MARINA MESOPOTAMICA 22 (1): 25 -36 2007

THE EFFECTIVENESS OF THE CARNIVOROUS FISHES ON FOOD RESOURCES IN THE NORTHWEST ARABIAN GULF

A. R. M. Mohamed, N. A. Hussain * and U. A. Yousif**

Department of Fisheries, College of Agriculture, Basrah University, Iraq

**Department of Biology, College of Science, Basrah University, Iraq*

***Marine Science Centre, Basrah University, Iraq*

ABSTRACT

The effectiveness of thirteen carnivorous fish species on food resources in Iraqi marine waters, northwest Arabian Gulf were studied from July 1998 to June 1999. The results revealed that specialization or selectivity is common trend among predators examined, depending mainly upon shrimps and small fishes. Specialized feeding indicate a clear partitioning of food resources among components. The most effective fish species on shrimp and fish reserve were *Polynemus sextarius* and *Saurida tumbil* respectively. Shrimps seem to be the most important food item than fishes and others in the study area.

INTRODUCTION

The study of feeding behavior of marine fishes is necessary in fish stock assessment and ecosystem modeling. For example, methods of multi-species virtual population analysis (Sparre, 1998; Bulgakova, *et al.* 2001) and the ECOPATH II ecosystem model (Christensen and Pauly, 1993) require information on the dietary composition of fishes. Predator pressure is a pervasive influence on the evolution of populations and on the structure and function of nearly all marine communities and ecosystems (Duffy and Hay 2001).

Food consumption usually provides helpful information deciphering some of the higher level trophic relationship in an ecosystem. The emphasis in fish community studies has been on trophic relationships (Helfman, 1978). For effective management, resources used by top carnivorous must be defined because production at lower trophic levels

directly affects growth rates and fisheries yields, because predators could alter the structure and functioning of lower trophic levels (Hartman and Brandt, 1995).

Iraqi marine waters form the estuarine part of the Arabian Gulf is considered the most productive part of the Gulf (Bibik, 1970 and Al-Zubaidi, 1998). Consequently, this characteristic tends to attract many exclusively marine species both resident and migratory (Mohamed, *et al.*, 2001). These waters plays important role as feeding, nursery and protective grounds for many fish species (Ali *et al.* 1993; Hussain, *et al*., 1993; Hussain and Ahmed, 1995).

Although a considerable amount of research were carried out on the food habits of some of the investigated species and similar species in the region (Ahmed and Al-Mukhtar, 1982, Mohamed and Ali, 1994; Mohamed, *et al.*, 2000, 2003, 2004; Al-Daham and Mohamed, 2000, and Hussein, *et al*., 2001, 2002), relatively little attention was paid to the feeding relationships (Wright, 1988; Ali, *et al*., 1993; Hussain, *et al*. 1993; Hussain, inpress).

The overall objective of current study was to determine the effectiveness of carnivorous fish species on the consumption and depletion of some important trophic components (fish and shrimps).

MATERIALS AND METHODS

Monthly fish samples were obtained from the trawl catches of research boat 'Behar' (14m length, 125Hp) of the Marine Science Centre, Basrah University during July 1998 to June 1999 from the Iraqi marine waters, North West Arabian Gulf (Fig. 1). Fishes were collected by a shrimp trawl net (18m head rope length) with a mesh size of 21x21mm. The speed of the boat was 3 knots during fishing with a mean time of two hours per a haul. Every cruise lasted for five to seven days. Randomized subsamples of fish and shrimp were taken to estimate weight and number of each species in each haul. Number of the fishing boats in the area was recorded at each cruise. The area of fishing ground is 750 km^2 after Albadran, 1995. The fish were injected with 7% formalin in the alimentary canal before being preserved in crashed ice for subsequent analysis.

In the laboratory, fish were measured for total length (TL, mm) and weight (W, g) and the content of the stomach were examined. Stomach contents were identified according to Newell and Newell (1977) and Jones (1986), counted and weighed. Food items were quantified using three methods (Hyslop, 1980); percentage of frequency of occurrence, percentage of numerical and percentage of gravimetric compositions. The index of relative importance (Pinkas *et al*. (1971). was employed to assess the importance of various food items in the dietary of involved species.

