types of cartilaginous fish, *C. arabicum* *H. randalli*, in Iraqi marine waters, which obtained 365 individuals of the first species and 321 individuals of the second species it can also be attributed to the emergence of chondrichthyes species in the third station as it is deep water and has high transparency, as well as "relative stability of salinity and temperature compared to the first and second stations in which the carnivores and sharks swim freely in search of food" and what is characterized by deep water The high productivity and the

distribution of temperature and salinity ranges, and this was confirmed by the study of [3] during his study on Khor Abdullah. In the study of [23] 16 species of Chondrichthyes fish were recorded during their study on the Shatt al-Arab estuary and Khor al-Amaya, including seven sharks and nine rays moreover, the water depth is also less" compared to Khor al-Amaya. In another study [5] confirmed that the Chondrichthyes fish accounted for 12.6% of the total catch during his study on the Iraqi marine waters and attributed the reasons for this percentage of Chondrichthyes fish to the presence of continuous food in that period and the fish stocks available in the Iraqi marine waters.

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