Occurrence and Abundance Ratios of Alien versus Native Species in the Fish Assemblages of the Southern Iraqi Marshlands

Najah Abood Hussain[1], Israa Aziz Mohammed[2]

1Emirate Professor, Dept. Ecology, Science College, University of Basrah, Iraq
2Department of Ecology, Science College, University of Basrah, Iraq
*Corresponding Author E-mail: pgs.asraa.aziz@uobasrah.edu.iq

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Abstract

The degree of disturbance at fish assemblages in southern Iraqi marshes was quantified on the basis of number of native species occurrence ratio (NOR) and native abundance ratio (NAR) to the total number of species and individuals during the period from 2006 to 2024. Degree of disturbance status scores at Al-Hawaizah, Auda, Chybaish, Zachery, Dalmaj, West Hammar and Suq Al-Shuyukh marshes ranged between 50 -77% ,which equal to moderate and fine in disturbance status scale. Al-Shafi and East Hammar marshes express lower native occurrence ratio ranged 24-42% equal to disturbed to very disturbed status. Alien species number were varied between 3 to 11. Highest native species occurrence ratio (NOR) conceded with low salinity values at Al-Hawaizah, Chybaish, Auda, and West Hammer. The opposite case was in Al-Shafi and East Hammar marshes were alien species dominated. Invasive disturbed index (IDI) values s express negative relationship with number of native species and positive with alien species ratio at the southern marshes. IDI score at Al-Hawaizah , Auda, Zachery, Suq Al-Shuyukh and west Hammar marshes were low, ranged from 0.3 to 1.0. On contrary East Hammer marsh and Al Shafi scored the highest IDI values ranged from 1.37 to 3.6. Alien species had established successfully in southern marshes over relatively a short period. Native fluvial species lost its dominance to alien species especially in Al-Shafi and East Hammer marshes. Gradual decrease in occurrence and abundance of native species was noticed in southern marshes due to increase salinity. Alien species seem to be infested all Iraqi southern marshes. The most sever disturbance ratio was recorded at East Hammar marsh.

Keywords: Iraqi marshlands, Mesopotamia marshes, Marshes alien species, Wetlands exotic fish, Marshland native fish.

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Introduction

Iraqi southern marshes are the largest in the Middle East and southwest Asia. They are vast wetlands created by Tigris and Euphrates rivers replenishment and flooding. During the nineties of last century, they were drained to about seven percent of their original size, The marshes are characterized by their unique biodiversity and several rare species are occurred only in these marshes. Iraqi southern marshes are on the flying route of many migratory birds from the Middle East and Siberia to East Africa, and it is the spawning and nursery ground for anadromous marine fish and shrimp from the Arabian Gulf. Previously southern marshes produced 60 percent of the freshwater fish catch to the Iraqi local market, fishing was the major source of livelihood for the marsh Arabs, along with water buffalo herding (Hussain and Reiss, 2018).

Recently, the southern marshlands have faced many threats such as reginal global warming, the construction of several dams on the upper reaches of the Euphrates and Tigris rivers. The progressive development of oil and gas explorations and production led to desiccation of vast marshland areas. The original fish assemblages of marshlands consisted primarily of native species from Cyprinid (ARDI, 2006; CIMI, 2006).

To increase the inland fishery yield , several exotic fish species were introduced to Iraqi rivers, reservoirs and marshlands ,mainly carp species and dominated by common carp (*Cyprinus carpio*) and Prussian carp (*Carassius auratus*). After restoration of marshes in 2003, witnessed more exotic species were released including three Tilapia species and few ornamentals ones, (Al-Fasial, 2020). Currently exotic fish species are considered as the most common species in southern marshes (Hussain and Reiss, 2018; Mohammed, 2024).

Few studies have address the nature of the fish assemblage of restored southern marshes (IMPR, 2006; CIMI, 2006; Younis *et al*., 2011; Younis and Al-Shamary, 2012; Al-Thahaibawi *et al*., 2019), on Al-Hawaizah marsh. Al-Thahaibawi *et al*., (2015) on Auda marsh. (Al-Shamary, 2016) on Chybaish marsh. (Al-Zaidy *et al*., 2019) on Dalmaj marsh, (Abdullah, 2023) on Zachery marsh. (ARDI, 2006) on Al-Hawaizah ,Chybaish and Suq Al-Shuyukh marshes,(Al-Jabre and Hussain, 2022), on West Hammar marsh , (Abdullah *et al*., 2022) on Al-Shafi marsh. Most publications were concerned with East Hammer marsh (Hussain *et al*., 2009; Lazim, 2009; Mohamed *et al*., 2013; Mohamed *et al*., 2015; Hameed, 2014; Abdalhsan *et al*., 2019 and Mohammed, 2024).

The aim of the present study is to quantify the disturbance ratio of native and alien fish species occurrence and abundance in local marshes at southern Iraq by applying numerical and descriptive measure scheme to evaluate the status of fish assemblages disturbance due to occurrence and abundance of alien species.

