ISSN: 0067-2904

Fish Assemblage and Impact of Oscillation Between Drowning and Drought on Fish Size-Spectrum in the Al-Chibyaish Marsh, Southern Iraq

Abdul Hussein Jaafer Abdullah
Department of Marine Vertebrate, Marine Science Center, University of Basra, Basra, Iraq

Abstract

The present study was implemented in the period from January to December 2017, to assess the assemblage of fish, with the effects of some environmental factors and knowledge the impacts of annual periodic fluctuations between drowning and drought on the abundance and size-spectrum on the fish community in Al-Cibyaish marsh. Water temperature ranged between 13°C in January to 35°C in July, salinity from 2.90 PSU (Practical salinity unite) in February to 4.14 PSU in August. Hydrogen ion ranged between 7.60 in July to 8.30 in February. The present study appears contribution of environmental variables in the distribution, widespread and occurrence of fish assemblage in the Al-Chibyaish marsh. A total of 3294 specimens were collected represented 15 fish species affiliated to 15 genera, six families and five orders. Three fish species in present area were formed 72.38% of the total number of species in the marsh. *Planiliza abu* was the most abundant species formed 35.43%, *Alburnus mossulensis*, 19.22% and *Oreochromis aureus*, 17.73%. The ecological indices were within the range of previous studies and described as poor for diversity index ranged between1.38 in June to 1.96 in November. Richness index fluctuated from 0.96 in May and July to 1.96 in April and can express as half integrated. The evenness index values ranged from 0.68 in September to 0.85 in November and December indicate to semi-balanced or slightly balanced. Fish size revealed dominance of the small size due to high mortality in the dry season. The present study affirms prevalence and dominates of historical small native species *P. abu* and some of the small invasive species, which possess various functional characteristics, enable it to inhabit the marsh.

Keywords: Fish assemblage, Chibyaish marsh, drowning, drought, Southern Iraq.

التجمع السمكي وتأثير التذبذب بين الاغمار والجفاف على تردد أحجام الاسماك في أهوار الجبايش جنوبي العراق

عبد الحسين جعفر عبد الله

قسم الفقريات البحرية ، مركز علوم البحار ، جامعة البصرة، البصرة، العراق

الخلاصة

أُجريت الدراسة الحالية للمدة من كانون الثاني الى كانون الاول 2017 لتقيم التجمع السمكي، مع تاثير بعض العوامل البيئية ومعرفة بعض تأثيرات التذبذب السنوي الدوري بين الاغمار والجفاف على وفرة وتردد أحجام الاسماك في مجتمع الاسماك في هور الجبايش. تراوحت درجة الحرارة بين 13 °م في شهر كانون الثاني إلى 35 °م في في شهر تموز، والملوحة من 2.90 PSU (وحدة ملوحة عملية) في شهر شباط الى 4.14 PSU في آب. تراوح الاس الهيدروجيني بين 7.60 في شهر تموز الى 8.30 في شهر شباط. أظهرت الدراسة الحالية أسهام المتغيرات البيئية في توزيع وانتشار وتواجد التجمع السمكي في هور الجبايش.

*Email: abdalhussin112@yahoo.com

جمع 3294 نموذجاً مثلت 15 نوعاً من الاسماك تنتمي الى 15 جنساً وست عوائل وخمسة رتب. شكلت ثلاثة انواع 72.38% من العدد الكلي للانواع في هور الجبايش. كان النوع *Planiliza abu* الاكثر وفرة وشكل 35.43% وشكلَ النوع *Alburnus mossulensis* 19.22% والنوع *Oreochromis aureus* 17.73%. كانت قيم الادلة البيئية ضمن نتائج الدراسات السابقة ووصفت بانها فقيرة لقيم دليل التنوع Diversity Index وتراوحت بين 1.38 في شهر حزيران و 1.96 في شهر تشرين الثاني. تراوح دليل الغنى Richness index بين 0.96 في شهر آيار وتموز الى 1.96 في نيسان ويمكن ان يعبر عنه بالنصف متكامل. تراوح دليل التكافؤ Evenness index بين 0.68 في أيلول الى 0.85 في شهر تشرين الثاني وكانون الاول ويشير الى شبه متوازن او متوازن قليلاً. يبين حجم الاسماك هيمنة الاحجام الصغيرة تبعاً للهلاكات العالية التي يتعرض لها في وقت الجفاف. أكدت الدراسة انتشار وهيمنة النوع التاريخي المحلي الصغير *P. abu* وبعض الانواع الصغيرة الدخيلة التي تمتلك خصائص وظيفية متنوعة تمكنها من البقاء في الهور.

