On the Biological and Ecological Characteristics of Asian Jeery (*Silurus triostegus*) In the Euphrates River, Thi-Qar province, Iraq. II- Food habits of females

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Abstract

Dietary habits of females jerry (*Silurus triostegus*) in the Euphrates River in the city of Nasiriyah was studied for the period from February 2013 to January 2014. There was no previous studies on any biological aspect of this species, This work takes in to consideration the investigation of food habits of jeery females at the selected habitat. A total of 356 females were collected during several successful field trips over the course of the study using several fishing nets, namely, cast and draft nets. Electro fishing gear was also adopted in fishing to avoid selectivity of fishing gears and bias that may be inherent in methods of collection. This was accomplished in an attempt to obtain representative samples of the fish community colonizing the study habitat. Length and weight measurements required for the captured specimens were taken to the nearest mm and nearest mg respectively. Feeding activity and feeding intensity (fullness index) of the monthly samples were calculated . Stomach contents were analyzed using three methods of analyses: i.e. volumetric, numerical and frequency of occurrence. Index of relative importance of different food items was calculated. It was found that fishes were the main food component in the diet of jerry females according to the three analytical methods and it came first in the dietary relative importance followed by crustaceans.

I. Introduction

The importance of fresh water lies in its bio-diversity in biota of plants and animals origin . Fish form an important portion of the latter creatures and possess reasonable diversity in the medium. However, nearly 58 species of freshwater fishes are spread in Iraq's inland waters (Coad, 1991). many researchers over the past few decades, (Khalaf, 1961; Al-Daham, 1982; Hussein and Al-Kananni, 1993; Hussein 2000 ;. Rudaini *et. al*., 2001 and Al-Lami *et. al.*,2002; Assad, 1986; Al-Saad *et. al.*, 2010) accomplished various studies on the environmental and biological aspects of the inland water bodies. However, plenty of studies were executed on the Euphrates River (Fahd, 2001; Salman, 2006; Al-timimy, 2004; Kredy, 2006; Al-Shawi *et. al.*, 2007 and Saleh, 2007; Al-Shamm'a, 2009; Al-Noor, *et. al*. 2009; Salman *et. al*., 2010; Algum and Abdel Moneim, 2011; Al-Shidood, 2012 and Abdullah, 2015).

Several branches emerge from the Euphrates River during its running course in Iraq until achieving the southern sector at Basrah province. Water of the river considered to be warm and fresh with steadily increasing salinity as we headed southerly. The water is generally moderately alkaline (Hussein et al., 2000, Hussein *et al*., 2006, and Hussein *et al*., 2008) all over the year reflecting the general status of Iraqi inland waters.

However, the study of dietary habits, in general, especially freshwater fishes, is the subject of ongoing research as it forms the basis for the development of fisheries management and is one of the key factors for successful fish farming and management, sustainable development and identification of species-related relationships such as competition, predation and feeding overlap (Hussein, 1983). As well as understanding of some relationships among species, especially fish feeding habits and behavior (Hussein, 2000; Hussein, 1983; Alsa, 2007; Identifying what fish in their environment are involved with (Hussein, 2000). It takes in consideration integration with other studies on the environmental characteristics of the same water body, and the different habitats by which fish may feed (Nikolsky, 1963; Mohamed *et al*., 2004). Fish species in the water habitats are distributed according to their food requirements (Hussein, 2000 and Taher, 2010). The invasion of introduced species in many inland water bodies severely affect this distribution. They may compete with indigenous species on different sources of the environment; might consume them and other components as prey or may transmit some pathogenic agents or modify the stability of the

environment (Hussein, 2000 and Ligas, 2007). However, the exotic freshwater fish impose fundamental risks on the survival and genetic integrity of local fish species. Moyle *et al*., (1987) summed up the effects of introduced species and their disadvantages on the environment and biodiversity of local species.

Hussein (1983) pointed out that one of the most important factors for optimal utilization of any water body is knowledge of the food habits of fish community. Therefore, the study of fish food habits has received considerable attention from researchers including Barak and Mohamed, 1982; Hussein, 1983; Hussein and Al-Kanaani, 1991,1993 and 1995; Al-Shammaa 2006 Hussein *et. al*.,2008; Mohamed *et al*., 2009). The identification of food elements and fish intake provides a clear idea of the nature of the relationships between organisms in the aquatic environment. (Nikolsky, 1963; Luna *et al*., 2008)

Ramires-Luna *et al*., (2008) concluded that the analysis of fish diet provides an understanding of the feeding strategy and interaction within species components or among other species. However, it is well known that the composition of food in fish stomachs differs according to various aquatic environments (Hussein and Mahdi, 1999). Also, the environmental characteristics or the density and abundance of food ingredients in that environment are reflected on their contribution in fish food (Nikolski, 1963; Faltas, 1996).

The Asian jerry (*Silurus triostegus*) has a wide spread in many water localities of Iraq, namely the Shatt Al-Arab river, the southern Iraqi marshes, and the Euphrates river, achieving Haditha of Anbar province and the Tigris river to Samarra (Al-Debakel, 1986; Al-Sayab,1988). This species earn economic importance in some countries, especially in Turkey and Syria.

Jerry was studied by many workers (Al-Sayab, 1988; Wahab, 2006; Jumaili *et al*., 2012). In this study on the species' biology in Al-Hammar marsh,Al-Sayab(1988) pointed out that it is a predatory fish that feeds mainly on other species of fish as well as shrimp, crabs and frogs are also included in the menu. Al-Sayab(1988)considered jerry as a carnivore. However, no previous study was conducted on this species or its dietary habits in the selected locality of Euphrates river . This study tend to investigate the dietary habits of this species females in the middle reaches of Euphrates River in the city of Thi Qar.

