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Growth and Exploitation Rates of Four Cyprinids Fish in Al-Diwaniya River, Iraq

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Abstract: *The growth, mortality and exploitation rates of cyprinids fish, Carasobarbus luteus, Arabibarbus grypus, Mesopotamichthys sharpeyi, Luciobarbus xanthopterus and Leuciscus vorax in Al-Diwaniya River, middle of Iraq were assessed from November 2016 to October 2017. Sampling was carried out by using four types of fishing gears. The relative abundance of these species were 10.1, 6.4, 6.3, 5.6 and 5.1% of the total catch, respectively. Growth patterns were allometric according to the length-weight relationships for all species. Asymptotic lengths($L\infty$) were 35, 58, 61, 73 and 56 cm for C. luteus, L. vorax, A. grypus, L. xanthopterus and M. sharpeyi, respectively. The lowest value of the growth performance index(Φ) was 2.53 for C. luteus and the highest one was 3.13 for A. grypus. Analysis of mortality using length-based cohort analysis gave fishing mortality rates greatly higher than the natural mortality rates for all species. It could be concluded that all studied fish populations in the river were under heavy fishing pressure. Therefore, it is necessary to impose fishing (exploitation) regulation by activating the national law of fishing, exploiting and protecting aquatic resources.*

Key Words: *Cyprinids, growth, exploitation, Al-Diwaniya River, Iraq*

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I. Introduction

Cyprinidae is the largest and most diverse fish family and the largest vertebrate animal family in general, represented by 3959 species of which only 1,716 remain extant, divided into about 280 genera (Fricke *et al.,* 2019). It is native to North America, Africa and Eurasia, and consider the most important and widespread family of fish in the freshwater systems of Iraq, ca. 72% of native fish (Coad, 2010). A major element of Iraqi inland commercial species include *Carasobarbus luteus, Arabibarbus grypus, Mesopotamichthys sharpeyi, Luciobarbus xanthopterus* and *Leuciscus vorax* belonging to this family.

The himri barbal, *C. luteus* (Heckel, 1843) is a cyprinid that is endemic and widely distributed in the Mesopotamian, both lotic and lentic habitats in Turkey, Syria, Iraq and Iran (Coad, 2010). Several works have been done on the growth rate of *C. luteus* at different localities in these countries (Barak and Mohamed, 1983; Al-Rudainy*et al*., 2002a; Al Hazzaa, 2005; Gökçek and Akyurt, 2008; Mohamed *et al*., 2010; Al-Amari*et al*., 2012; Baboli and Sayahi, 2014; Eydizadeh*, et al*., 2014; Bilici*et al*., 2017). Also, there are some studies in Iraq and Iran freshwaters that were carried out to attain information on exploitation rate of *C. luteus* (Al-Rudainy and Al-Nasri, 2004; Mohamed *et al*., 2006; Eydizadeh *et al*., 2013; Mohamed, 2014; Mohamed *et al*., 2016).

The Shabbot, *A. grypus* (Heckel, 1843) belongs to Cyprinidae which inhabits the rivers, lakes, dams and marshes of the Mesopotamian basin and its tributaries in Turkey, Syria, Iraq and Iran (Coad, 2010). The growth of *A. grypus*h as been studied by several scientists in these countries, such as Ahmed (1974), Al-Hakim(1976), Al-Hakim *et al.,*(1981), Bawazeer (1981), Szypula *et al.*(2001), Mohamed *et al*. (2005), Oymak*et al*. (2008). Hussain *et al*.(2012) and Keivany and Faradonbe (2016). Other studies on the mortality and exploitation rates of *A. grypus* were conducted in Euphrates river, Iraq (Al-Rudaini *et al*., 2007) and in Karoon river, Iran (Hashemi and Mortazavi, 2011).

The Shillig, *Leuciscus vorax* (Heckel, 1843) is a native cyprinid inhabits along the Euphrates and Tigris Rivers and and adjacent drainage basins in Turkey, Syria, Iraq and Iran (Beckman, 1962; Coad, 2010). Some studies about growth rate of this species in different waters have been reported (Shafi and Jasim, 1982; Szypula *et al.,* 2001; Hashemi *et al*., 2013; Oymake *et al*., 2011; Al-Saleh, *et al.,* 2012; Duman and Gűl, 2013; Khaddara, 2014; Mohamed *et al.,* 2017). Few works have been published on exploitation rate of the species in Iraqi and Turkish waters (Abbas and Al-Rudainy, 2006; Duman and Gűl, 2013; Mutlak *et al*., 2017).

The Gattan, *Luciobarbus xanthopterus* (Heckel, 1843) is a commercially important and distinctive wild riverine cyprinid in Tigris and Euphrates system and adjacent drainage basins in Turkey (Ciçek *et al*., 2015), Iraq (Coad, 2010) and Iran (Coad, 1998). Some studies about growth rate of this species in Iraqi waters have been done (Bawazeer, 1981; Abu Alhana and Al-Rudainy*,* 2000; Al-Rudainy *et al*., 2002b) and about exploitation rate (Al-Nasiri *et al.*, 2004; Mohamed *et al.,* 2005; Abbas and Al-Rudainy, 2007).

