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The composition of the small fish assemblage in Al-Hawizeh marsh, Southern Iraq, after inscription on the World Heritage List

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Abstract

A total of 6666 individuals of small fish species were captured from four studied stations w ithin Al-Hawizeh Marsh southern of Iraq from December 2017 to November 2018 to evaluate the fish assemblage in the Al-Hawizeh Marsh environment and identify the most important species suitable for living in the marsh environment. The captured fish were belonged to 13 species; three species achieved 85% of the small fish community in Al-Hawizeh marsh, which follows: *Planiliza abu* occupied the first rank of 3208 individuals recorded with 48.12%, *Coptodon zilli* occupied the second rank of 1929 individuals, giving a percentage of 28.94%, whereas *Carassius auratus* came in the third rank, where achieved 7.93% of the total number of small fish captured in the study area. Nine fish species appeared in (9-12) months (common species), including *Alburnus mossulensis, C.auratus , C. zillii , Hemiculter leucisculus, P. abu, Acanthobrama marmid, Carasobarbus luteus Carasobarbus sublimus,* and *Leuciscus vorax* and only one species, *Oreochromis aureus* recorded in 8 months (seasonal species). Three fish caught showed in only one month (Occasional species) including *Mastacembelus mastacembelus*, *Heteropneustes fossilis*, and *Silurus triostegus*. The ecological indices were used in this study, where diversity index (H) varied from (1.15 - 1.65) with an overall value of 1.46, as well as, the richness index (D) changed from (1.04 -1.77) with an overall value of 1.36. Moreover, the evenness index (J) ranged from 0.57 to 0.67, with an overall value of 0.57.

Keywords: Fish assemblages, Al- Hawizeh marsh, Ecological indices**,** World Heritage List, Iraq.

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تركيبة تجمع صغار الاسماك في هور الحويزة جنوب العراق بعد ادراجها ضمن لائحة التراث العالمي

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الخلاصة

تم اصطياد ما مجموعه 6666 فرداً من الاسماك صغيرة الحجم من أربع محطات مدروسة ضمن هور الحويزة جنوب العراق للفترة من كانون الأول 2017 إلى تشرين الثاني 2018 لتقييم تجمع الأسماك في بيئة هور الحويزة وتحديد أهم الأنواع المناسبة للعيش في بيئة الهور. وكانت الأسماك المصطادة تنتمي إلى 13 نوعاً، حققت ثلاثة أنواع منها 85% من مجتمع الأسماك الصغيرة في هور الحويزة، وهي: حيث احالت *Planiliza abu* المرتبة الأولى بواقع 3208 فرداً مسجلاً بنسبة 48.12 %، واحتلت *Coptodon zilli* المرتبة الثانية بواقع 1929 فرداً مسجلاً بنسبة 28.94%، فيما جاءت *Carassius auratus* في المرتبة الثالثة حيث حققت 7.93% من إجمالي عدد الأسماك الصغيرة المصطادة في منطقة الدراسة .ظهرت تسعة أنواع من الأسماك خلال (9-12) شهراً (أنواع شائعة) وهي *Alburnus mossulensis, C.auratus , C. zillii , Hemiculter leucisculus, P. abu, Acanthobrama marmid, Carasobarbus luteus Carasobarbus sublimus, and Leuciscus vorax* ونوع واحد فقط وهو *Oreochromis aureus* تم تسجيله خلال 8 أشهر (أنواع موسمية). ظهرت ثلاثة انواع من الاسماك تم اصطيادها خلال شهر واحد فقط (أنواع عرضية) وهي *Mastacembelus mastacembelus, Heteropneustes fossilis, and Silurus triostegus* . تم استخدام مؤشرات التنوع البيولوجي في هذه الدراسة حيث تراوح مؤشر التنوع (H) من (1.15 - 1.65) بقيمة إجمالية 1.46، وكذلك تغير مؤشر الثراء (D) من (1.04 - 1.77) بقيمة إجمالية 1.36. علاوة على ذلك، تراوح مؤشر التساوي (J) من 0.57 إلى 0.67، بقيمة إجمالية قدرها 0.57.

الكلمات المفتاحية : تجمعات الأسماك، هور الحويزة، المؤشرات البيئية، قائمة التراث العالمي، العراق.