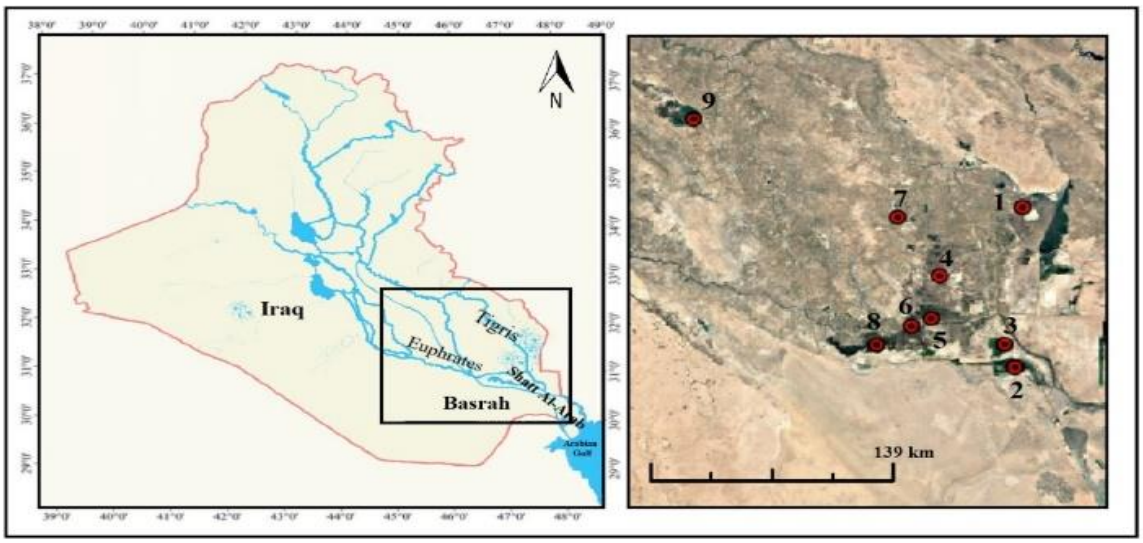
Materials And Methods

Major local marshes at southern provinces of Iraq, as pointed out in map (1).

1-Fish data:

Data on occurrence and abundance of fish species were obtained from previous published studies at local southern marshes. Fishing methods were similar and applying

the following fishing methods 1-Seine net 2-Cast net, 3- Electrical fishing 4- Recording other fishermen catch.



Map (1): Map Showing the Geographical locations of southern Iraqi marshes Numbers are Cross ponding to their local nomenclature.

No.	Local marshes	Latitude	Longitude
1	Al- Hawaizah	31°37'59.16" N	47°35'44.32" E
2	East Hammer	30°41'52.61" N	47°32'40.51" E
3	Al- Shafi	30°50'1.10" N	47°29'1.81" E
4	Zachery	31°14'0.36" N	47° 6'8.87" E
5	Chybaish	30°59'3.39" N	47° 3'9.33" E
6	Suq Al-Shuyukh	30° 51' 50" N	46°40'.42 " E
7	Auda	31°34'38.42" N	46°51'10.55" E
8	West Hammar	30°49'46.62" N	46°43'42.77" E
9	Dalmaj	32°12'59.88" N	45°26'11.79" E

2-Fish Classification

Fish species were classified according to, (Al-Fasial and Mutlak, 2014).

3-Fish Origin

Different fish species were categorized according to their ecological origin based on Al-Fasial, 2020) into two categories: Native (N) and Alien (A). The Alien group include exotic, ornamental, marine and freshwater invader.

4-Analysis of Fish Species Occurrence and Abundance ratios:

4-1-Native occurrence ratio to total fish species in the sample (NOR):

NOR=NO/TO *100

NO= Number of native species observed in the sample.
TO= Total occurrence of species in the sample

4-2-Abundance of Native species ratio to total number of individuals in the sample (NAR):

NAR= NA / TA *100
NA= Number of native species abundance (individuals) in the sample.
TA= Total abundance (individuals) of all species in the sample {native + exotic + marine + ornamental + invasive}.

5-Degree of disturbance:
To estimate the degree of disturbance in fish assemblages at southern marshes, we applied the following expression and their equivalent numbers ranges to quantify each case separately as follows (Table.1 ; 2).
Status description: NO = Native species occurrence in the sample; TO=Total occurrence of all species in the sample.

Table(1): Assessment of disturbance ratio based on native occurrence to total fish species occurrence (NOR= NO /TO %).

NOR	Habitat* status description
90-100	Integrated
70-89	Fine
50-69	Moderate
30-49	Disturbed
29-10	Very disturbed
9-0	Totally disturbed

*Marshes biotopes.

Table (2). Assessing disturbance ratio of native abundance to total species abundance **(**NAR =NA/TA %). NA= Native Species Abundance in the sample. TA= Total abundance of all species individuals in the sample.

NAR	Habitat status description
90-100	Incorporated
70-89	Average
50-69	Medium
30-49	Upset
29-10	Very upset
9-0	Totally upset

*Marshes biotopes.

6-Invasive Disturbed Index (IDI): (Larentis *et al*., 2022)

$IDI = N_{alien} / N_{native}$

IDI: Invasive Disturbed Index

N_{alien}: Number of alien species (or number of alien individuals)

N_{native}: Number of native species (or number of native individuals)

Results

1. Tidal status and salinity ranges at local southern marshes:

Local marshes including Al-Hawaizah, Auda, Chybaish, Zachery, Dalmaj, West Hammar and Suq Al-Shuyukh, were all non-tidal marshes with salinity ranged between 1.7 to 4.7 psu. Accordingly, their aquatic environment classified as oligohaline to mesohaline habitats. Al-Shafi and East Hammar marshes characterized by semidiurnal tide, and higher salinities and their habitat regraded as mesohaline to hypersaline (Table.3).