The Bunnei, *M. sharpeyi* (Heckel, 1843) is a native and highly commercial cyprinid species inhabitıng the rivers, lakes, dams and marshes of Euphrates-Tigris and adjacent drainage basins in Turkey, Syria, Iraq and Iran (Beckman, 1962; Coad, 2010; Ciçek *et al*., 2015). Some works have been done on the growth rate of *C. luteus* in Iraqi waters (Al-Hakim, 1976;Mohamed and Barak, 1988; Abd, 1989; Mohamed *et al*., 2012) and in Iran (Hashemi *et al*., 2014). However, unfortunately no studies were detected dealing with the exploitation of this species.

Despite of the commercially important of these species and alone consisted 33.5% of fish assemblage in Al-Diwaniya river, middle of Iraq (Mohamed and Al-Jubouri, 2017), there is no study conducted about the growth and exploitation rates for these species in this river. Therefore, the objective of this work was to describe the growth, mortality and exploitation rates of four cyprinids fish in the Al-Diwaniya River, middle of Iraq. This study will help in formulating the fishery management policies for these commercial species in the river.

II. Materials and Methods

Fish were captured monthly from two sites in the AL-Diwaniya River, Al-Qadisiyah Province between Daghghara barrier through Sinniyah district to the AL-Diwaniya city from November 2016 to October 2017 (Fig. 1), using seine net (3m long and 2.5m depth with a 20mm mesh size), gill nets (25m long with 20x20, 30x30 and 50x50mm mesh sizes), cast net (9m diameter with 15x15mm mesh size) and electro-fishing equipment (provides 150-300V). It was reported that the water temperature varied from 10.2°C in March to 32.8°C in August, dissolved oxygen fluctuated from 5.0mg/l in August to 9.6mg/l cm in February, salinity values ranged from 0.55‰ in April to 0.79‰ in October (Mohamed and Al-Jubouri, 2017).

The total length (L, mm) was measured to the largest possible number of fish in the field. Subsamples were collected for each species and transported to the laboratory for analysis. The total length and the total weight (W) were measured to the nearest 1 mm and 0.1 g, respectively. The length-weight relationship was estimated for each species by using formula (Le Cren, 1951): $W= a L^b$, where W is the total weight in grams, L is the total length in cm, a and b are constants. The growth type was tested using t-test (Ricker, 1975). After measurements, four to six scales were removed from the left side of each fish between the lateral line and the dorsal fin base and prepared for ageing. Scale reading was carried out using Projectina microscope (20X).

Fig. 1. Map of Al-Qadisiyah Province showing the sampling sites in Al-Diwaniya River

From the magnified image of the scale, total scale radius and the distance between the focus and their respective annuli were measured for back calculation (Bagenal and Tesch, 1978). The von Bertalanffy growth equation for length was fitted to the back calculated mean length at age of the species by means of Beverton and Holt method (Ricker, 1975).Based on von Bertalanffy growth parameters, the performance index (Φ') was calculated as $\Phi' = \log10\ K + 2\log10\ L\infty$ (Pauly and Munro,1984).

The length cohort analysis (Jones, 1984) was applied to provide information about the mortality rates of the species using length frequency distributions and von Bertalanffy growth parameters (L∞ and K) of each species in the river, which calculated from back calculation data. Total mortality rate (Z) was estimated by length-converted catch curve (Pauly, 1984). Estimation of natural mortality rate was obtained through Pauly's empirical model (Pauly 1980):

$$\text{Log}(M)=(0.0066) -0.279 \log(L\infty) +0.6543 \log(K) + 0.4634 \log(T),$$

where L∞ and K are the von Bertalanffy growth parameters and T is the mean annual temperature at the study area, which is taken as 21.7˚C. Fishing mortality (F) was calculated using the formula, F= Z-M and Exploitation rate (E) was determined from the relationship, E= F/Z (Ricker, 1975).

Data were statistically analyzed by using Microsoft Office Excel 2010.

III. Results

Relative abundance

During the study a total of 27 species of primary freshwater fish belonging to eight families were recorded from the study river. The monthly variations in the percentages of *C. luteus, L. vorax , A. grypus, L. xanthopterus* and *M. sharpeyi* are illustrated in Figure 2. *C. luteus* constituted 10.1% from the total catch it varies from 1.5% in October to 13.7% in July, while *L. vorax* formed 6.4%, ranging from 2.0% in October to 10.2% in January. *A. grypus* comprised 6.3% of the total catch and its abundance ranged from 0.45% in October to 9.3% in June, whereas *L. xanthopterus* constituted 5.6% from the total catch and it fluctuated from 0.6% in October to 9.1% in February. Meanwhile, *M. sharpeyi* formed 5.1% of the total catch and its abundance changed from 0.6% in October to 8.5% in February.