II. Materials and Methodology

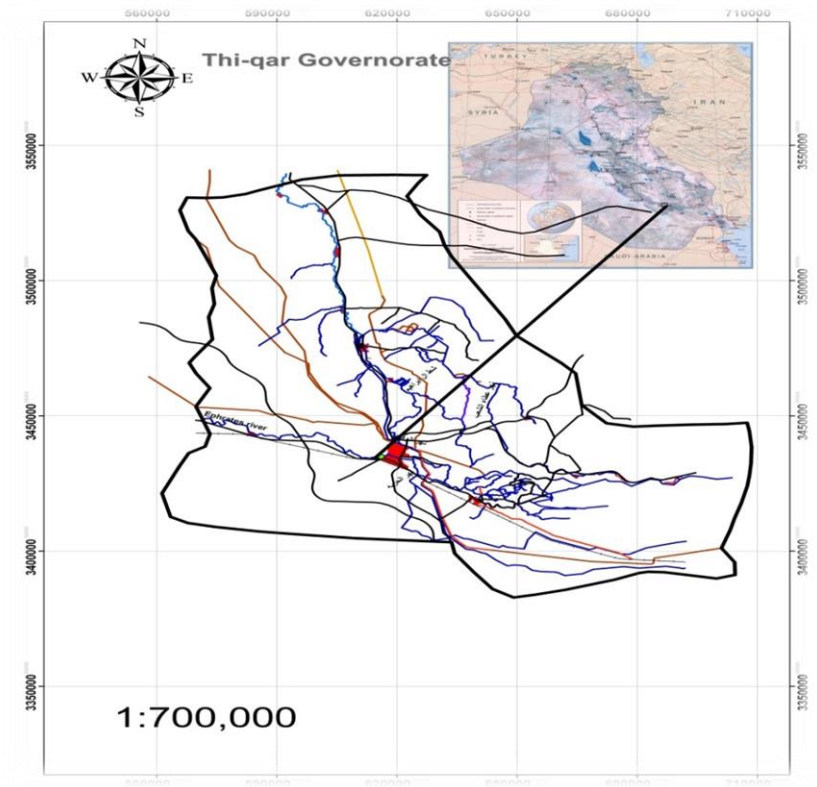
II.1. Description of study area

The Euphrates River Occupies, the twenty-fourth position among the world rivers. It is one of the longest rivers in Asia (Whitton, 1975). It springs from the mountains of southeastern Turkey (Al-Masoudi, 2000). Euphrates is one of the two main rivers running the Iraqi territory as long as 1060 kilometers or about 35% of its total length (2800 km, UNESCO, 2002) situated in Iraq (Frenken, 2009). The river classified within the longest rivers in the world and is one of the longest rivers in the Middle East (Jehad, 1984).

This river is considered as one of the most important sources of fresh water for human consumption, watering plants, industrial purposes and navigation. However, salinity increases as it is directed downstream as a result of the release drainage water from adjacent agricultural lands as well as domestic sewage from the residential areas. The marshlands that penetrates by the river after passing the city of Nasiriyah, is drained in eighties of the last century because of an irresponsible regime and this era considered as an environment offense.

River also contains many local and exotic species of fish i.e. himri (*Barbus luteus*); Shillig (*Aspius vorax*); jerry (*Silurus triostegus*); common carp (*Cyprinus carpio*); broadband siminan (*Acanthobramamarmid*); tilapia (*Tilapia zilli*); shaboot (*Barbus grypus*); Khishni (*Liza abu*) and other freshwater fishes present many Iraqi water bodies. The river also contains invertebrates as Mollusca ; crustaceans and representatives of various families of aquatic insects . However, detailed description on the river was given in Hussein and Fahad (in press). Figure (1) shows location of sampling in the river.

Fig. (1) Map showing the location of sampling in the middle reaches of the Euphrates river in Thi Qar Province.



II.2. Methods of fish sampling

Fish samples were collected on monthly basis by two or three field trips per month. The successive trips are for the purpose of collecting representative samples. The study was completed from February 2013 until January 2014. Fishes were traps by the cast fishing nets of different sizes to obtain a random sample representing the actual fish population in the location .The electrotherapy method was also used to avoid the selectivity and prejudice that may be inherent in other sampling methods. However, these precautions were taken in consideration to confirm the above objectives in obtaining random samples representing the stock in the studied environment.

Collected samples were kept in cork containers containing crushed ice until returning to the laboratory to complete the required measurements of the study. In the laboratory, the required measurements were taken for total and standard lengths to the nearest mm using a measuring board. The measured sizes were distributed each month to several length groups to determine the frequency distribution of the stock in the study area and to indicate the prevailing sizes.

II.3. Measurements approved in this study and food analyses

The required measurements for captured individuals were taken in the laboratory. Lengths were taken to the nearest mm. The total weight of each specimen was measured separately to the nearest milligram. The abdominal cavity was opened and stomachs recovered and individually preserved. Total fish weight, weight minus the digestive tract and the clean weights were determined to the nearest milligram. Each stomach was given a degree of fullness by consulting Ball (1961)scale.

II.4. Calculation of feeding intensity

The intensity of feeding (the rate of fullness index) was estimated according to (Ball, 1961) scale which consists of seven degrees (0-7) as 0 representing empty stomach, 0.5 - containing a very tiny amounts of food, 1 - quarterly full, 2 - half full, 3 - three quarters full , 4 - stomach is full of food, 5 - stomach distended (swollen).