Introduction

The southern Iraqi marshes sit in the middle of extensive floodplains originated by Tigris and Euphrates rivers system in the lower Mesopotamian basin; it's the largest wetland in southwest Asia occupied more than 15000 km^2 approximately, covering 44% of freshwater bodies in Iraq [1, 2]. These wetlands represented the most reproductive habitats; provide many benefits to local communities [3]. The marshes in the south of Iraq play very vital role in water filtering from various pollutant, biodiversity resources, a tourist and recreational place, possesses social and economic values. Marshes are considerable fisheries associate the marine fisheries that gave it an international dimensions support to it listed in the world heritage list, as well as a good ecosystems, include of many unique species of fish, plant, invertebrates, birds, and stations for migrating birds in flyway from Siberia to Africa [4]. Marshes are a unique ecosystem formed as natural refuge for many fish species, birds and aquatic invertebrate. The habitats features, hydrological and physiochemical properties creating high richness, biodiversity and productivity. Marshes were most important areas for breeding and wintering fishes and waterfowl species populations. The extents of marshlands were highly dynamic ecosystem due to the deeply linked in water levels effluent from melting of snow water during the spring [5, 6].

Since the 1980s, large parts of marshes have suffered from drought due to the construction of many dams on the heads of Tigris and Euphrates rivers and dried up during the 1990s, after the inundation in 2003, the problems continued due to decrease of water levels and deterioration of water quality [6, 7].

Fish size-spectrum use as evident indicator of a healthy environment, hence the parameters point to fish size propagation of wild fish populations frequently employ to evaluating the state of fish communities to helpful in management of fisheries widely in the world [8, 9]. Fish size in many countries use as tool in ecosystem assessments and a measure of the exposure of fisheries to fishing pressure that makes large size of fish more susceptible to removing and environmental stressors such as high temperature and annual fluctuations between drought and drowning, which reduces the number and length of fish [10, 11].

Several studies have been conducted on southern marshes after drowning in 2003focused on nature of fish assemblage [12- 18, 6].

Another studies deal with plant and phytoplankton populations before [19] and after desiccation [20].

The objectives of the present study is to assess fish assemblage, with effects of some environmental factors and the impact the periodic annual fluctuated between drowning and drought on fish abundance and fish size-spectrum in Al-Chibyaish marshes.

Materials and methods

Description of study area

The central marshes in southern Iraq are the largest natural wetland in southwest Asia bordering by Missan province and Thiqar province from the west and Al-Basrah province from the southeast (Figure-1). These marshes received the waters from Tigris River across of Shatt Al-Muamuna and Al-Magar Al-Kabir covered about 3000 km^2 and extend to 4000 km^2 in the flood season. The water sources that feed the Al-Chibyaish marsh were affected by the creation of the Al-Ezz River, which

collects the waters of the Tigris River branches and converts it into the Euphrates River away from the marsh [6, 18].

The study was performed in the southwest Al-Chibyaish marsh N30º 56́ 22̋ E 47˚ 06́ 014̋ in Abu-Chullana region 6 km south of Al-Chibyaish town. The location of the study area was determined by GPS made in Garmin Company Taiwan.

The total length (cm) and weight (g) of each specimen were measured by digital scale SF-400 manufactured in China. The samples of fishes were monthly collected from the area from January to December 2017. Two fishing methods were used to collect the fishes, electrofishing by generator engine (500V, 10A) and fixed nets (30 to 40m) length (19 to 45mm mesh size). Fish species identified due to [21, 22]. The environmental factors were measured coincidence with the sampling process; water temperature (℃) was measured by a mercurial thermometer, salinity (PSU) and pH by Lovibond-Sensor Direct 150 Germany manufactured. The assemblage of fishes analyzed with the following:

Relative abundance % = $(n_i / N)* 100$ due to [23]

ni: represented number of individuals of the species N: Total number of individuals of all species.

Fish diversity $H = - \sum Pi \ln pi$ [24]

H: diversity index P_i: a proportion of species individuals in the sample

Richness index $D= S-1/\ln N$ ……. [25]

D: richness index S: number of species N: Total number of individuals

Evenness index $J= H/\ln s$ …… [26]

J: evenness index H: diversity index S: number of species

The important economic fish species divided into length groups to determine length frequency of each length group versus the number of fish as diagrams.

Occurrence of species due to [27] as the following:

Common species that found in monthly catch samples from 9 to12 months. Seasonal species appeared in the monthly catch samples from 6 to 8 months. Occasional fish species catch from one to 5 months.

The statistical analysis for correlation relationships was implemented by SPSS version 20. Canonical correspondences Analyses (CCA). Program to analyses the relationships between the environmental factor and number of fish species and individuals in the present work area.