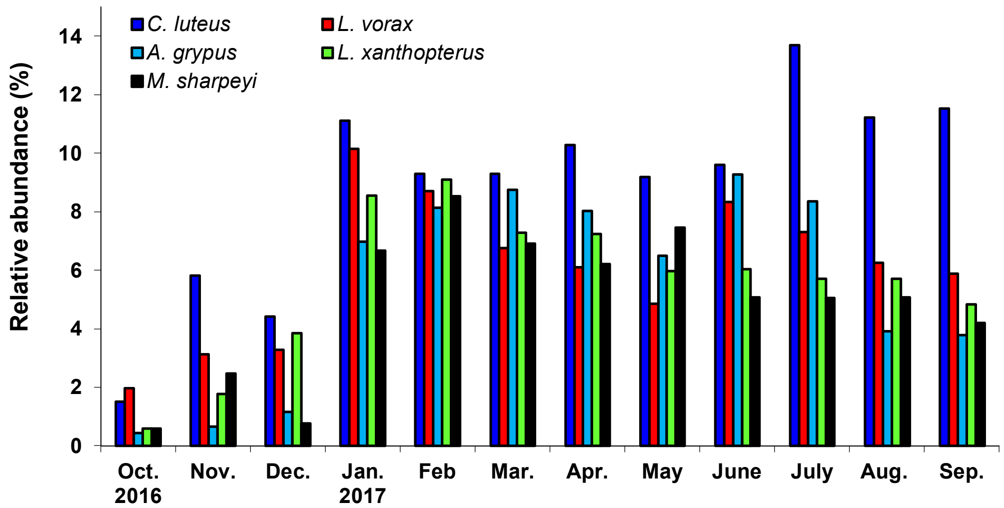

Fig.2.The relative abundance ofthe studied fish species in AL-Diwaniya River

Growth Pattern

The length–weight relationships for the five fish species are illustrated in Figure 3. The study was based on 2545 specimens which included 556 specimens of *C. luteus*, 494 specimens of *A. grypus,*501 specimens of *L. vorax*, 522 specimens of *L. xanthopterus* and 472 specimens of *M. sharpeyi*. The descriptive statistics of the length-weight relationships in the five species are given in Table 1. In terms of growth type, Student's *t*-test on the b-values for all these species showed that the slopes varied significantly (t= 2.13, 8.17, 6.94, 2.87 and 9.94, respectively, P<0.05) from the value of 3, indicating allometric growth in all studied species.

Table.1. Descriptive statistics of length-weight relationship for the five fish species

Species	a	b	r²	Total length (cm)
C. luteus	0.013	3.053	0.965	8.0-30.6
A. grypus	0.020	2.754	0. 944	18.4-51.4
L. vorax	0.007	3.029	0.974	10.0-55.5
L.. xanthopterus	0.008	3.093	0.946	12.0-60.2
M. sharpeyi	0.037	2.651	0.924	12.0-45.0

Table 2 explains the average lengths at the various ages as determined from scales by back calculation,the values of von Bertalanffy growth constants (L∞ and K) and the growth performance index (Φ) of the five fish species. The total lengths of *C. luteus* varied from 10.3 to 29.3 cm for ages 1 to 7 years, and for *A. grypus* from 20.2 to 48.3 cm for ages 1 to 5 years. The lengths of *L. vorax* ranged from 14.3 to 51.5 cm for ages 1 to 8 years, while of *L. xanthopterus* from 15.3 to 57.1 cm for ages 1 to 7 years and those of *M. sharpeyi* ranged from 11.8 to 44.0 cm for ages 1 to 8 years. The values of the asymptotic length ($L\infty$) were 35, 58, 61, 73 and 56 cm for *C. luteus, L. vorax , A. grypus, L. xanthopterus* and *M. sharpeyi*, respectively. The lowest value of the growth performance index (Φ) was 2.53 for *C. luteus* and the highest one was 3.13 for *A. grypus.*