Introduction

Wetlands are the most productive ecosystems in the world and cover at least 6% of the Earth's surface (Cherry,2011). It plays a key role in hydrological and biogeochemical cycles, supports and harbors a large part of the world's biodiversity, and provides multiple services to humankind (Mitsch and Gosselink,2000; Junk *et al.*, 2013). The southern Iraqi marshes are characterized by their high productivity. They are considered a natural refuge for many aquatic organisms and Iraq's primary source of inland fisheries (60%) (FAO, 1999 ; Al-Hilli *et al.*, 2009).

Invasive species have devastating impacts on native species (Davis, 2009; Simberloff and Rejmánek ,2011). This may lead to a decline in their abundance or extinction and an enormous impact on natural and cultivated ecosystems (Hussein, 2000; Mohamed *et al*., 2010). Thus, any rise in the number of predators can influence diversity. Also, human disturbance, such as pollution, may lead to species extinctions (Gomiero and Braga, 2006).

Few studies have been conducted about small fish in inland waters represented by rivers and marshes in Iraq, including the study of Hussain *et al.* (1997) on the composition of small fish community in Shatt al-Arab River, where the community finds it consists of 25 species belonging to 13 fish families, all belonging to the class of bony fish. Jasim (2003) studied some biological aspects. He assessed the evidence for describing the assemblage of juvenile fishes in Shat Al-Arabs, Shatt al-Basrah canal, and formed larvae, juveniles, and adults 21.52%, 41.87%, and 36.61%, respectively of the total number of fish in those two environments. Matlak *et al.* (2008) noted that some Marine fish breed and feed in the east Hammar marsh from the waters of the Arab Gulf to the rivers through the Shatt al-Arab.

The current study aims to determine the composition of small fish community in Al-Hawizeh Marsh after it was inscribed on the World Heritage List, However, other studies carried out on Al-Hawizeh marsh after 2019 like (Al-Thahaibawi 2019; **Salim and Abed ,2021) for the Environment and conservation Southern Iraqi Marshes.** As well as, Mohamed, (2014) carried out a study on the stock of freshwater, *Planiza abu*, in East Al-Hammar, Hawizeh and Chybaish marshes, southern Iraq, to determine abundance, growth and exploitation rates of *P. abu* after two years of restoration.

The study by Heneghan *et al*. (2019) has observed that the fish body size is frequently used as the primary criterion for determining the physiological characteristics of a fish species and its role in the ecosystem. Other studies carried out on Al-Hawizeh marsh after 2019, like Al-Thahaibawi *et al*.(2019) on fish community structure in Al-Hawizeh marsh, and the study by Salim and Abed (2021) for the Environment and conservation of the Southern Iraqi Marshes. Moreover, Al-Thahaibawi *et al*.(2023) used fourteen metrics for measuring the Integrated Biological Index (IBI) to evaluate the Al-Hawizeh marsh environment after inscribed on the World Heritage list. Another study conducted by Al-Thahaibawi *et al*.(2025) in Al-Hawizeh marsh on seasonal and locational changes in the concentrations of some heavy metals accumulated in muscles of the fish *Carasobarbus luteus* species, which are considered economically important fish, and the extent of their impacts on human health.

Materials and Methods

Description of Al-Hawizeh marsh

Al-Hawizeh Marsh is considered a water body shared between Iraq and Iran regarding location and food resources. The area is located about 70 km from Al-Ammara city, extending between the coordinates (Latitude/Longitude: 31°00’–31°45’N, 47°25’–47°50’E). It is distributed with 79% in Iraqi territory and 21% in Iranian territory (Al-Ali, 1994; Domad, 2008). The Iraqi part of the marsh is distributed by 67% and 33% to Maysan and Basrah provinces, respectively. The marsh contains many water bodies as Al-Sannaf, Um Al-Niaj, Abu-Athbah, Al-Adaim, Al-Doob, Al-Jakah, Al-Saffia (Fig. 1).