2. Native occurrence ratio (NOR) and disturbance status at the southern marshes:

Variations in NOR values at several local southern marshes. NOR values variation also existed between studies on the same local marshes. Degree of disturbance in Al-Hawaizah marsh ranged between 57.8 -77% equal to fine in Auda, Chybaish, Zachery and Dalmaj, their NOR ranged between 50 to 66% equal to moderate. West Hammer and Suq Al-Shuyukh marshes ranged 54.1 to 61.0 equal to moderate disturbance status. AL- Shafi and East Hammar marshes showed lower NOR score ranged 21.7 to 42.1% equal to disturbed to very disturbed status. NOR values of Al- Hawaizah marsh degraded from 77.0% to 57.8% within seven years. While in Zachery, Auda, Chybaish , Dalmaj , Suq Al-Shuyukh, and West Hammar marshes decrease to 50% . Tidal marshes scored very low NOR values. Alien species number at Al-Hawaizah marshes varied between 3 to 8 species. In Auda, Chybaish, Zachery and Dalmaj marshes ranged from 5 to 9, while in West Hammar and Suq Al-Shuyukh marshes 7 to 11 species. However in Al-Shafi and East Hammar marshes experience major increase in number of alien species ranged 11 to 18 species, which correspond to disturbed to very disturbed ratio (Table.3).

Table (3): Native occurrence score (NOR) ,degree of disturbance status of species assemblages at southern marshes. NOR =NO/TO =Number of native species /total number of species.

Local Marshes	Number Native species	Number Alien Species (A)	NOR	Disturbance status	Tidal status	Salinity (psu)	Reference
Al-Hawaizah	13	7	65%	Moderate	Non tidal	2.0	ARDI (2006)
Al-Hawaizah	10	3	77%	Fine	Non tidal	1.7	Youns *et al.* (2011)
Al-Hawaizah	14	6	70%	Fine	Non tidal	1.8	Youns & Al- Shamary (2012)

Al-Hawaizah	11	8	57.8%	Fine	Non tidal	2.5	Al-Thahaibawi *et al.* (2019)
Zachery	9	9	50%	Moderate	Non tidal	2.3	Abdullah (2023)
Auda	11	8	58%	Moderate	Non tidal	2	Al-Thahaibawi *et al.* (2015)
Chybaish	12	8	66%	Moderate	Non tidal	1.6	Mohamed *et al.* (2012)
Chybaish	13	7	65%	Moderate	Non tidal	6.3	Al-Shamary (2016)
Dalmaj	10	5	66%	Moderate	Non tidal	6.8	Al-Zaidy *et al.* (2019)
SuqAl-Shuyukh	11	7	61%	Moderate	Non tidal	1,8	ARDI (2006)
West Hammar	13	11	54.1%	Moderate	Non tidal	5.5	Al-Jabre &Hussain (2024)
Al- Shafi	8	11	42.1%	Disturbed	Tidal	2.8	Abdullah *et al.* (2022)
East Hammar	13	18	42%	Disturbed	Tidal	1.6	Hussain *et al.* (2009)
East Hammar	5	18	21.7%	Very disturbed	Tidal	8.7	Abdalhsan *et al.* (2020)
East Hammar	5	16	24%	Very disturbed	Tidal	5.2	Mohammed (2024)

3. Native abundance ratio (NAR) and their disturbance status:

NAR value at Al-Hawaizah, Chybaish and Auda local marshes ranged from 60.0 to 68.2 % indicating medium disturbance status. Lower values 39.9% recorded in Western Hammar marshes equivalent to upset disturbance status. Al-Shafi and East Hammar marshes represent distinct cases differing from other southern local marshes where native abundance ratio ranged 6.5 to 41.1 % and disturbance status varied from upset to very upset (Table .4).

Table(4): Native Abundance ratio (NAR) and disturbance status of fish assemblages at southern marshes, NA = number of individuals of native species, AA= number of individuals of alien species and TA = total number of individuals.

Local marsh	Native Abundance /Total abundance (NA/TA)	Alien Abundance /Total abundance AA/TA	NAR	Disturbance status	Reference
Al-Hawaizah	2720/3990	1270/3990	68.17	Medium	Youns *et al.* (2011)
Al-Hawaizah	2055/3294	1239/3294	62.4	Medium	Al-Thahaibawi *et al.* (2019)
Chybaish	9677/14231	4554/14231	68%	Medium	Al- Shamary (2016)
Auda	11307/18860	7553/18860	60%	Medium	Al-Thahaibawi *et al.* (2015)
West Hammar	3241/ 8118	4877/8118	39.9	Upset	Al-Jabre &Hussain (2024)
Al- Shafi	81/197	116/197	41.1	Upset	Abdullah *et al.* (2022)
East Hammar	6804/16199	9395/16199	42.0	Upset	Hussain *et al.* (2009)
East Hammar	390/12133	11743/12133	3.2	Totally upset	Abdullah (2017)
East Hammar	2514/11529	9015/11528	21,8	Very upset	Abdalhsan *et al.* (2020)
East Hammar	374/5767	5393/5767	6.5	Very upset	Mohammed (2024)

4. Relation between NOR and salinity values.

The Highest NOR values coincided with low salinity values at in Al- Hawaizah, Chybaish, Auda, and West Hammar accompanied with highest number of native species and lowest alien ones. Opposite case obtained at Al-Shafi and East Hammar marshes were alien species dominated and also their individuals, due to higher salinity values, which facilitate the occurrence and abundance of alien species. Apparently the decline in NOR values accompanied with sharp increase in salinity at the southern marshes (Fig.1).