Feeding intensity = (total scores obtained from the fullness index / number of feeding fish) x 100

II.5. Calculation of feeding activity

Feeding activity was calculated according to the equation given by Gordin(1977)The feeding activity of the stock was calculated as follows:

Feeding activity = (No. feeding fish / total number of tested fishes) x 100

II.6. Stomach analyses

The abdominal cavity of each specimen was opened by a sharp knife and the digestive tract was extracted. Fish weight minus the digestive tract was taken in addition to the clean weight of each individual (i.e. weight minus all the viscera). Each stomach was opened to investigate the consumed food .This species possess a distinct stomach, which was adopted to study and analyze the consumed diet. Stomach samples were individually preserved in plastic containers with labels carrying information about the specimen and containing 70% ethyl alcohol for further examination .At analysis, after opening each stomach with sharp scissors the food items eaten were placed in a petri dish to examine the ingested ingredients and segregated under an anatomical microscope. Consumed categories were isolated according to their taxonomical level.

Three methods were used to analyze food components, namely the volumetric, the numerical, and frequency of occurrence methods in order to obtain a clear picture representing ingested food and to avoid the disadvantages of each single analytical method.

The relative importance index (IRI%) for each consumed food item was also calculated according to Pinkas *et. al*.(1971).

In the preceding summary description to each analytical method is provided:

II.6.1.volumetric method

In this method, the volume of each food item consumed was determined and expressed as a percentage of the total volume of food ingredients of the examined stomach. Several volumetrical methods have been adopted by researchers to measure the extent of food intake (Hynes, 1950; Windell, 1968). Each method has its own specificity and uses. The latter was taken in consideration in the present work. Volumes of food components were determined separately and classified into the nearest taxonomic category. The method of displacement of each category was adopted using several sizes of Calibrated Cylinders. Prior to volume measurement, the contents of the liberated food items were placed on filter paper to absorb excess moisture, as long as the water held in the ingested food may cause errors in estimating the true volume (Hyslop, 1980). This method of calculating direct volume may be the best and most accurate techniques to give convincing results, provided that a correction coefficient is given to compensate for the effects of potential digestion of ingested items wherever required (Pillay, 1954; Hyslop, 1980; Hussein, 1983). However, when a semi-digested food element exists, it was given a reasonable correction rate based on an estimate of the size of the original specimen before partial digestion (Hyslop, 1980; Hussein, 1983).

II.6.2. Numerical method

In this method, the number of individuals for each food item encountered in stomach contents of the examined fish was determined and expressed as a percentage of the total number of all items consumed in order to determine the relative abundance of the food item in the entire diet of the species.

II.6.3. Frequency of occurrence method

In this method, the number of stomachs that contain one or more individuals of the concerned food item were determine and expressed as a percentage of total stomachs containing food. This finding determines the percentage of samples from the community that feeds on that component and provides an initial indication of the preference of the food elements available in the environment for the species under investigation, but does not suffice to derive a clear conclusion for feeding habits.

II.7. Index of relative importance

The relative importance index (IRI%) for each food item was calculated according to (Pinkas et al., 1971) as follows:

IRI = [(% N +% V)% F Since:
% N = the numerical percentage of each food component.
% V = Percentage of volume of each food component.
% F = Percentage of occurrence of each food component in the tested feeding fish.

III. Results

Table (1) Data on the smallest and largest females and other related characteristics encountered in the catch from the Euphrates River at the city of Thi Qar for the period from February 2013 to January 2014

Category	Catch date	T.L mm	S.L. mm	T.W. g	M.O mm	C.L g	S.W. g	G.W. g	V.W. g	F.I
Minimum	Mar.	335	305	280	42	220	12.9	41.3	10.6	Empty
Maximum	Sept.	819	741	4420	72	4030	90.2	27.5	142.5	Empty

Where: T.L= total length; S.L.= standard length; T.W.= total weight; M.O.= mouth opening; C.L.= cleaned weight; S.W.= stomach weight; G.W. gonad weight; V.W.= Viscera weight; F.I.= fullness index.

Table (1) reveals that the smallest female collected from the investigated location was recovered in March and measuring 335 mm in total length and 305 mm in standard length. The total weight was 280g, however, the largest female was captured in September measuring 819and 741 mm in total and standard lengths respectively. It was weighing 4420 g. Both females recovered were containing empty stomachs.

Table (2) Numbers of examined specimens of females at each monthfrom the Euphrates River from February 2013 to January 2014 and changes in the index of fullness and feeding activity

Month	No. Spec.	No. E.S.	% E.S.	% S.C.F.	F. I.	No. S.C.F.	Feeding Activity
February	18	14	77.77	22.22	2	4	22.2
March	36	22	61.11	38.88	2.64	14	38.88
April	34	20	58.82	41.17	3.42	14	41.17
May	64	44	68.75	25	2.5	16	25
June	22	14	63.63	36.36	2.38	8	36.36
July	40	30	75	25	3.5	10	25
August	18	12	66.66	33.33	3	6	33.33
September	24	18	75	25	4	6	25
October	36	28	77.77	22.22	3.25	8	22.22
November	16	10	62.5	37.5	3	6	37.5
December	26	20	76.92	23.07	3.33	6	16.66
January	22	18	81.81	18.18	3	4	18.18

Where: E.S= Empty stomachs; % E.S.= percentage empty stomachs; %S.C.F= percentage stomach containing food; F.I.= fullness index.

Table (2) shows number of individual females tested on monthly basis throughout the year in the studied environment. Samples recovered were varied in different months and were higher in the autumn months (March, April and May), accounted for 67 captured females, where the highest was encountered in May (32) followed by July (20). Female jerry were present in the catch throughout the year. The lowest number was collected in November (8) followed by February and August (9). It can be also noted that members of the stock was consuming food all over the year, but the proportions of empty stomachs were monthly varied and were encountered in each monthly catch. Further fishes were active in feeding all the year round, but the highest value of feeding activity was

recorded in April (41.17%) followed by March (38.88) associated with normal rise in water temperature and the lowest was in December (16.66%) reflecting the decline in water temperature in the location.