Fish were collected monthly from December 2017 to November 2018 at four chosen stations, including Um Al-Ward, Um Al-Niaj, Al-Souda North, and Al-Adaim marshes, in Al-Hawizeh Marsh during the study time. Sampling taken by using three means of fishing at each site, including fixed gill nets with average lengths between (50 to 100 meters long with 16×16mm to 67×67 mm mesh size), cast nets with diameters ranging between (6-9) mm and between 25×25 and 40×40 mesh size and electro-fishing were conducted using a generator engine that provides 300-400V and 10A. This method was used in areas where the vegetation was very dense. Fish were classified according to

their species based on Al-Daham (1977), Eschmeyer (2015), and Coad (2010, 2016, and 2017).

The Relative abundance of small fish was calculated using the following equations (Odum,1970).

Relative abundance (Ra) % = (*ni*/ N) 100

ni = The number of individuals species in the monthly sample

N = The total number of small fish individuals in the monthly sample

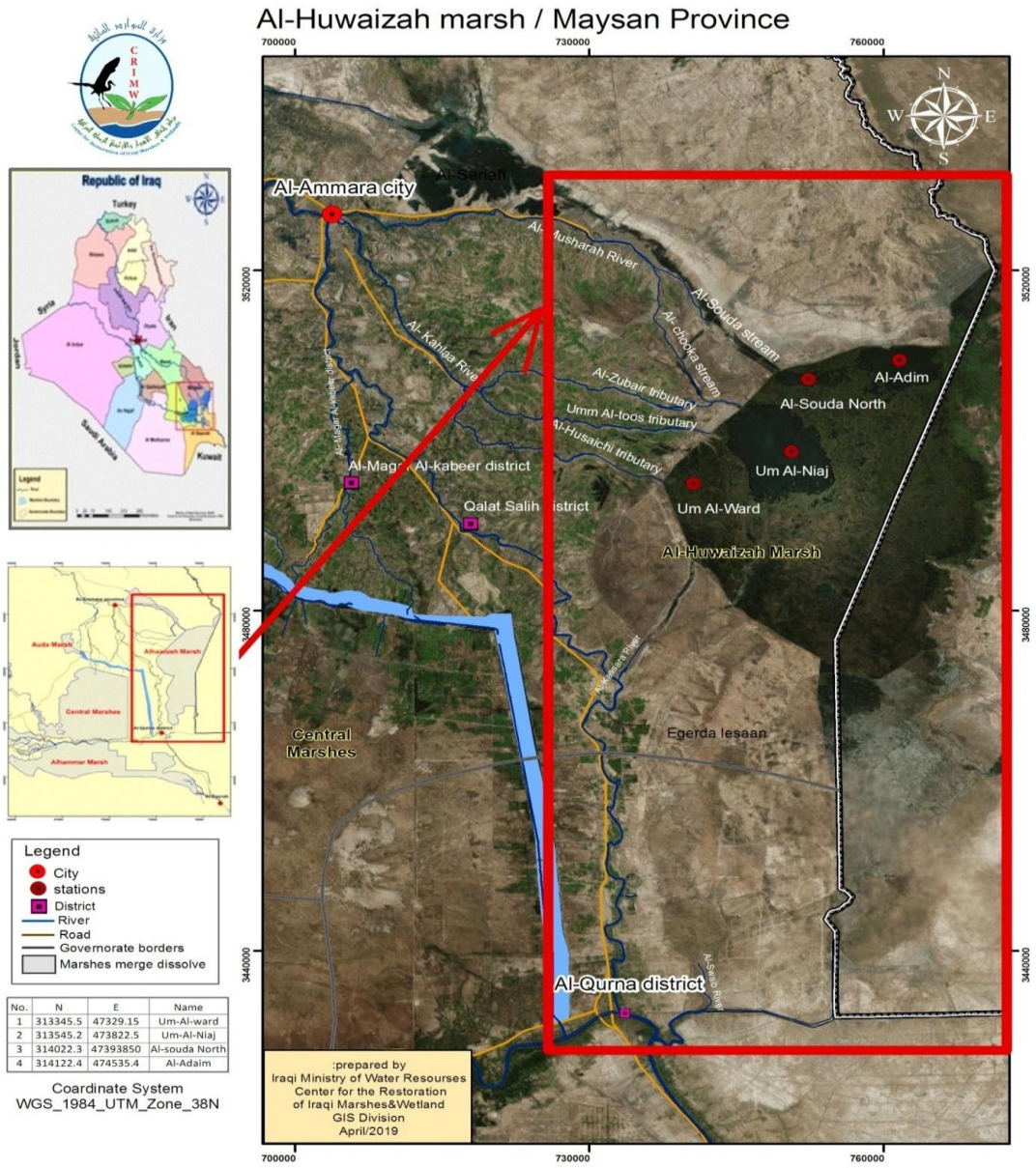

Figure 1: Al-Hawizeh marsh site in the Maysan province, southern Iraq by CRIM (2019).