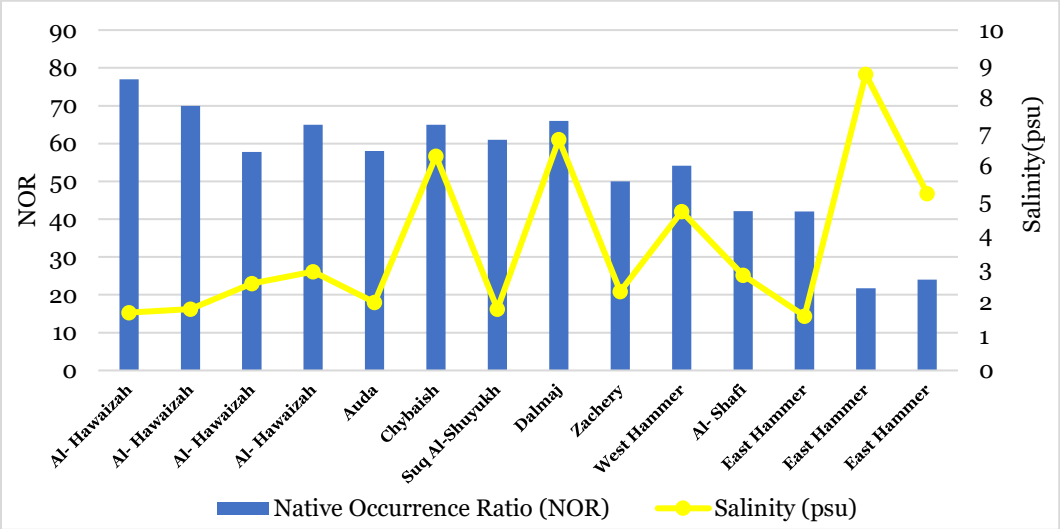


Figure (1): Showing the relation between native species occurrence ratios and salinity (psu) as recorded by recent studies in southern Marshes.

5. NOR relation with Shannon diversity index values.

The values of Shannon diversity index at Al- Hawaizah, Auda, Zachery and West Hammar marshes ranged between 1.41 to 1.97 .but in East Hammar and Shafi marshes showed higher score influenced by higher occurrence of alien species. Total number of species obtained at local marshes also increased the diversity index. Increase in number of alien species had a positive effect on Shannon diversity index especially at East Hammar marsh. Generally positive relationship seem to be existed between total number of species and Shannon diversity index at the southern marshes.

High NOR in Al-Hawaizah marsh characterized by low Shannon diversity index values. The same was noticed in Auda, Al- Chybiyesh, Zachery, Suq Al-Shuyukh and West Hammer marshes but at a lower grade. Al-Shafi and East Hammar marshes characterized by higher Shannon diversity index accompanied with the lowest NOR (Fig.2).

6. Relation between NAR and Shannon diversity index values:

A decline trend observed of NAR (Native abundance ratio) and diversity index as mention by (Younis *et al.*, 2011) at Al-Hawaizah marsh to reach lowest level as recorded by (Mohammed, 2024). Gradual increase in alien species abundance to reach the peak as registered by (Abdullah *et al.*, 2017). Mostly Shannon diversity showed a progressive

increase accompanied by decrease in number of native species at the southern marshes (Fig.3).

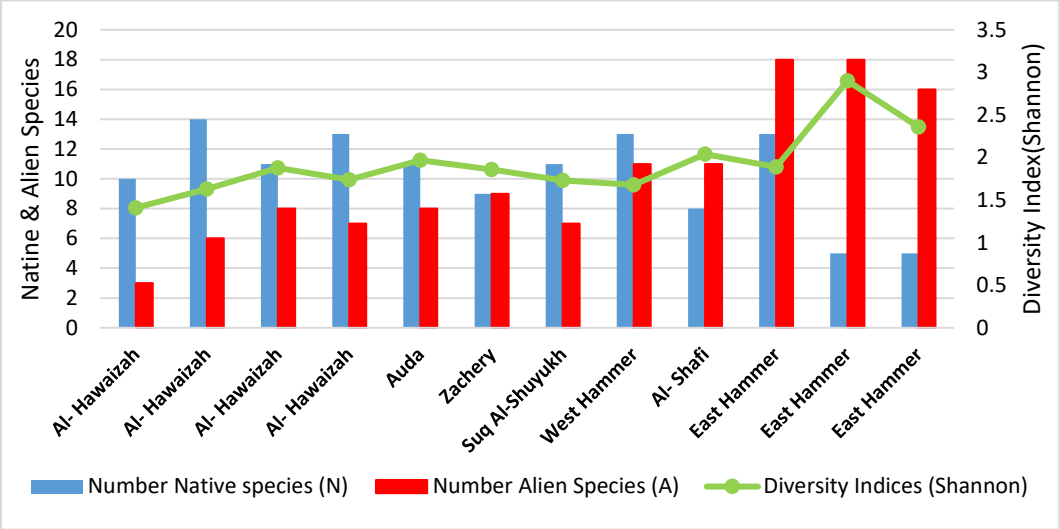


Figure (2): Express the relation between numbers of native, alien species with Shannon diversity index in the southern Marshes.