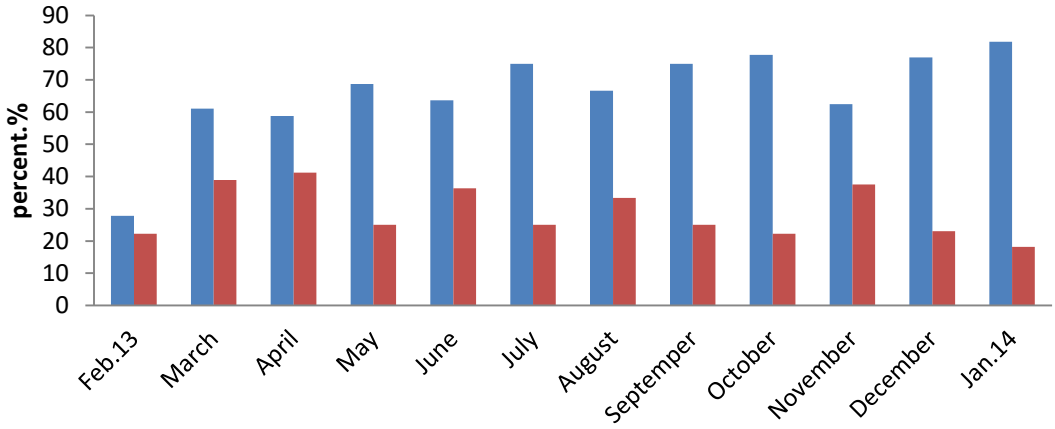
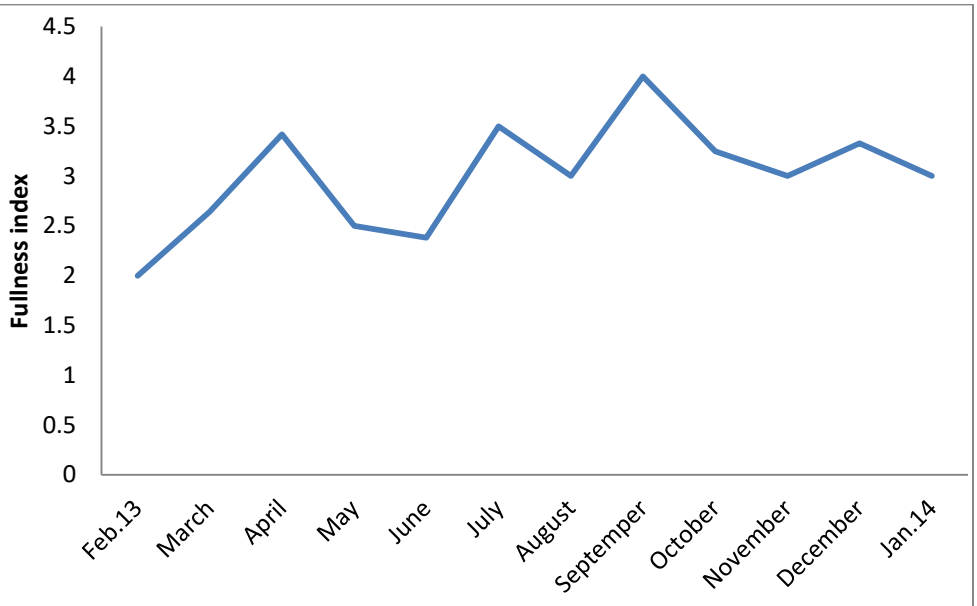


Fig. (2) % of empty stomachs and those containing food (feeding activity) for females from the selected location of Euphrates River

Table (2) and Figure (1) show the monthly changes in feeding activity, providing the proportions of stomachs containing food and those empty for female Jerry in the study environment. It is clear that the proportions of empty stomachs, in general, are higher than those containing food. They offer the highest proportions in cold months of the year. The highest was in January (81.81%) followed by October (77.77 %) and December (76.92 %). On the other hand, the highest contribution of stomachs containing food were encountered in the warm months of the year (i.e. March, April and June).



Fib. (3) Mean monthly fullness index for jerry females in the study location of Euphrates rived

Figure (3) shows the monthly differences in mean fullness index of females jerry caught from the river Euphrates in the city of Thi Qar. It has been revealed that females continued feeding throughout the year, but at varying rates in different months of the year. The highest rate of fullness index was recorded in September (4), followed by April and July (3.5). whereas the lowest rate was recorded in February.

III.1. Food analyses

A total of 356 female stomachs were examined and analyzed as shown in Table 3. The monthly changes in volume, numerical and the frequency of occurrence contributions of various food items in the female diet were calculated to obtain an idea on the contribution of food items by each method of analysis.

It was observed that fish constituted a large proportion of the food components according to the three methods of analysis (volumetric, numerical and frequency of occurrence), which dominated the rest of the components of food throughout the year. Crustaceans, especially prawn, came in the second grade following fishes. Crustaceans were not recovered from the diet during the cold months(October to February), except in November. Aquatic plants contributed in meager proportions.

III.1.1.Volumetric method

Fish represented the only food component consumed during the winter months (December, January and February) as well as in September and October, with a percentage contribution at all those months 100%. Fishes contribution was also high in the rest of the year, but only declined in May. Crustaceans showed the highest contribution in volumetric analysis in May followed by April. They were not consumed during the cold months of the year (December to February), in addition to September and October.

III.1.2.Numerical method

Fishes also formed the staple food component in the numerical contribution for several months (September, October, January and February) as it formed the only food component consumed and accounted for 100%. Its numerical contribution was high during March and November. It came in varying proportions and relatively high in other months of the year and was the lowest in April.