The presence of small fish species is classified into three main groups according to the collection period and their presence in monthly captured samples (Tyler, 1971). Fish species varied in their division into Common species, which means the Presence from (9-12) months, Seasonal species, which means the occurrence from (6-8) months, and Occasional species.

The following equation obtains the Shannon-Weaver index of diversity:

$H = -\Sigma\, pi\, ln\, pi$ (Shannon and Weaver, 1949) where :

H= Diversity index

Ni = The number of individuals in one species

N = The number of individuals for all species

The species richness calculated using the equation $D = (S-1)/ ln\, N$ (Margalef, 1968) where :

D = The Richness Index

S=The number of species

N=The number of individuals

The evenness index is $J = H / \ln S$ (Pielou, 1977) where:

J= Evenness index

H= Shannon diversity index

S= the total number of species

Results

A total of 6666 specimens of small fish species were collected from four locations within Al-Hawizah Marsh Southern of Iraq, belonging to 13 species. Monthly variations in the number of small fish species in the marsh are illustrated in Figure 2. The Number of small fish species ranged from 6 species in August, September, and October to 13 species in December 2017.

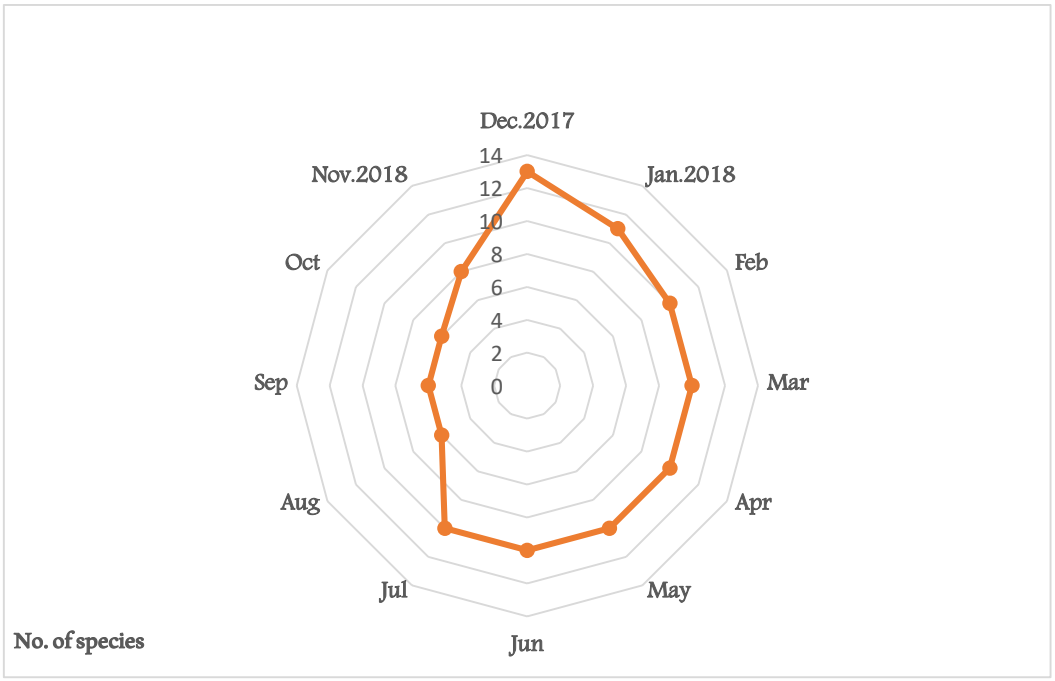

Figure 2: The variations monthly in total number of small fish species of Al-Hawizeh marsh during the current study

The highest number, 989 individuals obtained in January, comprised 14.8% of the total individual number, while the lowest number, 104 individuals collected in October, comprised 0.16% of the total individual number of fish captured (Fig.3).