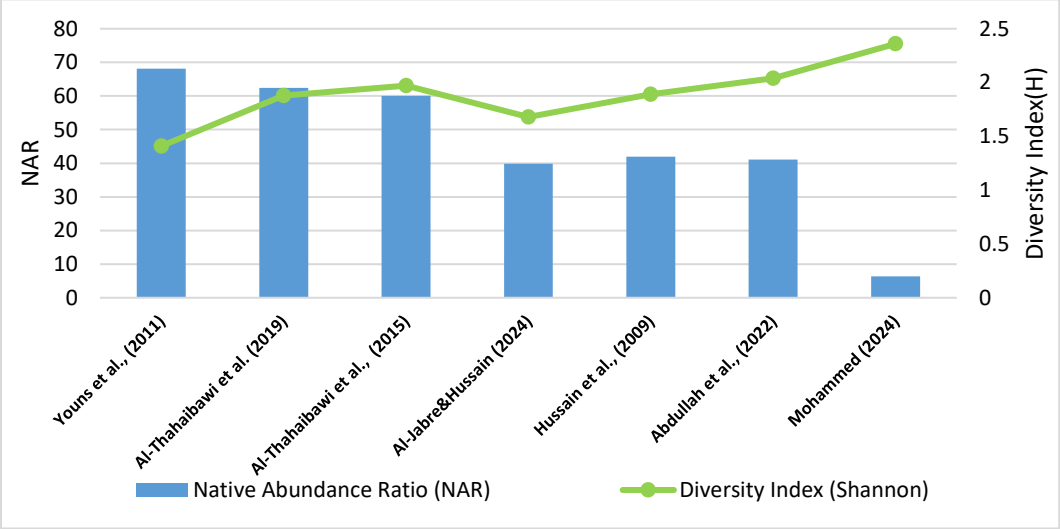


Figure (3). Relationship between native, alien abundance ratios and Shannon diversity index at the Southern Marshes.

7. Relation between numbers of native and alien species with IDI values.

An inverse relationship appear to be existed between number of native species and values of IDI values in the southern marshes. Positive relationship existed between alien species numbers and IDI, as the number of alien species increased IDI score raised. Al-Hawaizah marsh IDI registered low values ranged between 0.3 to 0.72 (Younis *et al.*, 2011; AL- Thahaibawi *et al.*, 2019). Auda and Zachery scored 0.72 and 1.0 respectively (AL-Thahaibawi *et al.*, 2015; Abdullah, 2023). Suq Al-Shuyukh and west Hammar marshes

recorded higher values 0.63 and 0.84 (ARDI, 2006; Al-Jabre and Hussain, 2022).East Hammar and Al Shafi marshes registered the highest IDI values ranged from 1.37 to 3.6 A positive relationship existed between alien species numbers and IDI; as the number of alien species increased, the IDI score rose (Table .5).

Table (5). Numbers of native and alien species with IDI (invasive disturbed index) values as calculated from previous studies at southern marshes.

Local Marshes	Number Native species (N)	Number Alien Species (A)	IDI	Reference
Al- Hawaizah	13	7	0.53	ARDI(2006)
Al- Hawaizah	10	3	0.3	Youns *et al.* (2011)
Al- Hawaizah	14	6	0.42	Youns & Al- Shamary (2012)
Al- Hawaizah	11	8	0.72	Al-Thahaibawi *et al.* (2019)
Chybaish	12	8	0.66	Mohamed *et al.* (2012)
Chybaish	13	7	0.54	Al- Shamary (2016)
Auda	11	8	0.72	Al-Thahaibawi *et al.* (2015)
Zachery	9	9	1.0	Abdullah (2023)
Suq Al- Shuyukh	11	7	0.63	ARDI (2006)
West Hammar	13	11	0.84	Al-Jabre&Hussain (2024)
Al- Shafi	8	11	1.37	Abdullah *et al.* (2022)
East Hammar	13	7	0.53	ARDI (2006)
East Hammar	13	18	1.38	Hussain *et al.* (2009)
East Hammar	5	18	3.6	Abdalhsan *et al.* (2020)
East Hammar	5	16	3.2	Mohammed (2024)

8. Relation between IDI scores and salinity values.

Positive relationship seem to be existed between IDI scores and salinity values at southern marshes. As salinity values increase, IDI scores raised especially in west Hammar and also East Hammar marshes (fig.4).