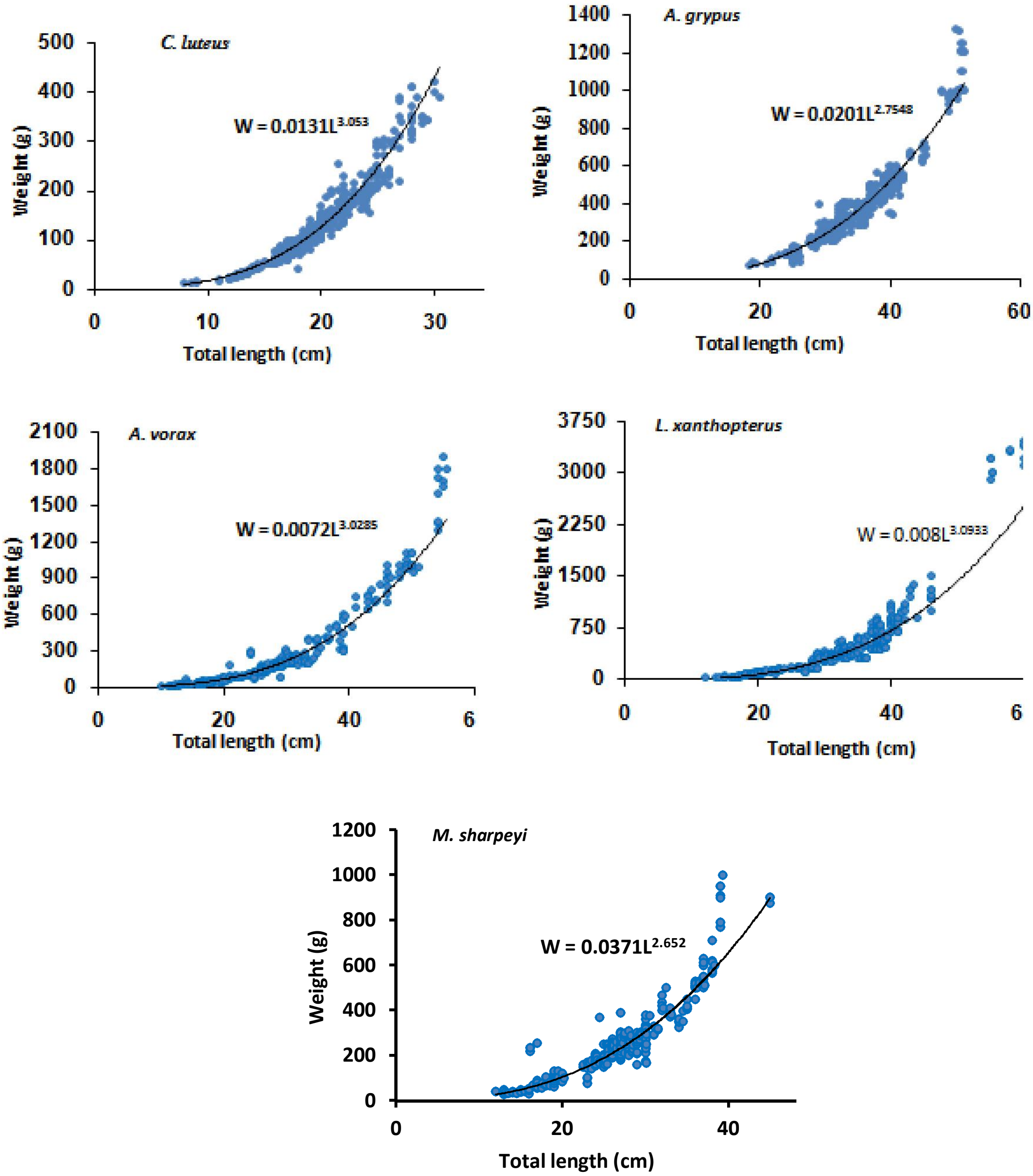

Fig. 3. The length-weight relationships of different fish species in Al-Diwaniya river

Mortality and exploitation rates

The results of length cohort analysis for the five fish species length data are given in Table 3. The analysis was based on the values of $L\infty$ and K for each species, and the following length ranges, *C. luteus* 8.0 to 30.0 cm, *A. grypus* 14.0 to 50.0 cm, *L. vorax* 11.0 to 53.0 cm, *L. xanthopterus* 11.0 to 59.0 and *M. sharpeyi* 11.0 to 54.0 cm.

The rates of total mortality (*Z*), natural mortality (*M*), fishing mortality (*F*) and exploitation (E) were estimated for each species as shown in Table 4. The lowest value of *Z* was 0.620 for *L. vorax* and the highest one was 1.985 for *A. grypus* (Fig. 4), while the lowest value of *M* was 0.241 for *L. xanthopterus* and the highest value was 0.385 for *A. grypus.* The lowest values of fishing mortality and exploitation rates were 0.618 and 0.640 for *L. vorax*, respectively, whereas the highest values were 1.600 and 0.806, respectively for *A. grypus.*

Table. 2. Age, growth, growth constants ($L\infty$ and *K*) and growth performance index (Φ) of the five fish species in AL-Diwaniya River

	Mean lengths at age (cm)										
Species	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	$L\infty$	K	Φ
C. luteus	10.3	16.4	19.9	23.2	25.9	27.9	29.3		35	0.280	2.53
A. grypus	20.2	32.0	39.0	43.9	48.3				58	0.391	3.13
L. vorax	14.3	23.4	31.0	38.2	42.9	45.9	48.7	51.5	61	0.220	2.92
L. xanthopterus	15.3	26.3	35.9	42.8	49.0	54.7	57.1		73	0.228	3.01
M. sharpeyi	11.8	21.4	26.2	30.5	34.5	37.8	41.1	44.0	56	0.228	2.83