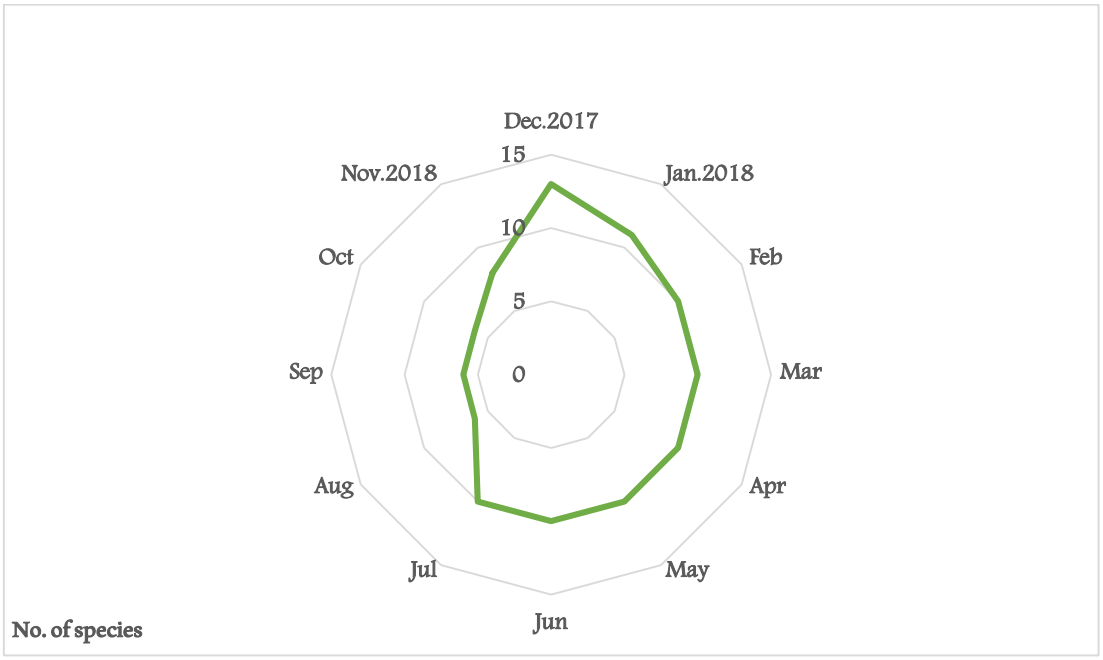

Figure 3: The variations monthly in the total number of fish individuals in Al-Hawizeh marsh during the current study

Three species forming 85% of the small fish community in Al-Hawizah marsh are as follows: *P. abu* occupied the first rank of 3208 specimens recorded with 48.12% of the total number of small fish, it was dominant in all study months, *C. zilli* occupied the second rank of 1929 individuals giving a percentage 28.94%, whereas *C. auratus* came in the third rank formed 7.93% of the total number of small fish captured.

According to Tyler (1971), five species have appeared in 12 months (common species) including *Alburnus mossulensis, Carassius auratus , Coptodon zillii , Hemiculter leucisculus* and *Planiliza abu.* The *A. mossulensis* species total length ranged from 2.3 cm in March to 9.7 in April, *C. auratus* ranged between 5.4 cm in February and 9.8 cm in July, *C. zillii* its total length varied from 5.1 cm in December 2017 to 9.9 cm in July 2018, *H. leucisculus* their length varied from 4.2 cm in March to 9.8 cm in May, whereas the length of *P. abu* laid between 2.0 cm in January to 9.8 in April, May, June, and September, as well, *Acanthobrama marmid* and *Carasobarbus luteus* species were recorded as small fish species in 10 months (common species) of the present study. The length of *A. marmid* varied from 4.6cm in March to 9.6 cm in July, so *C. luteus* length varied from 4.4 cm in January to 9.8 cm in March, April, May, and June.

Therefore two species *of Carasobarbus sublimus* and *Leuciscus vorax* occurrence in 9 months (common species) of the current study, the length of *C. sublimus* species ranged between 4.6cm in January, March and July, whereas *L. vorax* presented in length varied from 5.1cm in March to 9.9cm in May. Only one species of *Oreochromis aureus* was revealed in 8 months (seasonal species) during the present study. The lowest length of 7.6cm was in January, while the highest length of 9.9cm was found in December 2017.