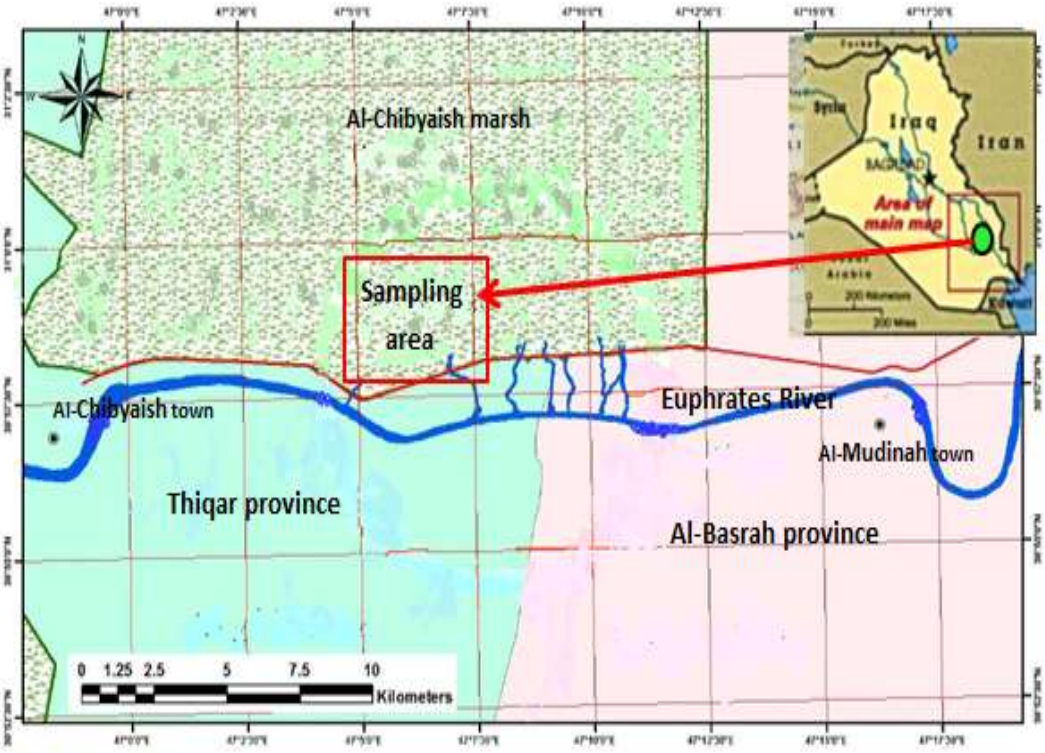

Figure 1- Map of the study area in Al-Chibyaish marsh southern Iraq

Results and discussion

Environmental factors

The lowest water temperature in Al-Chibyaish marsh was 13℃ in January 2017 and the highest 35℃ in July. The climate in south of Iraq nearest to subtropical characterized by two discriminative seasons, short temperate winter and long very hot summer with very short spring and autumn, temperatures in summer season exceed than 50 ° C**,** also water temperature rise to limits creating thermal stress on the aquatic organisms especially in shallow regions including fishes that perhaps forced to leave to the deep cold water or die, so temperature plying vital role in spatial distribution and behavior of fish [28, 29]. Temperature contributes in the distribution of fish assemblage horizontal and vertical in the water habitats [30, 31].

The salinity was 2.90 PSU in February to 4.14 PSU in August, the present results show that concentrations of salinity were monthly variable due to temperature rise and quantities of falling rain, however, the scarcity or absence of sensitive freshwater species was evident indicator on the influence of salinity in abundance and distribution of fish in Al-Chibyaish marsh [32, 33].

The values of pH fluctuated between 7.60 in July and August to 8.30 in February (Figure-2). However the high density presence of vegetation in the hot months in the marsh decrease the base ion in the water due to consumption of carbon dioxide in photosynthesis from the water leading to an increase in water pH values, generally Iraqi rivers waters tend to be to the basic direction that suitable for a fish living, these consistent with [34, 35]. pH values relatively inclined towards the base direction, on account of increasing ratio of carbonate and bicarbonate in the soil of the bottom, this is consistent with most studies in this field that implemented in Iraqi waters [36, 7].