Table.4. Total (Z), natural (M) and fishing (F) mortality rates, and exploitation rate (E) of the five fish species inAL-Diwaniya River

Species	Z	M	F	E
C. luteus	0.965	0.347	0.618	0.640
A. grypus	1.985	0.385	1.600	0.806
L. vorax	0.620	0.255	0.365	0.589
L. xanthopterus	1.692	0.241	1.451	0.858
M. sharpeyi	0.849	0.253	0.596	0.702

IV. Discussion

Estimation of growth and mortality of exploitable species is very important since stock assessment and management rely on these population. King (2007) stated that the appropriate assessment and management of a fishery requires an understanding of the biology, life cycle and distribution of the species on which it is based and the aim of stock status assessment is to understand the current status of resources exploitation relative to the long-term sustainable levels.

The study revealed that *C. luteus, A. grypus, L. vorax , L. xanthopterus* and *M. sharpeyi* represented together more than one-third (33.5%) of the total abundance of fish in Al-Diwaniya river. Mohamed and Al-Jobury (2017) mentioned that the ichthyofauna of this river is dominated by cyprinid species. The percentage *C. luteus* in the present study was better than that of *C. luteus* in some other Iraqi waters, 3.2% of fish assemblage in Hilla river (Al-Amari, 2011), 2.1% of fish in Dokan reservoir (Sadik and Abbs, 2014) and 1.8% of fish in Shatt Al-Arab River (Mohamed and Abood, 2017), but less than that in Euphrates river near the Musayib power station, which constituted 16.4% of the fish assemblage (AL-Rudainy *et al.*, 2006), 21.04% of fish in Euphrates river at Hindiya city (Al-Amari *et al.*, 2012), 29.4% of fish in Al-Huwaizah marsh (Mohamed, 2014) and 15.4% of fish assemblage in the Tigris river at Al-Kut dam (Abbas *et al.* 2015).

The proportion of *A. grypus* in the Diwaniyah river is close similar to its percentage in fish assemblage in Tigris river, Tharthar arm (Wahab, 2013), but it is better than that recorded in other Iraqi studies, such as Mohamed *et al.* (2008) in Al-Huwaza marsh, Al-Amari (2011) in Hilla river, Khaddara (2014) in Euphrates river at Hindiya barrier, Shaker and Wabab (2015) in Tharthar reservoir and Mohamed and Abood (2017) in Shatt Al-Arab river. In other waters, *A. grypus* constituted 11.10% of the fish assemblage in Euphrates river near the Musayib power station (Al-Temimy, 2004), 13.4% of fish in Dokan reservoir (Siddiq and Abbas 2013) and 7.3 % of fish in Tigris river at Kut barrier (Abbas *et al.*, 2015).

The contribution of *L. vorax* in the fish assemblage in the present study was better than that of some Iraqi waters, such as in Hilla river (Al-Amari, 2011) and in Shatt Al-Arab river (Mohamed and Abood, 2017), whereas less than in other waters such as in Euphrates river at Hindia (Al-Amari *et al.,* 2012; Khaddara, 2014; Abbas *et al.,* 2017) and in Tigris river at Kut barrier (Abbas *et al*., 2015).

The influence of *L. xanthopterus* in the fish assemblage in Al-Diwaniyah river was less than that of some Iraqi waters. It accounted for 16.6% of fish in Haditha dam (Al-Rudainy *et al*, 2001), 10.42% of fish in Euphrates river near the Musayib power station (Mohamed *et al*, 2005) and 7.1% of fish in Dokan reservoir (Siddiq and Abbas, 2013). However, they were better than the figures recorded by Al-Amari *et al.* (2012), Khaddara (2014) and Abbas *et al.* (2017).

Table.3. Length basedcohort analysis of fish species in Al-Diwaniya River (2016-2017)