9. Relation between IDI scores and Shannon diversity index values.

Parallel relationship seem to be existed between Shannon diversity index and IDI in Al-Hawaizah, Auda, Zachery, Suq Al- Shuyukh and West Hammar marshes. At Al-Shafi and East Hammar marshes sharp increase in IDI values to be equal to that of Shannon diversity index ,Mainly due to existence of alien species as marine migratory species from Shatt Al Arab estuary (Mohammed, 2024). Positive relationship existed between Shannon diversity index and IDI values at the southern marshes (Fig.5).

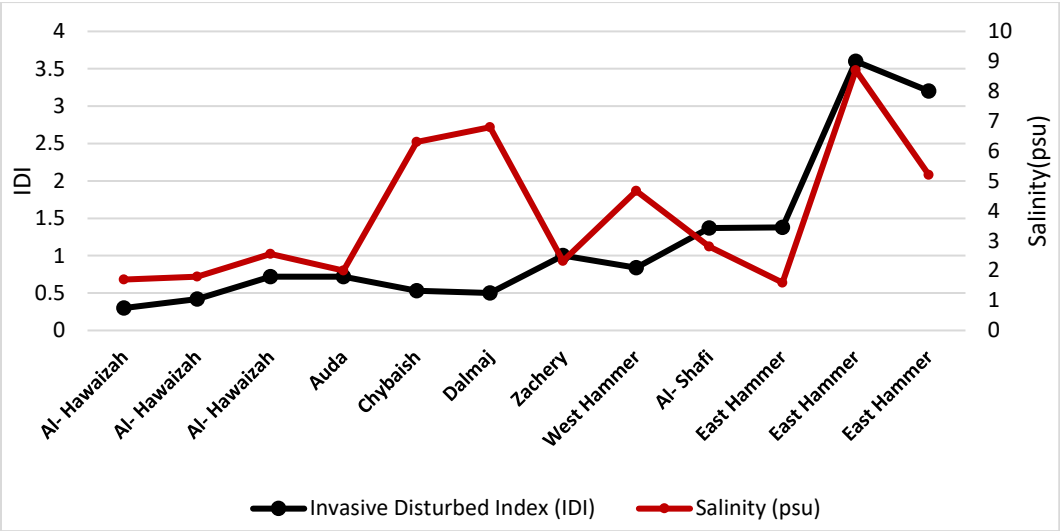


Figure (4): Exhibited the relationship between IDI (invasive disturbance index) scores and salinity values (psu) at the southern marshes.

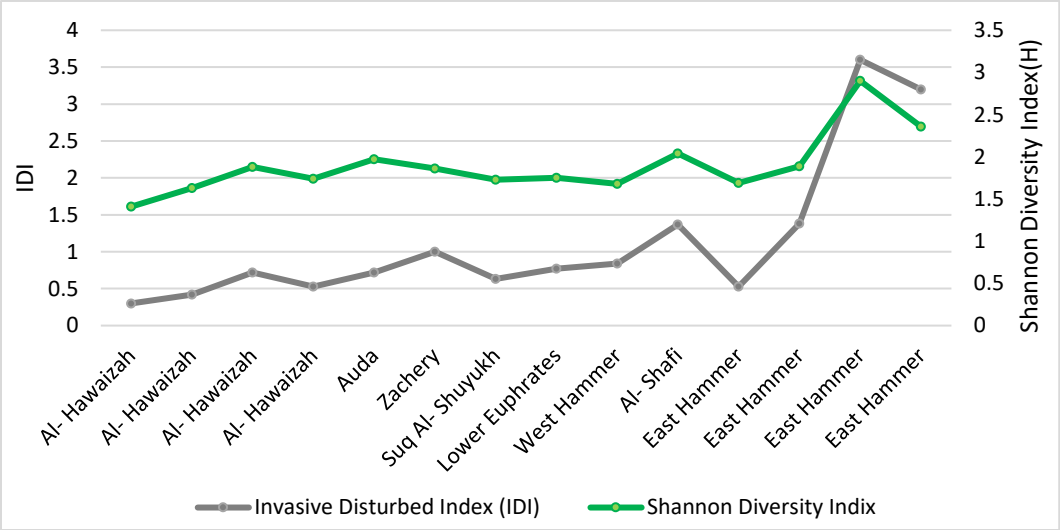


Figure (5): Display the relation between Shannon diversity index and IDI values.

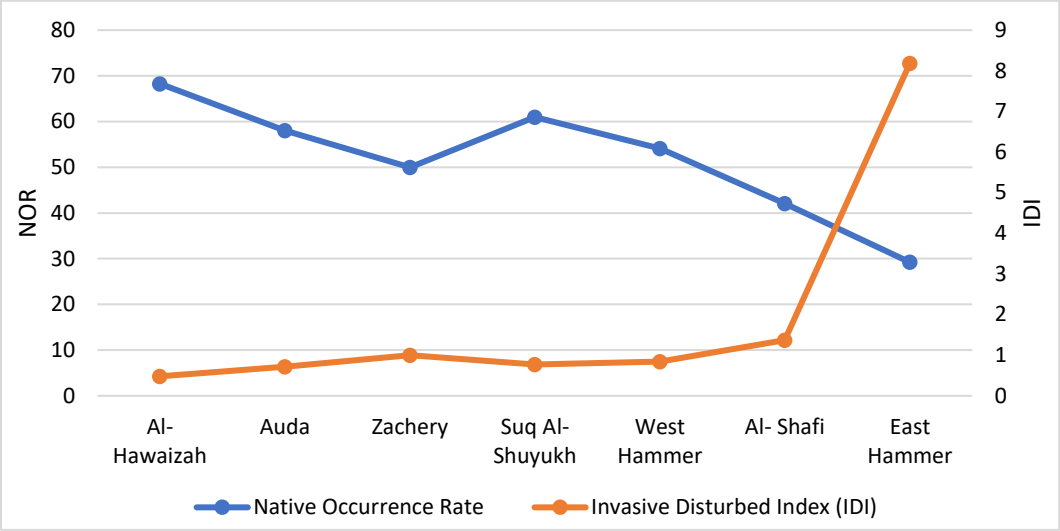
10. NOR values verses IDI scores:

Negative relationship seems to be existed between NOR and IDI scores in the southern marshes. NOR scored high values at Al-Hawaizah, Auda, Zachery, Suq Al-Shuyukh, West Hammar and Al-Shafi marshes. But decrease sharply at East Hammar marsh, due to increase of alien species mainly due to increase in marine migratory species from Shatt al Arab estuary.

NOR values ranged between 68.26 to54.1% which equivalent to moderate disturbance native status .Al-Shafi and East Hammar got lower values 42.1 and 29.2 % respectively, which equal to disturbed and very disturbed. Average IDI values at Al-Hawaizah, Auda,

Zachery, Suq Al-Shuyukh and West Hammer from 0.48 to 0.84. However Al-Shafi and East Hammar achieved higher values 1.37 to 8.18.

Negative relationship seems to be existed between NOR and IDI scores at the southern marshes. Especially at East Hammar marsh, due to increase in alien species mainly marine migratory species from Shatt al Arab estuary (Fig.6).



Figure(6): Display the relation between NOR and IDI values at the southern marshes.

11-Average NOR values and IDI scores at the southern marshes .

Average NOR values ranged between 68.26 to 29.23 at Al- Hawaizah marsh and East Hammar marsh respectively. Disturbance native status varied from moderate at Al-Hawaizah, Auda, Zachery, Chybaish and Suq Al-Shuyukh to disturbed and Very disturbed at Al-Shafi and East Hammar marshes respectively. IDI score varied in southern marshes from 0.48 at Al-Hawaizah to 8.18 at East Hammar marsh (Table, 6).

Table (6): Average values of NOR, disturbance native status and IDI values at the southern marshes.

Local Marshes	Average NOR (NO/TO %)	Disturbance native status	IDI
Al-Hawaizah	68.26	Moderate	0.48
Auda	58%	Moderate	0.72
Zachery	50%	Moderate	1.0
Chybaish	65.5%	Moderate	0.6
Suq Al-Shuyukh	61 %	Moderate	0.77
West Hammar	54.10%	Moderate	0.84
Al-Shafi	42.10%	Disturbed	1.37
East Hammar	29.23	Very disturbed	8.18

Discussion

Previous surveys on constituent of the fish assemblages in the southern marshes indicated that they formed of riverine indigenous native , anadromous and few estuarine species. These species were derived mainly from Tigris, Euphrates rivers and Shatt al Arab estuary. Consequently, all exotic., ornamental and marine occurred in marshes considered as alien invasive species to the pristine habitat of the southern marshes. (Khalaf, 1961; Hussain, 2014).

Southern restored marshes characterized by their high biological productivity (IMRP, 2006). Consequently the southern marshes became an important feeding and nursery ground for native and migratory fishes and birds (Richardson and Hussain, 2006).

The release of many exotic species into southern marshes especially the three exotic Tilapia fish species (*O. niloticus*, *C. zilii* and *O.aureus*) after 2007 was coincided by a steady increase in salinity at southern marshes, which facilitated the thrive of exotic and migratory marine species especially at East Hammar marsh (Mohamed *et al*., 2012). The release of exotic species led to fundamental changes in the nature of the fish assemblages due to the high abundance of alien species replacing the originally dominant native riverine fishes (Hasan and Resen, 2019). Increase occurrence and abundance of alien fish at the southern marshes change the previous natural consistence of the fish assemblage and it is no longer considered as exclusive native ones but mixed of several native and alien species.

Habeeb *et al*. (2023) Indicated that drastic aquatic habitat changes such as sharp salinity increase in southern marshes, induce significant changes in the productivity pattern, availability of food resource and aquatic biota densities. These changes were in favor of exotic and marine migratory species, Consequently altered the constituent of the fish assemblage through the departure of native riverine from southern marshes like what happened in East Hammar marsh during 2018 (Abdullah *et al*., 2017; Richardson and Hussain, 2006).

Major threat facing the southern marshes through in continuous decrease in fresh water inflow from Tigris, Euphrates and Shatt Al Arab rivers. Led to steady increased in salinity at southern marshes after inundation in 2003, altered the aquatic environment from oligohaline to mesohaline, resulted in disappearance of many sensitive native fish like Kattan (*Luciobarbus xanthopterus)*, Shaboot *(Arabibarbus grypus)* and Benny (*Mesopotamichthys sharpeyi*), since these species are strictly freshwater and unable to tolerate mesohaline habitat (Abdalhsan, 2019). Moreover, alien species exploited the mesohaline environment to thrive in the marshes and exerted fierce competition on available food resources especially the three aggressive Tilapia fish species. Exotic African Tilapia species were known to tolerate harsh environment conditions (Vicente and Fonseca, 2013). Accordingly, a gradual decrease in occurrence and abundance of native species due to increase in salinity and the thrive of alien fish.