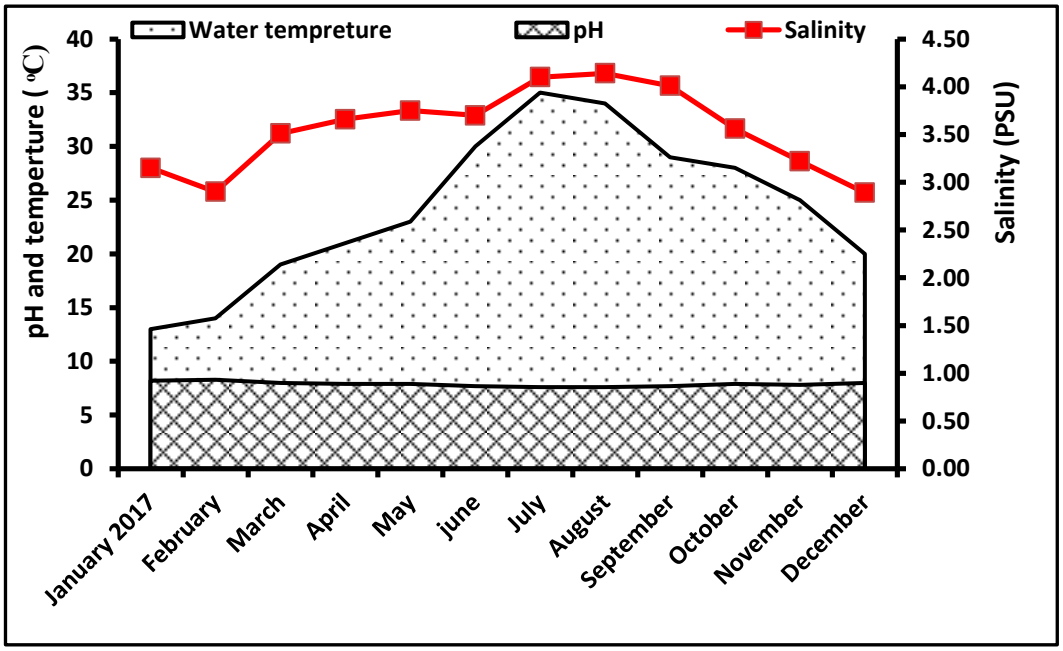

Figure 2- The monthly variations in the environmental factors in Al-Chibyish marsh from January to December 2017

The correlation relationships (r) between the number of species and individuals stabilized as correlation coefficient value (r). Weak negative correlations (r= - 0. 130), (r= - 0.332), were observed between the temperature and number of species and individuals, respectively in Al-Chibyaish marsh. Very weak positive correlation (r= 0.077) was shown between a number of species and salinity and negative weak correlation (r=−0.198), showed between the number of individuals and salinity.

The study revealed a positive correlation between the number of individuals and pH, with a reverse relationship between temperature and salinity, whereas a positive correlation was found between the number of species, temperature and salinity with negative correlation with pH, the present diagram shows that the temperature and pH factors mainly are more influential in the environment of fish

assemblage in the present study area (Figure-3)

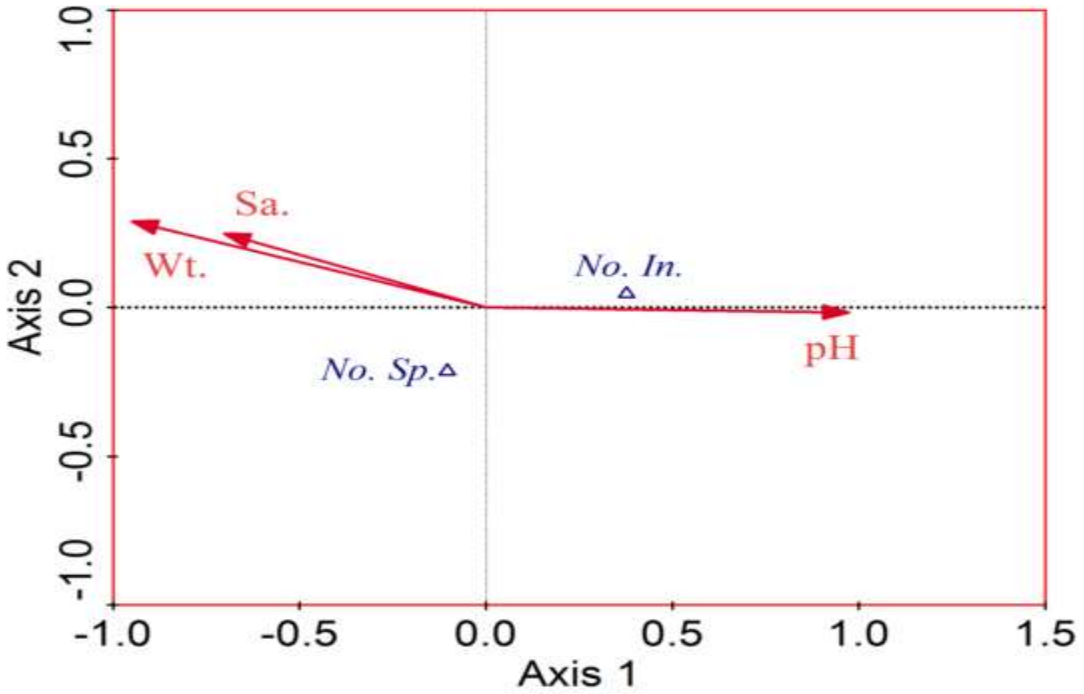

Figure 3- CCA diagram illustration influence of temperature, salinity, and pH on the number of species and individuals in the assemblage of fish in Al-Chibyaish marsh. Wt.: Water temperature, Sa: Salinity, pH: Hydrogen ion.