C. luteus				*A. grypus*				*L. vorax*				*L. xanthopterus*				*M. sharpeyi*			
Length group (cm)	N	ln (N/Δt)	t⁻	Length group (mm)	N	ln (N/Δt)	t⁻	Length group (cm)	N	ln (N/Δt)	t⁻	Length group (mm)	N	ln (N/Δt)	t⁻	Length group (cm)	N	ln (N/Δt)	t⁻
8	6	3.90	0.89	14	2	2.91	0.83	11	58	5.36	0.84	11	15	4.23	0.84	11	9	3.78	1.25
9	5	3.68	1.02	16	1	2.17	0.95	14	148	5.71	1.23	14	31	4.91	1.07	13	42	5.27	1.47
10	3	3.13	1.17	18	18	5.01	1.07	17	109	6.89	1.54	17	57	5.46	1.31	15	30	4.89	1.70
11	4	3.38	1.32	20	1	2.07	1.20	20	41	4.81	1.77	20	68	5.58	1.57	17	26	4.69	1.94
12	42	5.69	1.47	22	11	4.41	1.34	23	68	5.24	2.33	23	29	4.67	1.84	19	45	5.19	2.20
13	72	6.18	1.63	24	122	6.76	1.48	26	105	5.59	2.72	26	67	5.44	2.13	21	3	2.42	2.47
14	39	5.52	1.80	26	26	5.15	1.64	29	123	5.65	3.15	29	112	5.89	2.44	23	62	5.39	2.76
15	60	5.90	1.98	28	69	6.06	1.80	32	27	4.03	3.62	32	136	6.01	2.78	25	122	6.00	3.07
16	74	6.06	2.17	30	91	6.27	1.98	35	46	4.45	4.15	35	106	5.68	3.14	27	128	5.98	3.40
17	111	6.41	2.37	32	114	6.41	2.17	38	20	3.49	4.74	38	133	5.82	3.53	29	78	5.41	3.75
18	66	5.83	2.58	34	72	5.87	2.37	41	10	2.64	5.42	41	23	3.98	3.95	31	16	3.75	4.13
19	128	6.428	2.798	36	114	6.24	2.60	44	21	3.21	6.23	44	15	3.44	4.42	33	30	4.29	4.55
20	117	6.272	3.035	38	63	5.55	2.84	47	14	2.59	7.22	47	-	-	4.95	35	34	4.32	5.00
21	96	6.003	3.290	40	57	5.34	3.12	50	7	1.62	8.48	50	-	-	5.54	37	22	3.78	5.50
22	119	6.141	3.564	42	23	4.30	3.42	53	11	1.68	10.26	53	3	1.44	6.23	39	19	3.52	6.06
23	71	5.541	3.861	44	7	2.97	3.78	-	-	-	-	56	2	0.86	7.04	41	-	-	6.70
24	84	5.619	4.185	46	-	-	4.19	-	-	-	-	59	6	1.74	8.02	43	-	-	7.43
25	78	5.445	4.541	48	23	3.79	4.69	-	-	-	-	-	-	-	-	45	4	1.49	8.30
26	43	4.739	4.937	50	39	4.07	5.31	-	-	-	-	-	-	-	-	-	-	-	-
27	27	4.149	5.383	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
28	59	4.788	5.893	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
29	11	2.942	6.488	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
30	4	1.731	7.203	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