What is contained in the stomachs is a few species of fish, including *C. auratus*, which is recorded in the stomach of about 50% of the feeding females. The length of Prussian carp ranging between 80 - 160 mm. The second species of ingested fish was *Tilapia* sp. Where its length was between 50 and 170 mm. and fed on khishni (*Liza abu*).The lengths were between 40-140 mm and the siminan (*Acanthobramamarmid*) of 50 mm. Cannibalism phenomenon was also recorded as two specimens measuring 180 and 200 mm were recovered from stomachs of female predators, Predators were caught in June and September respectively. They were 760 mm and 780 mm in total length and weighing 3050 g and 4012 g in the same order. Crustaceans found in female stomachs were only represented by prawn at maximum length of prey 40 mm.

III.1.3.Frequency of occurrence method

Fish prey formed the main food category in the occurrence for several months (September, October, December, January and February) and was the only food component occurred in the stomachs contents(100%). Also their occurrence was high during March (88.89%) and November (83.33%), and came in different reasonable proportions in the other periods of the year, but the lowest value was encountered in May. Crustaceans came in the second position with the highest frequency recorded in May followed by August. They did not recovered from stomachs contents in several months (September, October, January, January and February). The lowest occurrence was in November.

Table (3) Monthly changes in diet components according to volumetrically; numerically and frequency of occurrence methods of food analyses for jerry females collected from the Euphrates River.

Month	No. collec. fishes	No. feed. Fishes	Fishes			Prawn		
			% volume	% number	% occur.	% volume	% number	% occur.
February	18	4	100	100	100	0	0	0
March	36	14	96.64	82.61	88.89	3.36	17.39	16.67
April	34	14	68.98	55.89	77.27	31.02	44.11	31.82
May	64	16	27.78	61.11	64.70	72.22	38.89	35.29
June	22	8	75.61	66.67	60	24.39	33.34	40
July	40	10	87.78	75	72.72	21.22	25	27.27
August	18	6	76.92	66.67	66.66	23.07	33.34	33.33
September	24	6	100	100	100	0	0	0
October	36	8	100	100	100	0	0	0
November	16	6	98.80	83.34	83.33	1.11	16.67	16.66
December	26	6	100	100	100	0	0	0
January	22	4	100	100	100	0	0	0
Total								

III.2. Index of relative importance (IRI) calculated for food ingredients

Table (4) represents the percentage composition of index of relative importance for diet components of jerry females from the Euphrates River for the period from February 2013 to January 2014.

Food item	Feb	Mar	Apri	May	Jun	July	Aug	Sept.	Oct.	Nov	Dec	Jan.
Fish	**100**	**97,9**	**97,6**	**59,5**	**78,7**	**90,4**	**83,6**	**100**	**100**	**98,1**	**100**	**100**
Prawn	**0**	**2,12**	**2,41**	**40,5**	**21,3**	**9,62**	**16,4**	**0**	**0**	**1,91**	**0**	**0**

Table (4) shows the percentage contribution of the relative importance index for the two main food items of jerry females from the Euphrates River during the study period. Fishes were the only important food item in several months (January, February, September, October and December). Also possess the highest importance in March, April and November, with 98% and the lowest percentage of importance was encountered in May (59.46%), where the crustaceans represented by prawn shows the highest percentage of the relative importance index (40.5) followed by June (21,3%) and the lowest importance was in November (1.91%).

VI. Discussion

Oscoz *et al*., (2006) indicates that food relations in fish community may vary depending on species adaptations and different stages of life history. On the other hand, Ramires-Luna *et al*., (2008) suggested that the analyses of fish diet provides an understanding of the feeding strategy and potential of interaction within species components or among different fish species colonizing the region. However, studying the dietary habits of fish in their natural environment is an important aspect of fishery biology (Hussein, 1983). It is not only recognizes the qualitative and quantitative determinations of the food items eaten by fish, but also contributes to the identification of feeding relationships between them and other aquatic organisms (Hussein, 1983; Ramires -Luna *et al*.,2008).Results of the present work showed that feeding chronology of female jerry did not cease throughout the study period, but it relatively varied withvarious months. Overall, there was a significant increase in food intake during the warmer months, as food consumption by fishes was directly proportional to the relatively rise in water temperature due to increase in metabolic activity (Windell and Brown, 1978).This is consistent with the studies executed by Al-Sayab (1988);Wahab (2006) and Al-Mansy (2015). Several workers pointed out that rates of feeding activity and metabolism are clearly associated with temperature changes (Lagler *et al.*, 1962; Hussein, 1983; Al-Sayab, 1988 and Al-Mansy, 2015). Jayaramaiah *et al*., (1996) also indicates that the relative rise in water temperature within the limits of species tolerance increases food consumption and digestion rates. However, the relatively high food activity of females throughout the year may relate to food abundance and the prevail temperature in the locality that should not exceed the appropriate limits for species tolerance.

Results reveals that females feeding activity and the fullness index criteria exhibited the highest values in the warmer months of the year that associated with the reasonable rise in water temperature, but those criteria showed the lowest values in winter. This confirm the effect of the fluctuation in temperature (Hussein, 1983, and Al-Sayab, 1988; Wahab, 2006 ; Hussein and Al-Kanaani, 1989, 1991 and Hussein and Mahdi. 2000; Al- Mansy, 2015).

The study deduced that females jerry is carnivore and mainly predatory to fish component (Piscivore) as they form a significant proportion in food, as well as feeding on prawn and crabs to a limited extent. This is aided by their large and wide mouth and the speed they owned that might be assist in capturing the prey (Randall, 1983). However, it also noted that some female individuals practiced cannibalism.

Results of the present work concerning the menu are consistent with those reported by other researchers (Al-Sayab, 1988; Al-Mansy, 2015) with some minor variations. Hussein and Mahdi (1999) deduced that food components may vary in different environments and these differences may be due to the density and abundance of dietarycomponents in these environments, which are clearly reflected in diet intake (Nikolski, 1963; Hussein, 1983; Hussein and Al-Kanaani, 1989;Faltas, 1996).