Fish species composition

Number of species and individuals

A total of 3294 individuals comprising 15 fish species of fish represented 15 genera and six families included five orders were caught from the study area, nine of which belonging to Cyprinidae, all of them were freshwater species, six fish species were alien, all of them affiliate to Osteichthyes (Table-1). The lowest numbers of species were six fish species caught in July and December, while the highest12 fish species caught in April.

Wide monthly variations in the number of individuals were observed in Al-Chibyaish marsh represented by 3294 specimens ranged between 106 in August to 533 individuals in February and May (Figure-4).

The present results refers to occurrence of 15 fish species in Al-Chibyaish marsh most of them belonging to Cyprinidae, the present finding close to the results of most of the previous studies that conducted on Al-Chibyaish marsh after the drowning in 2003 [6], collected 14 fish species [2], recorded 14 fish species.

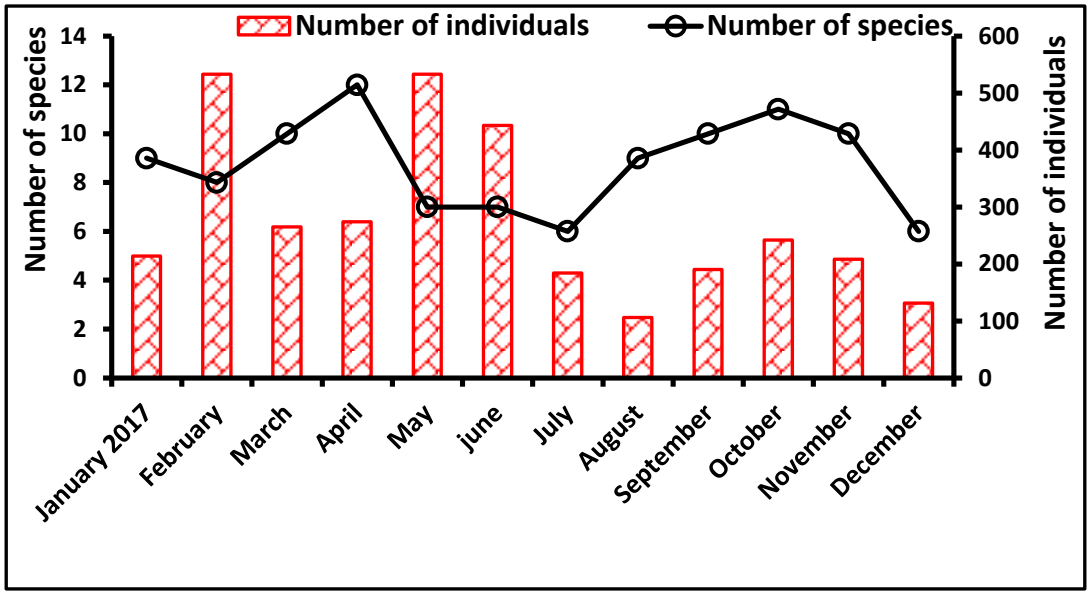

Figure 4- Monthly variations in the number of species and individuals in Al-Chibyaish marsh
Relative abundance

Three species presiding the relative abundance formed 72.37% of the total number of species in Al-Chibyaish marsh in the study period from January to December 2017, *Planiliza abu* 35.43%, *Alburnus mossulensis* 19.22% and *Oreochromis aureus* 17.73%. The alien fish species were six composed 37.64% of the total caught. Cyprinidae the most dominance family comprise 37.92%, including nine fish species, Mugilidae 35.43% represented by *P. abu* and Cichlidae 24.07% contain two fish species *O. aureus* and *Coptodon zillii* (Table-1).

The Cypriniformes order included nine species, Perciformes and Siluriformes represented by two fish species of each order. The order Mugiliformes one fish species and Synbranchiformes participate in one fish species [37], pointed that wetlands periodically exposed to the seasonal hydrological changes, represented by drought in summer months and fluctuated between drowning and drought in the other months. The low water incoming discharge and increase of evaporation process in summer season lead to dryness of the most parts of the marsh, except some of the feeding deep rivers that are come from the Euphrates River and deep ponds, these conditions create large reduction in fish populations density (abundance) and small size-spectrum as consequence from growth of new generations of species populations, due to periodic annually dehydration, that marsh subjected, mainly in hot month due to the decline in water level cause high mortality in fish species [38, 39], so the fish populations face to mortality in dry season, reflect the status of hydrological situation in the wetland, the present results close to [37, 40].