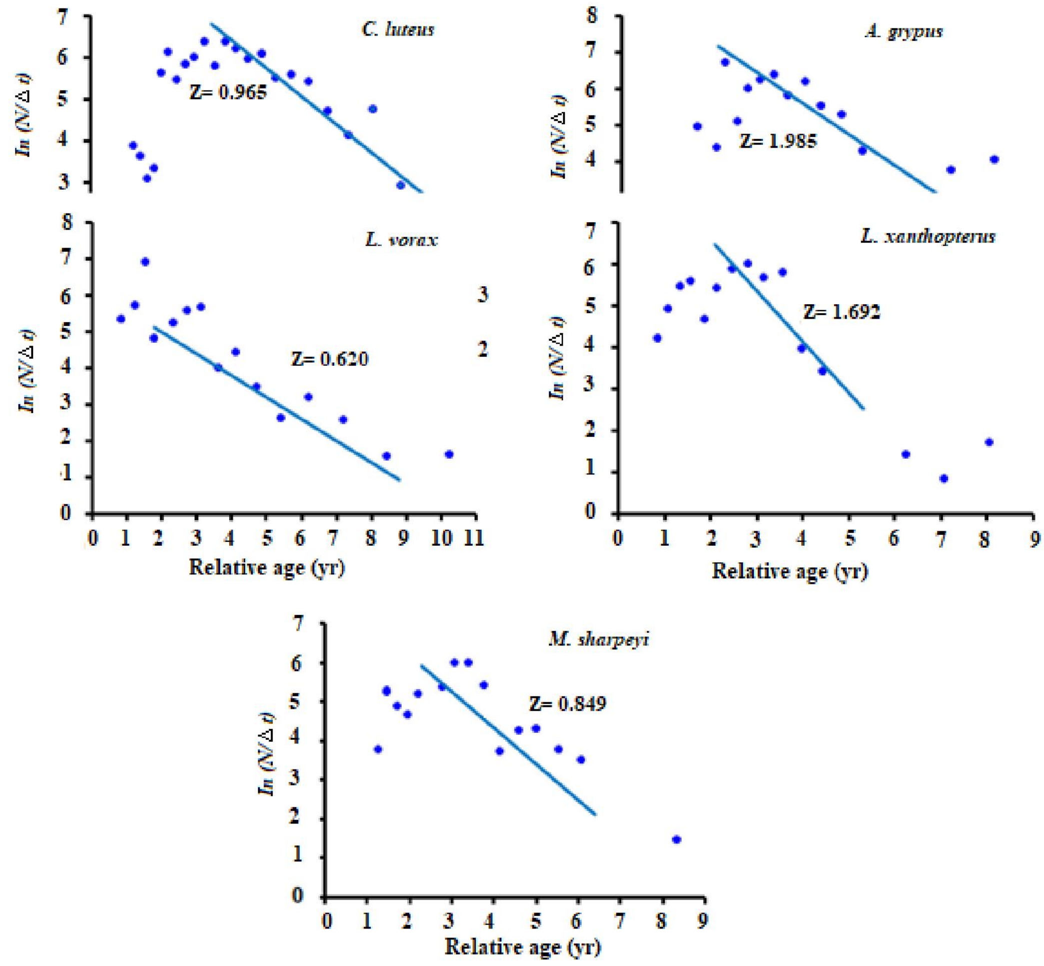

Fig. 4. Length-converted catch curves of the studied fish collected from Al-Diwaniya River

M. sharpeyi contribution in the current study was better than that found in many other Iraqi waters, such as in Euphrates river at Hindia (Al-Temimy, 2004; Al-Amari *et al.*, 2012), in Hilla river (Al-Amari, 2011) and in Shatt Al-Arab river (Mohamed and Abood, 2017).

However, Hashemi *et al.,* (2011) mentioned that *C. luteus, M. sharpeyi L. vorax* and *A. grypus* constituted 29.4, 10.4, 7.35 and 0.78%, respectively of the wetland fish assemblage in Shadegan Wetland, Iran.

The study shown that the length-weight relationships for the five studied species showed allometric growth, indicating that the fish weight increased greater than its length (Bagenal and Tesch, 1978). Several authors have reported both isometric and allometric growth for the studied species from various water bodies. *C. luteus* showed allometric growth in Qarma marsh (Barak and Mohamed, 1983), Euphrates river (Mohamed *et al*., 2006) and Attaturk lake (Gökçek and Akyurt, 2008), whereas in other waters exhibited isometric growth (Al-Hazzaa, 2005; Mohamed *et al*., 2010; Al-Amari *et al*., 2012; Mohamed, 2014).The growth of *A. grypus* was allometric in some waters, such as in Tharthar lake (Ahmed, 1974), Euphrates river (Mohamed *et al*., 2005) and Hilla river (Hussain *et al*., 2012), and isometric in other waters (Szypula *et al*., 2001; Eydizadeh *et al*., 2014). Growth of *L. vorax* varied from allometric in East Hammar marsh (Mohamed *et al*., 2017), Attaturk lake (Oymak*et al.,* 2011), Euphrates river, Syria (Al-Saleh *et al*., 2012) and wetlands, Iran (Hashemi *et al*., 2013) to isometric growth in others (Wahab, 2013; Khaddara, 2014). *L. xanthopterus* revealed allometric growth by Al-Jerian (1974) in Tharthar reservoir, Al-Rudainy *et al*. (2002b) in Euphrates river, Wahab (2013) in Tigris river, while was isometric in other waters (Abu Alhana and Al-Rudainy, 2000; Al-Nasiri *et al.,* 2004). M. *sharpeyi* showed allometric growth in Razzazah lake (Al-Hakim, 1976), Al-Hammar marsh (Mohamed and Barak, 1988) and Al-Swab marsh (Mohamed *et al*., 2012). Beverton and Holt (1957) stated that significant variations from isometric growth are rare in fish. Many factors such as differences in habitat, differences in size range of fish, number of specimens examined, fish activities, sex, stage of maturity, food availability and seasonal growth rates could contribute to the differences in growth of fish (Ricker, 1975; Lowe-McConnell, 1987).

The asymptotic length ($L\infty$) in *C. luteus* was similar to that recorded for the species in Al-Swab marsh, 35.0 cm (Mohamed *et al*., 2010) and in Tigris river, Turkey, 35.4 cm (Bilici *et al*., 2017), and was better than that recorded for the species in Euphrates river, 32.0 cm (Mohamed *et al*., 2006) and in Karoon river, Iran, 27.5 cm (Baboli and Sayahi, 2014), although was lower than the value 40.3 cm recorded for the species in in Orontes river, Turkey (Gökçek and Akyurt, 2008), 37.5 cm in Al-Azimmarsh, Iran (Eydizadeh *et al*., 2013), 37.0 cm in Al-Huwazah marsh (Mohamed, 2014), and 37.9cm in East Hammar marsh (Mohamed *et al.* 2016). $L\infty$ value of *L. vorax* determined in the present study was better than that recorded for the species in Euphrates river, 52.3 cm (Abbas and Al-Rudainy, 2006) and in Diyala river, 45.7 cm (Al-Rudainy, 2008), but was lower comparable to those in other waters, 91.0 cm in Habbaniyah lake (Shafi and Jasim, 1982), 218.5 cm in Attaturk dam, Turkey (Oymak *et al*., 2011), 92.7 cm in Karakaya reservoir, Turkey (Duman and Gűl, 2013) and 65.1 cm in East Hammar marsh (Mutlak *et al*., 2017). $L\infty$ of M. *sharpeyi* in Al-Diwaniyah river was lower than those recorded for the species in Al-Hammar marsh (Mohamed and Barak, 1988) and in Al-Swab marsh (Mohamed *et al.,* 2012). Such differences in the growth of fish are due to variations in environmental conditions as well as sampling techniques, fishing pressure, genetic features, availability of dietary items and computations (Bartulovic *et al.,* 2004; Lall and Tibbetts, 2009; Bajaj, 2017).