However, for the importance of studying food habits, many researchers (Windelland Brown,1978; Hussein,1983) have pointed out that our current understanding of the various topics on fishery biology, such as migration, growth, and seasonal variations in condition factor are derived from the study based on stomach analysis. Hyslop (1980) noted that the study of food intake, which depends on the analysis of stomach contents is an effective application in fisheries environment.

The current trends in food analyses studies aimed at determining more accurately the quantitative and qualitative aspects of food, as well as the degree of food preference; impact of season, temperature and size of fish on levels of consumption. Methods of food analysis and relative importance were discussed by many researchers (Windell,

1968; Windell and Brown, 1978; Hyslop, 1980 and Hussein, 1983). It is therefore, In the present study, three main methods of food analysis were adopted, namely the numerical, volumetric and frequency of occurrence, as the two former methods show the relative importance of each food item in quantitative form and the latter in qualitative manner. The combination of the three analytical methods is necessary in order to avoid the limitations and defects of each single one.

However, limitations and biases encountered within each method of food analysis confirm that relying on one method do not provide an integrated and actual picture of food importance (Windell, 1968; Hyslop, 1980; Hussein, 1983). Windell (1968) therefore, suggested combination the two analytical methods i.e. volumetric and numerical to determine the importance of food components acquired by the species.

Hallawell and Abel (1971) proposed adoption of measures that take into account different ways of food analysis and are more representative of feeding habits. On the other hand, Pinkas *et al*., (1971) developed the Index of Relative Importance (IRI). This index unite the results obtained from the three analytical methods in one single value that can be relied on to castrate the importance of each food category in the species diet , as well as it seeks to hide the disadvantages of each single method of food analysis. However, all these suggestions were taken in consideration in the present investigation.

Results of stomach analyses in the present work revealed that fish form the most important diet for females. This is consistent with Al-Sayab (1988); Wahab (2006) and Al-Mansy (2015) findings. On the other hand, the study deduced that the contribution of prawn in females diet was limited and aquatic plants found in meager amounts. This lead to conclude that they may be consumed accidentally when females were feeding on crustaceans and aquatic insects (Hussein, 1983; Al-Mansy, 2015).

V. References

Abdullah, S. A. G. (2015). A comparative environmental study on the effect of the water barrier in the Mudayna district at the lower reaches of the Euphrates River. MSc. Thesis, Coll. Agriculture, Univ. Basrah. 127 p. (in Arabic)

Al-Daham, N.K. (1982). The ichthyofauna of Iraq and the Arab Gulf. Acheck-list. Bull. Basrah. Nat. Hist. Mus., (4): 1-120.

Al-Debakel, A. J. (1986). Structure of fish species in the Shatt al-Basrah Canal and their food relations. MSc. Thesis,coll. Agriculture, University of Basrah, 118 p. (in Arabic)

Algum, F. M. and Abdel Moneim, I. A. (2011) Effect of the main eastern drainage system on some physical and chemical properties of the Euphrates River waters in the city of Samawah, Iraq. Uruk Journal of Scientific Research, (1) 4: 67-76 (in Arabic)

Al-jumaily, E. S. Ahmed; Al-Rawi A. H. A. and Ghali M. A. H. (2012). A Comparative Histological Study of the eye Retina of *Silkyustriostegus* and Larynx, *Liza abu*, Proceedings of the Eleventh Scientific Conference, Faculty of Veterinary Medicine, 111-122. (in Arabic).

Al-Lami, A. A. ; Ali, I.; Hassan, A. K. and Miften, F. S. (2002). The study of Daphnia in the Hemrin Dam reservoirf. Iraqi Agriculture Journal. 7: 86-93. (in Arabic)

Al-Masoudi, R. M. Ali Odeh (2000). Water resources and their role in agricultural production in Karbala governorate. MSc. Thesis / Faculty of Education - Ibn Rushed - University of Baghdad (in Arabic)

Al-Mansi, K. A. Ali (2015). The relationship of some environmental characteristics with the food habits of three coexistence local fish species living in the lower reaches environment of the Euphrates. MSc. Thesis, Coll. Agriculture, University of Basrah. 131 p. (in Arabic)

Al-Nour, S. S.; Hassan and Mohammed, A. R. M. and Faris, R. A. K. (2009). Structure of Fisheries at the lower reaches of the Euphrates River, Qurna, Iraqi Agricultural Journal (Special Issue), 14 (8): 157-169. (in Arabic).

Al-Shammaa, A. A. (2006). Diet composition of three Catfishes from Al-Hammar Marsh, Al-Fuhoud, Iraq. Marsh Bull. 2: 154-159.

Alsa,A. and AK, A. (2007).A study on the population structure of the tench (*Tincatinca*L.,1758) inhabiting Beysehir Lake (Konya-Turkey). Turkish Journal of IrremunciableparaExtramadura, CamaraOficial de Comercio e Industria de Caceres, Caceres,111-115.

Al-Saad, H. T.;Hello, M. A. ;AL-Taein, S. M. and Double, A. Z. (2010). Water Quality of the Iraqi southern marshes Mesopot .J. Mar. Sci. 25(2):188-204.

Assad, N. M., Hassan, S. and Noury, N. (1986). Detailed study on water quality of Iraq. II. Water quality of Euphrates River. Sci. Bull. No. 123. 179. Ministry of Irrigation. Water and Soil Res. Inst.