On the other hand, three species of fish caught appeared in only one month (Occasional species) during the present study, including *Mastacembelus mastacembelus, Heteropneustes fossilis*, and *Silurus triostegus*, but their length of these species were varied; however, *M. mastacembelus* ranged in length from 3.1cm to 9.8cm in December 2017; moreover, the two species of *H. fossilis* and *S. triostegus* were the difference in their length from 9.6cm to 9.9cm and 8.2cm to 9.9cm in December respectively (Table, 1).

Table 1: Monthly changes in number of small fish lengths less than (<10cm) in Al-Hawizeh marsh

Species	Dec 2017	Jan 2018	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Total No.	Relative abundance%
Acanthobrama marmid	5	9	5	6	2	8	11	6		1	4		57	0.81
Alburnus mossulensis	20	16	18	22	16	23	29	30	6	4	8	7	199	2.99
Carasobarbus luteus	33	55	50	29	7	16	23	35	2			11	261	3.92
Carasobarbus sublimus	19	17	20	13	3	5	14	25				5	121	1.82
Carassius auratus	49	34	75	74	50	53	65	59	14	16	19	21	529	7.94
Coptodon zillii	289	352	283	279	196	144	129	121	36	29	28	43	1932	28.98
Hemiculter leucisculus	12	15	19	16	13	5	5	4	4	2	2	5	99	1.49
Heteropneustes fossilis	8												8	0.12
Leuciscus vorax	21	29	23	24	12	7	9	7				4	136	2.04
Mastacembelus mastacembelus	3												3	0.05
Oreochromis aureus	17	19	15	11	5	8	10	5					90	1.35
Planiliza abu	391	443	392	304	259	338	359	367	54	70	43	188	3208	48.12
Silurus triostegus	23												23	0.35
Total	890	989	900	778	563	607	654	659	116	122	104	284	6666	100

The ecological indices

The monthly variations in diversity, richness, and evenness indices of small fish assemblage in Al-Hawizeh marsh are shown in Figure 4. The diversity index (H) varied from 1.15 in January to 1.65 in December, with an overall value of 1.46. The richness index (D) changed from 1.04 in September to 1.77 in December, with an overall value of 1.36. As well as, the evenness index (J) ranged from 0.57 in November to 0.67 in August, with an overall value of 0.57.

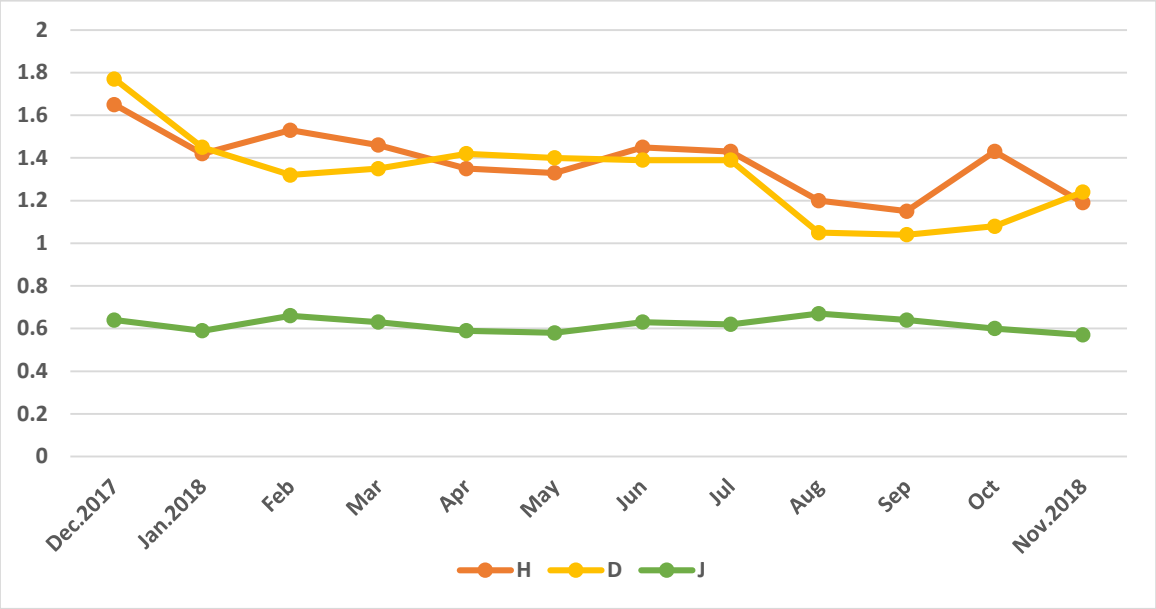

Figure 3: The variations in monthly values of ecological indices of small fish species in Al-Hawizeh marsh