The value of $L\infty$ of *A. grypus* in the present study was lower than those obtained by the various authors in different regions (Al-Hakim *et al*., 1981; Bawazeer, 1981; Szypula *et al*., 2001; Al-Rudinay *et al*., 2007; Oymak *et al*., 2008; Hashemi and Mortazavi, 2011). Also, the $L\infty$ of *L. xanthopterus* in the study river was lower than most of the earlier studies, such as Tharthar, Razzazah and Habbaniyah lakes (Polservice*,* 1984) and Al-Qadisiyah dam (Abu Alhana and Al-Rudainy, 2000), while was slightly better than those recorded in Euphrates river (Mohamed, *et al*., 2005) and Haditha dam (Abbas and Al-Rudainy, 2007). These differences may be due to the high rates of exploitation of both species in the study river or to the small size of the river compared to other environments (Goldstein and Meador, 2004; Baboli and Sayahi, 2014). However, Coad (2010) stated that mature individuals of *A. grypus* move upstream to the spawning grounds, it spawns further upstream than mature individuals of *L. xanthopterus* in the Euphrates river 30 km beyond Haditha and beyond Daur on the Tigris river and in summer under low water level conditions and high temperatures, the smaller fish remain in the lower reaches of rivers but the larger fish migrate up rivers and tributaries, returning in September and October when temperatures fall.

The estimated growth performance index ($Ø$) for *C. luteus* in the present study was higher than the value of 2.33 obtained for the species from Karoon river, Iran (Baboli and Sayahi, 2014) and that of 2.55 from Al-Huwazah marsh (Mohamed, 2014), but the value was lower than the value of 2.76 for the species from Al-Azim marsh, Iran (Eydizadeh *et al*., 2013). The present value of ($Ø$) for *A. grypus* was lower than the value of 3.26 for the species from Tharthar and Habbaniyah lakes (Szypula *et al.,* 2001) and 3.31 from Karoon river, Iran (Hashemi and Mortazavi, 2011). The value of ($Ø$) for *A. vorax* was comparable with other values calculated at different geographic localities (Shafi and Jasim, 1982; Abbas and Al-Rudainy, 2006; Duman and Gűl, 2013; Mutlak *et al.,* 2017). Any previous data on the growth performance index ($Ø$) for *L. xanthopterus* and *M. sharpeyi* could not be found in the literature for comparison.

Analysis of mortality using length-converted catch curves and Pauly's empirical equation, gave fishing mortality rates of studied species greatly higher than the natural mortality rates of these species. It could be concluded that all studied fish stocks in Al-Diwaniya river were under the overexploitation. Gulland (1969**)** reported that the optimum exploitation rate of any exploited stock is about 0.5, i.e. fishing mortality should be about equal to natural mortality. The exploitation rate of *C. luteus* in the present work was similar to that recorded for the species in Al-Huwazah marsh, *E*= 0.64 (Mohamed, 2014) and higher than the values obtained at different other geographic localities (Mohamed *et al.,* 2006; Eydizadeh *et al*., 2013; Mohamed *et al.,* 2017). Also, *A. grypus* stock in Karoon river, Iran was suffered from heavy exploitation, *E*= 0.71 (Hashemi and Mortazavi, 2011), while in Euphrates river was unexploited, *E*=0.42 (Al-Rudainy *et al*., 2007). The exploitation rate of *A. vorax* in the present study was higher than the value (*E*= 0.44) obtained by Abbas and Al-Rudainy (2006) in Euphrates river, *E*= 0.56 by Duman and Gűl (2013) in Karakaya Reservoir, Turkey and *E*= 0.48 by Mutlak *et al.* (2017) in East Hammar marsh. The *A. xanthopterus* stock in present work suffered from heavy exploitation and was greatly higher than the same species stocks in other studies (Al-Nasiri *et al.,* 2004; Mohamed *et al.,* 2005; Abbas and Al-Rudainy, 2007). No previous study on the exploitation rate of *M. sharpeyi* found in the literature for comparison.

These results are important for fisheries management authorities as they suggest that the resource is overexploited, therefore, it is necessary to impose fishing (exploitation) regulationby activating the national law of fishing, exploiting and protecting aquatic resources.

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