Al-Sayab, A. A. (1988). Ecology and biology of the Asian jerry *Silurustriostegus*Heckel in Hawr al-Hammar, Southern Iraq. MSc. Thesis, Coll. Agriculture, Univ. Basrah, 121 p. (in Arabic)

Al-Shidood, A.H. T. (2012) Environmental study of *Ceratophyllum demersum* L. and its role in removing cadmium from the Euphrates River at the city of Nasiriyah. MSc. Thesis, Thi Qar University, Coll. Education for Pure Sciences, 97 p. (in Arabic)

Al-Tamimi, L. M. Abbas (2004). Ecology and biology assesses a fish community in the Euphrates River near Al-Musayab power station. PhD thesis, College of Agriculture, University of Basrah. 147 pp. (in Arabic).

Ball, J. N. (1961). On the food of the brown trout of LdynTegid. Proc. Zool. Soc. Lond. 137: 599-622.

Barak, A.A. and Mohamed, A.R.M. (1982). Food habits of Cyprinid fish, *Barbusluteus* (Heckel). Iraqi J. Mar. Sci., 1 (1): 59-67.

Coad, B. W. (1991).Fishes of the Tigris- Euphrates basin: A critical Checklist.Syllogeus, 68: 1-49.

Fahad, K. K. (2001) ecological study in the southern sector of Euphrates at Nasyriya city. MSc thesis, Basrah University. pp-57.

Faltas, S. N. (1996). Food and feeding habits of gurnards, *Trigla lucerne* (Linnaeus, 1758) and *Trigloporuslastovisa* (Brunnich, 1768) in the Egyptian Mediterranean waters. Bull. Nat. Inst. Oceanogr. & Fish., A. R. E., 22: 167- 179.

Gordon, J. D. (1977) The fish population in inshore waters of the west coast of Scotland. The food and feeding of the whiting (*Morlangiusmorlangius* L.)J. Fish Biology 11: 513-229.

Hellawell ,J. M. and Abel, R .(1971). A rapid volumetric method for the analysis of the food of fishes. J. Fish Biol.3,29-27.

Hussein, S. A.(1983). The biology of the fresh water eel (*Anguilla Anguilla* L.) in four tributaries of the river Tweed, Scotland. ph.D. Thesis, Univ. Edinburgh, 399 p.

Hussein, S. A.; Al-Sabounji, A. A. and Fahad K. K. (2008). Seasonal differences in some physical and chemical factors. Thi Qar J. 1 (4): 13-20. (in Arabic)

Hussein, S. A., Al-Sabonchi, A. A. and Fahad K. K. (2006) Environmental characteristics of the Euphrates River in the city of Nasiriyah. Seasonal differences in physical and chemical conditions. Journal of the University of Thi Qar, (2) 2: 2-6 (in Arabic)

Hussein, S. A. and Fahad, K. K. (2008) Seasonal changes in nutrient concentrations and chlorophyll in the Gharraf canal, one of the main branches of the Tigris River, Southern Iraq. Basrah Journal of Agricultural Sciences: 21 (special issue) 239-251.(in Arabic)

Hussein, S.A. and Mahdi, A.A. (1999) Comparative studies on relative importance of various dietary items for two Sciaenids *Johnieopssina* and *Johniusbelangerii*(Cuvier, 1830) from North West Arabian Gulf. Basrah J. Agric. Sci.,12(1),13-19.

Hussein, S.A. and Al-Kanaani, S.M. (1989).Feeding ecology of shilig, *Aspius vorax* (Heckel) in Al-Hammar march, southern Iraq, 1.Diet of small individuals. Basrah J. Agr. Sci., 2 (1):81-92.

Hussein, S. A. and Fahad, K.K. (in press) On the biological and ecological characteristics of Asian jeery(*Silurustriostegus*) in the middle reaches of the Euphrates River, Thi Qar province, Iraq. I- Abiotic environmental characters

Hussein, S. A.(1983). The biology of the fresh water eel (*Anguilla Anguilla* L.) in four tributaries of the river Tweed,Scotland. ph. D. Thesis, Univ. Edinburgh, 399 p.

Hussein, S.A. and Al-Kanaani, S.M. (1989).Feeding ecology of shilig, *Aspiusvorax*(Heckel) in Al-Hammar march, southern Iraq, 1.Diet of small individuals. Basrah J. Agrc. Sci., 2 (1):81-92.

Hussein, S. A. and Al-Kanaani, S. M. (1991). Feeding ecology of shillg, *Aspiusvorax* (Heckel) in Al-Hammar marsh, Southern Iraq, II-Diet of large individuals. Basrah J. Agric. Sci. 4(1-2): 113-122.

Hussein, S. A. and Al-Kananni, S. M. (1993). Feeding ecology of the shilig*Aspiusvorax*Heckel from Al-Hammar marsh, southern Iraq III. Seasonal pattern of feeding. Marina Mesopotamia 8(1): 91-103.

Hussein, S. A. and Al-Knnaani, S. M. (1995). Diurnal variation in some ecological condition and feeding chronology of two fresh water fishes (*B. Sharpeyi* and *B. Luteus*) from Marshes, Basrah, Iraq. J. Basrah Res. 11(1): 21-33.

Hussein, S.A. and Mahdi, A.A. (1999). Comparative study on relative importance of various dietary items for two Sciaenids*Johnieopssina* and *Johniusbelangerii* (Cuvier, 1830), collected from the Shatt Al-Arab estuary, Northwest Arabian Gulf, Iraq. Basrah J. Agric. Sci., 12(1): 13-19.

Hussein, S. A. (2000). Interaction between introduced exotics and native Icthyofauna and their impact on aquatic ecosystems, southern Iraq. Basrah J. Sci. B.18(2): 125-146.

Hussein, S. A.; Al- Essa, S. A. and Al-Sewech A. R., (2000) Comparative studies on ecological features of Khora canal and the Shatt Al-Arab estuary, Southern Iraq. Basrah J. Agric. Sci., 15 (4): 27-41.