The local native species *P. abu* most abundant species in the present study area, characterized by small size as adaptation to difficult conditions evolve strategies that enable it to stay in isolated, overcrowded, low-oxygen ponds in dry seasons and high temperatures, particularly feeding strategies that based on available of organic detritus available at the bottom [2].

[22], mentioned that is the native species *A. mossulensis* most abundant species in the marshes southern Iraq, and the most dominant species in the Tharthar, Habbaniah, and Razzah leaks, formed 10% of total catch, this consort with the present result in Al-Chibyaish marsh when the present study found the species in the second rank of abundant constitute 19.22% of the total number of species.

The invasion species *O. aureus* have feature enable the species from wide spread and distribution in the new habitats, additional to own unique reproductive strategic provides protection and parental care and have a high tolerance for difficult conditions [41, 7].

Table 1- Fish species, families, orders with the relative abundance in Al-Chibyaish marsh from January to December 2017

Species	%	Family	%	Order
Carassius gibelio [x]	**11.54**	**Cyprinidae**	**37.92**	**Cypriniformes**
Carasobarbus luteus	**2.82**			
Leuciscus vorax	**1.55**			
Cyprinus carpio [x]	**1.67**			
Alburnus mossulensis	**19.22**			
Acanthobrama marmid	**0.58**			
Hemiculter leucisculus [x]	**0.27**			
Mesopotamichthys sharpeyi	**0.21**			
Cyprinon kais	**0.06**			
Coptodon zillii [x]	**6.34**	**Cichlidae**	**24.07**	**Percifomes**
Oreochromis aureus [x]	**17.73**			
Planiliza abu	**35.43**	**Mugilidae**	**35.43**	**Mugiliformes**
Silurus triostegus	**2.40**	**Siluridae**	**2.40**	**Siluriformes**
Heteropneustes fossilis [x]	**0.09**	**Heteropneuetidae**	**0.09**	
Mastacembelus mastacembelus	**0.09**	**Mastacembelidae**	**0.09**	**Synbranchiformes**

[x] **Alien fish species**

Ecological indices

The monthly values of ecological indices in Al-Chibyaish marsh revealed large variations from January to December 2017. Diversity index values fluctuated between 1.38 in June to 1.96 in November. Richness index ranged from 0.96 in May and July to 1.96 in April, while evenness index values differ from 0.68 in September to 0.85 in November and December (Figure-5). The values of diversity index were described as poor, while richness index, tend toward half integrated. The values of evenness index refer to semi-balanced or slightly balanced, these consequences of ecological indices correspondence with trends of the previous studies that implemented on Al-Chibyaish marsh and vicinity regions [3, 6, 7].

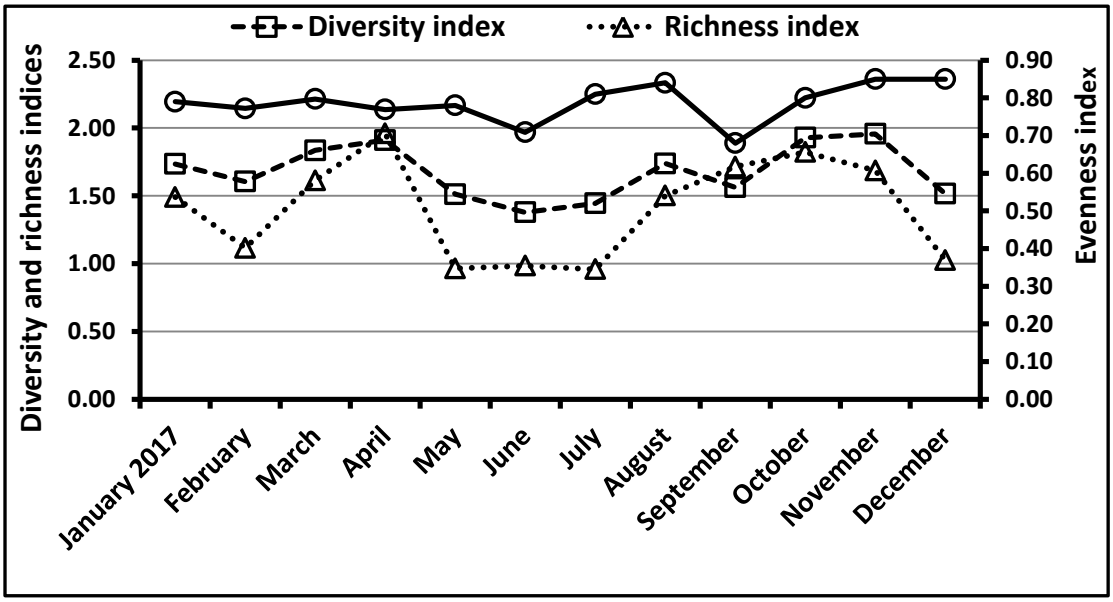

Figure 5- Monthly variations in ecological indices in Al-Chibyaish marsh from January to December 2017