Discussion

The southern marshes are considered a natural refuge for many aquatic organisms and a major source of inland fisheries in Iraq. The results of the present study showed differences in the length of some small fish species such as *A. mossulensis* (2.3 - 9.7cm), *C. auratus* (5.4 -9.8 cm), *C. zillii* (5.1- 9.9 cm), *H. leucisculus* (4.2 -9.8 cm), *P. abu* (2.0 - 9.8), *A. marmid* (4.6 - 9.6 cm), *C. luteus* (4.4 - 9.8 cm), *C. sublimus* species (4.6cm), *L. vorax* (5.- 9.9cm), *O. aureus* (7.- 9.9cm), *M. mastacembelus* (3.1 - 9.8cm) and *H. fossilis* and *S. triostegus* species were the difference in their length from (9.6- 9.9cm) and (8.2- 9.9cm) respectively.

The presence of small fish for most species leads to the conclusion that the Al-Hawizeh marsh is a breeding, nursery, and feeding area for many freshwater fish species. Moreover, this area is to feed and breed fish, and the abundance of its food is appropriate, which coincides with the abundance of dense Phytoplankton. Al-Hawizeh marsh was distinguished by the density of its submergence and floating aquatic plants. Their decomposition eventually leads to increased organic matter used by phytoplankton in the manufacture of food and thus increases the material detrivores that would be fertile ground for fish feedstock.

In this study, Al-Hawizeh marsh recorded thirty species of aquatic plants belonging to 25 genera and also found that the vegetation cover plays a crucial role in preserving the natural environment and enhancing the lives of humans and other living organisms as well as recording the presence of mature fish for some species, which indicates that the Al-Hawizah Marsh area is considered as breeding, nursery and feeding area for many species of fish. As well as in a study running on the eastern Al-Hammar marsh, which is considered the area is a nursery and feeding for ten species of marine fish. Some caught fish of *P. abu* in the present study ranged between 2cm and 9.8cm. Whereas in another study, the *P. abu* species was found to be the size of 1.4 cm as the smallest length in April, May 2009, and March 2010. Also, in a study of the lower end of the Tigris River observed the smallest length of fish *P. Abu* is 2 cm. At the same time, Other studies in the Northern part of the Shatt al-Arab River pointed to the presence of larvae of *P. abu* during the period from February to May.

On the other hand, Al-Thahaibawi *et al*.(2023) showed the increase in the number of *C. zilli* individuals in the Iraqi environment and their presence in all monthly fishing samples; this case was not recorded in previously conducted studies, which were conducted after re-flooding Al-Hawizeh marsh. However, the small sizes of the *C. zillii* species in the present study were not recorded as less than 5cm. The *C. zilli* species were recorded in a wide range of salinity in rivers and oceans, and they are tolerant to different environmental conditions. In the case of *C. auratus* species, the smaller sizes were found in the area adjacent to the aquatic plants because the marshes were areas suitable for their abundance of food and environmental conditions. In another study of Al-Hawizeh marsh recorded large numbers of *C. auratus* reached a length of less than 5 cm. The results of

the present study indicated that the sizes of young fish *C. luteus* ranged between 4.4cm to 9.8cm. In contrast, no recorded small sizes of this species were found in the study on East Al-Hammar marsh. In addition, small fish less than 7 cm were not recorded in the Al-Hawizeh marsh, and 6 cm in the Al-Chybaish marsh.

The number of native species is naturally declining, accompanied by an increase in the number of alien species higher than that recorded in a previous study on Al Hawizeh marsh, that represented as a form of disturbance coming from human influences, entering these species represents the increasing biological disturbance with deteriorating water quality and environment (Al-Thahaibawi *et al*., 2023).

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