Hussein, S. A. and Mahdi, A. A. (2000). Seasonal variations in food habits of two selected sizes of *Johnioeopssina* (cuvier, 1830) from North West Arabian Gulf. Basrah J. Agric. Sci. 13(1): 29-38.

Hynes, H. B. N.(1950). The food of fresh water sticklebacks *Gasterostensaculeatus* and *pygosteuspungitius*,with A review .of methods wesd in studies of the food of fishes. J. Hnim. Ecol.,19:36-58.

Hyslop, E. J. (1980). Stomach content analysis : a review of methods andtheir application. J. Fish Biol., 17 : 411-429.

Kredy, H. M. (2006). Study of environmental determinants of the Euphrates River in Thi Qar governorate. Journal of the University of Thi Qar 2 (2): 137-140. (in Arabic).

Jahad, U. A. (2014). Evaluation water quality index for irrigation in the north of Hilla city by using the Canadian and Bhargava methods.J. of Baby. Uni. Engine. Sci. (22) (2): 346-353.

Jayaramaiah, D.; Hanumanthappa, H. and Chandra- Mohan, K. (1996). Food and feeding habits of *Upeneusvittatus*(Lacepede) from Mangalore coast. Environ. Ecol., 14 (2): 425- 428.

Khalaf, K.T. (1961). The marine and fresh water fishes of Iraq. Baghdad. Al- Rabitta press. 164pp .

Lagler, K. F (1956). Freshwater fishery biology 2nd od .wm.c. Brown Co.Publ., Iowa, USA, 421 pp.

Ligas, A. (2007)Population dynamics of the channel catfish Ictaluruspunctatus (Rafinesque, 1818)in the Ombrone River (Tuscany Italy).Atti Soc. tosc. Sci. nat., Mem., Serie B, 114.

Luna, V. R.; Navia, A. F. and Rubio, E. A. (2008). Food habits and feeding ecology of an estuarine fish assemblage of northern pacific coast of Ecuador. American Journal of Aquatic Sciences, 3(3): 361- 372.

Mohamed, A. R. M.; Hussein, S. A. and Mutlak, F. M. (2004). Food habit of *Upeneussulphureus* in Iraqi marine waters, north west Arabian Gulf/Iraq. Marina Mesopotamica 19(1): 171-187.

Mohamed, A.R.M.; Hussain, N.A.; Al-Noor, S.S.; Coad, B.W. and Mutlak, F.M. (2009). Status of diadromous fish species in the restored East Hammar Marsh in Southern Iraq. J. Amer. Fish. Soc., 69: 577-588.

Moyle P.B., Li H.W., Barton B., (1987). The Frankenstein effect:impact of introduced fishes on native fishes of North America.In: Stroud R.H. (ed.), The role of fish culture in fisheries management:415-426. American Fisheries Society, Bethesda.

Nikolsky, G.V. (1963). The ecology of fishes. Acad. Press, London and New York, 325 pp.

Oscoz, J.; Leuda, P. M; Miranda R. and Escala, M. C. (2006). Summer feeding relationships of the co- occurring *Phoxinusphoxinus*and*Gobiolozanoi*(Cyprinidae) in an Iberion river. Folia. Zool., 55(4): 418- 432.

Pillay ,T .V. R . (1954). Acritique of the method of study of food fishes .J. Zool . Sco .India 4:185-200

Pinkas, L. ; Oliphant, M. S. and Iverson, I. L. K. (1971). Food habits of albacore, blue fin tuna and bonito in California waters. U.S. Dep. Fish. Game Fish Bull. 152: 1–105.

Ramirez-Luna, V., Navia, A.F. and Rubio, E.A. (2008). Food habits and feeding ecology of an estuarine fish assemblage of northern Pacific coast of Equator. Pan-American Journal of aquatic Science, 3(3): 361- 372.

Randall, J. E. (1983) Red Sea Reef Fishes. IMMEL Pubishing. Road, London. 192 p.

Salman, A. H (2006). Biodiversity of fish and biology of two species found in theThirthar arm Tigris River. PhD thesis, College of Science, University of Mustansiriya, 102 pp.

Salman, J.M.; Hassan, F.M.; Saleh, M.M.(2010) Ecological study to use aquatic creatures as bio-indicators to polluting of the Euphrates waters with trace elements. Iraqi J. for market research and consumer protection 2 (3): 144-167.

Saleh, K.I. (2007). The first record for tilapia (*Tilapia zilli*) in Iraqi natural waters (the Euphrates) 1st sci. conf. of Coll. Agriculture. Basrah Univ. 27th November (summary) (in Arabic)

Taher, M .M.(2010). Specialization, trophic breadth and diet overlap of thirteen small marine fish species from Shatt Al-Basrah Canal, Southern Iraq Marsh Bull., 5(2) : 118 - 130.

UNESCO (2002). The challenge of achieving gender parity in Basic Education , A statistical Review.

Wahab, N. K. (2006). On the biology of some fish species in Basin of Tuz Jay River, Northern Iraq. PhD thesis, Coll. Agriculture, Univ. Baghdad, 191 pp. (in Arabic)

Whitton, B. A.(1975). River ecology. Black well Sci. Pub., Oxford, 310p.

Windell,J . T.(1968). Food analysis and rate of digestion .In methods of Assessment of fish production in fresh waters (ed.W . E . R.icker).ibp Handbook , No .3 Oxford: Blackwell Scientific publications PP.197-203.

Windell,J . T. and Bowen ,S. H. (1978) . Methods for study of fish diets based on analysis of stomach contents . In Methods for the Assessment of fish production in fresh waters . 3rdedn. (T. Bagnel,ed.)pp.219-226. Oxford: Blackwell Scientific publications .