Fish size -spectrum

The inserted charts illustrated length frequency of fishes (fish size) versus the fish number of important economic fishes in Al-Chibyaish marsh. The species *P. abu* appeared in the catch samples over the year, the prevailing size was 11 cm, the size ranged between 4 to 19 cm total lengths (TL). *Carassius gibelio* found in the fishing samples around the year except September, the length group 13 cm was the most dominant size which ranged from 9 to 26 cm TL. *Carasobarbus letus* recorded in ten months and disappeared in January and August, the dominant length group was 12 cm TL, ranged between 9 to 24 cm. The species *Leuciscus vorax* present in caught samples in nine months and missed in fishing samples in February, May, and July, the dominant length group 19 cm TL, fluctuated between 13 to34 cm TL. *Silurus triostegus* catch in eight months in Al-Chibyish marsh, 27 cm TL was the most dominant the length group, ranging from 19 to 41 TL. *Cyprinus carpio* appeared in eight months, the length group 14 cm the most dominant, length groups different from 9 to 27 cm (Figure-6). The water level fluctuation in the wetland causes the extermination for all generations of occurrence species in a dry period except some of the individuals that live in the deep rivers that penetrate inside the marsh and deep ponds. After an inundation, some of the species that entered the marsh started to reproductive creating new offspring of fishes characterized by small size and low abundance causing a large variation in fish size-spectrum of fish communities [42, 37]. Generally, the present work agrees with [13, 6, 2], in a coexistence of common, seasonal and occasional species in Al-Chibyaish marsh.

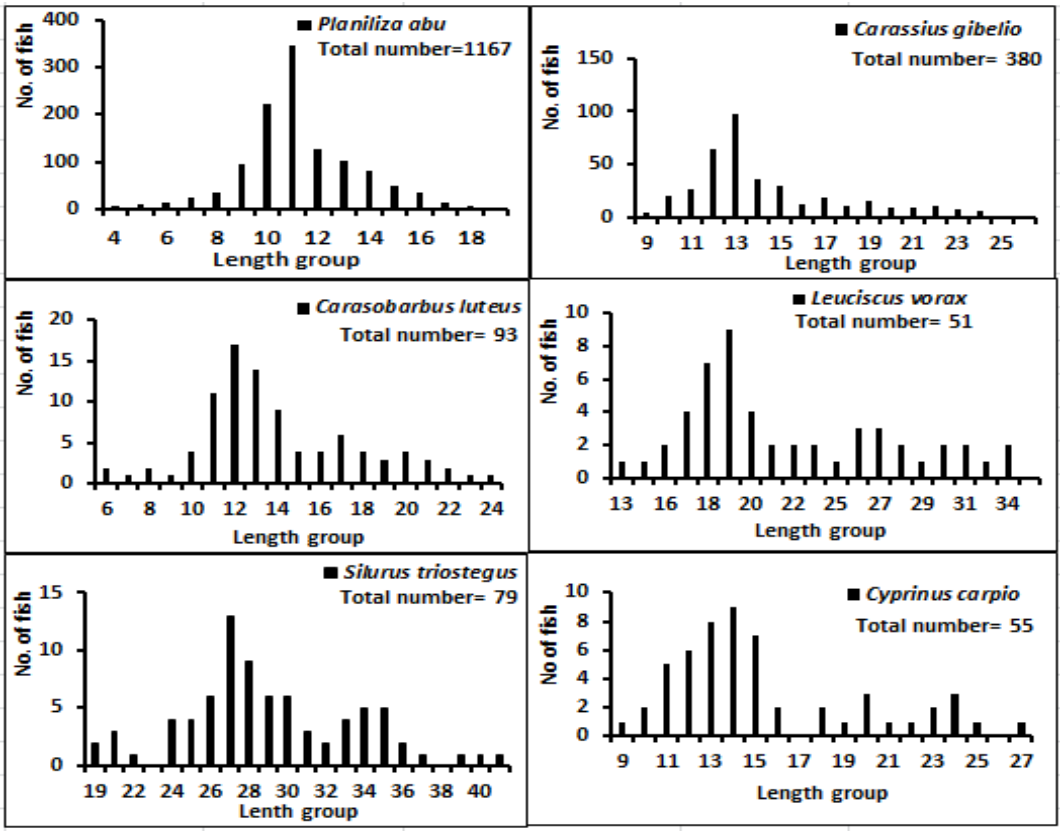

Figure 6- Distribution of length groups of the important economic fish species in Al-Chibyaish marsh from January to December 2017

Occurrence of species

The fishes in Al-Chibyaish marsh splits into three categories due to the monthly occurrence (Table-2). The common fish species comprise from six fish species, two of which *P. abu* and *O. aureus* appear in 12 months, two species *C. gibelio* and *A. mossulensis* catch in 11 months and two species *C. luteus* and *L. vorax* in nine months. Seasonal fish species included three fish species *C. carpio*, *C. zillii* and *S. triostegus* caught in eight months.