Pronounced effect of rising salinity on composition of fish assemblages at the local southern marshes. Increased salinity led to decreased number of native species in most

local marshes and the worse were at intertidal marshes of Basrah province. Non tidal southern marshes showed higher NOR (Native occurrence ratios) and lower alien ones. However tidal marshes (Al-Shafi and East Hammar marshes) showed the opposite of higher alien occurrence score. Low salinity values at Al-Hawaizah, Chybaish, Auda, Suq Al-Shuyukh and West Hammar accompanied with higher native occurrence score. As salinity increased led to decrease in native occurrence score and increase in alien existence as happened in Al-Shafi and East Hammer marshes.

Local marshes situated at the middle and southern Iraqi provinces acquired higher native occurrence and abundance ratios in comparison with Al-Shafi and East Hammar marshes at Basra Province. Moreover local marshes situated at Tigris river axis exhibited better native occurrence scores, in comparison with that on Euphrates and the worse at Shatt Al-Arab River.

Both NOR and IDI formulas estimated the average disturbance values of occurrence of native and alien species. But these two indices describe opposite values. Since the first measure number of native species and the second sum numbers of invader (alien) ones. NOR and IDI aims were similar ,the first estimated the number of native species ratio, while the second counting number of invader (alien) species ratio in fish assemblages. The two formulas have the same goal to estimate the degree of disturbance in original fish assemblages. Lower values of IDI obtained at the local marshes at middle ,western and southern provinces due to presence of exotic species, whereby marshes at Basrah province get higher values due to occurrence of exotic and estuarine migratory species from Shatt Al- Arab estuary. NOR express positive relationship seem to be existed between numbers of native species and diverse with alien species ratio.

The high presence of alien species illustrated their actual existence more than temporary occurrence with few or limited number of individuals. Karr *et al.* (1986) stated that the increase in number of alien species in river indicated to the increase in environmental disturbance of that water body.

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نسبة التواجد والوفرة للأنواع الدخيلة مقابل الأنواع المحلية في تجمعات الأسماك في أهوار جنوب العراق.

نجاح عبود حسين، اسراء عزيز محمد

1أستاذ متمرس، قسم علم البيئة، كلية العلوم، جامعة البصرة، العراق
2 قسم علم البيئة، كلية العلوم، جامعة البصرة، العراق
Corresponding Author E-mail: pgs.asraa.aziz@uobasrah.edu.iq

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المستخلص

حسبت درجة الاضطراب في تجمعات الأسماك في أهوار جنوب العراق نوعيا و كميًا على أساس نسبة وفرة الأنواع المحلية حددت (NOR&NAR) الكلي إلى إجمالي عدد الأنواع والأفراد خلال الفترة من 2006 إلى2024تراوحت درجات حالة الاضطراب في أهوار الحويزة، وعودة، وجبايش، وزكري، ودلمج، وغرب الحمّار وسوق الشيوخ بين 50-77%، وهو ما يعادل متوسطًا وجيدًا في مقياس حالة الاضطراب. تُظهر أهوار الشافي وشرق الحمّار نسبة وجود أقل للأنواع المحلية تتراوح بين 24-42%، وهو ما يعادل حالة مضطربة إلى مضطربة جدًا. تراوح عدد الأنواع بين 3 و 11 سُجلت أعلى نسبة تواجد للأنواع المحلية لغريبة مع الملوحة المنخفضة في الحويزة، وجيايش، وعودة، وغرب الحمّار وكانت الحالة المعاكسة في أهوار الشافي وشرق الحمّار، تُظهر قيم مؤشر الاضطراب الغازي حيث سيطرت الأنواع الدخيلة. علاقة (IDI) سلبية مع عدد الأنواع المحلية وعلاقة إيجابية مع نسبة الأنواع الدخيلة في الأهوار الجنوبية. كانت درجة IDI منخفضة في أهوار الحويزة، وعودة، وزكري، وسوق الشيوخ، وغرب الحمّار، حيث تراوحت من 0.3 إلى 1.0. على النقيض من ذلك، سجل أهوار شرق الحمّار والشافي أعلى قيم IDI، حيث تراوحت من 1.37 إلى 3.6. استوطنت الأنواع الدخيلة بنجاح في الأهوار الجنوبية خلال فترة قصيرة نسبيًا. فقدت الأنواع النهرية المحلية هيمنتها لصالح الأنواع الدخيلة، خاصة في أهوار الشافي وشرق الحمّار. لوحظ انخفاض تدريجي في تواجد ووفرة الأنواع المحلية في الأهوار الجنوبية بسبب زيادة الملوحة. يبدو أن الأنواع الدخيلة قد غزت جميع الأهوار الجنوبية العراقية. كما سُجلت أعلى نسبة اضطراب في هور شرق الحمّار

الكلمات المفتاحية: أهوار العراق، أهوار بلاد ما بين النهرين، الأنواع الدخيلة في الأهوار، ألاسماك الغريبة في الأراضي الرطبة، ألاسماك المحلية في الأهوار.