Table 2- The occurrence of fish species in Al-Chibyaish marsh from January to December 2017

	Species	Months of occurrence	No of species
Common fish species	***Planiliza abu, Oreochromis aureus***	**12**	**2**
	Carassius gibelio, Alburnus mossulensis	**11**	**2**
	Carasobarbus luteus, Leuciscus vorax	**9**	**2**
Seasonal species	***Cyprinus carpio,Coptodon zillii, Silurus triostegus***	**8**	**3**
Occasional species	***Mesopotamichthys sharpeyi***	**4**	**1**
	Heteropneustes fossilis	**3**	**1**
	Acanthobrama marmid, Hemiculter leucisculus	**2**	**2**
	Mastacembelus mastacembelus, Cyprinon kais	**1**	**2**

The occasional fish species consist of six species, *Mesopotamichthys sharpeyi* catch in four months, *Heteropneustes fossilis* catch in three months. Two species *Acanthobrama marmid* and *Hemiculter leucisculus* found in the samples in two months and two species *Mastacembelus mastacembelus* and *Cyprinon kais* in recorded in one month.

The common fish species formed 88.28% of the total number of species caught in

Al-Chibyaish marsh. Seasonal fish species compose 10. 41% of the total catch in the present study, while the occasional species take part in 1.31% of the total number of species (Figure-7)

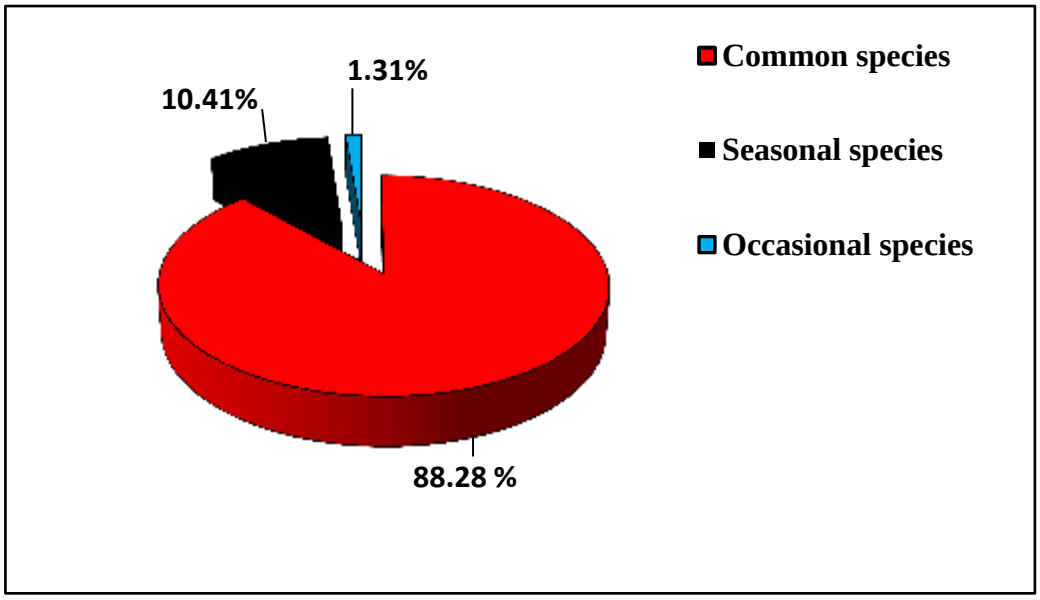

Figure 7- The ratio of species occurrence in Al-Chibyaish marsh from January to December 2017.

[6], recorded eight resident species four species in 12 months and four in ten months, these result nearly resemblance the present finding two in 12 months (*P. abu, O. aureus*), two in 11 months (*C. gibelio, A. mossulensis*) and two in nine months (*C. luteus, L. vorax*).

Conclusions

The present study shows dominance the historical native resident species that possess various functional features such as small body size, high tolerance for high temperature, low oxygen concentrations and high fecundity, with available their food as well as the some of the invasive species that have more functional traits enable it to spread in new habitats.

Acknowledgment

The author thankful Department of marine vertebrate, Marine science center, University of Basrah to offering all facilities to complete the work.

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