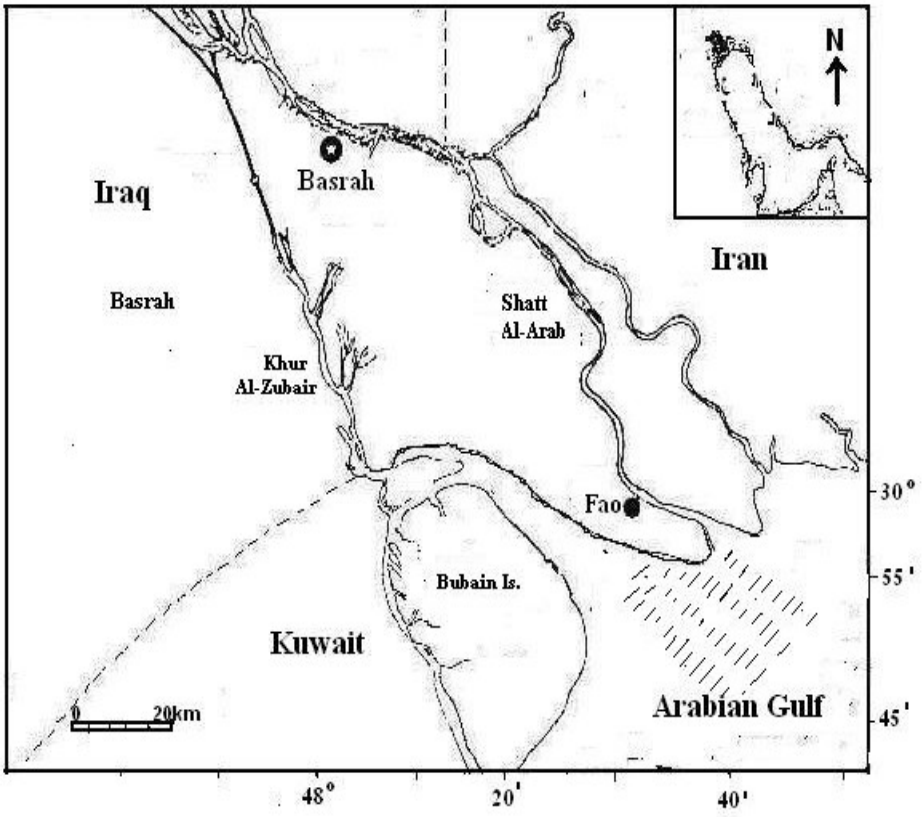

Figure 1. Location of sampling in the Iraqi marine waters, northwest

To study the effect of fish on a food resource, the following equations were used:

$$Np_{ij}\ \% = Np_{ij} / \sum_{j=1}^{n} Np_{ij} \times 100$$

$$Wp_{ij}\ \% = Wp_{ij} / \sum_{j=1}^{n} Wp_{ij} \times 100$$

$$Fp_{ij}\ \% = Fp_{ij} / \sum_{j=1}^{n} Fp_{ij} \times 100$$

Where, Np_{ij}%, Wp_{ij}% and Fp_{ij}% are the numerical, gravimetric and frequency proportions of food group (*i*) respectively that consumed by fish species (*j*) in the whole community that utilize food group (*i*) and *n* is number of fish species that utilize food group (*i*).

Formula of relative importance index George and Hadley (1979) was modified into:

$$AIN_{ij} = Fp_{ij}\% + Np_{ij}\% + Wp_{ij}\%$$

$$RIN_{ij} = AIN_{ij} / \sum_{j=1}^{n} AIN_{ij}$$

Where RIN_{ij} is the index of relative importance of the effectiveness of fish species (*j*) on the food group (*i*) resources in the habitat and n is number of food group (*i*). RIN_{ij} could be transferred to percentage after Cortés (1997).

Fish catch per unit effort (FCPUE) and shrimp catch per unit effort (SCPUE) were determined, depending on total catch of fish and shrimp and fishing hours in each cruise. Fish and shrimp biomass were estimated according to Pauly and Palomares (1987) using the information about number fishing boats in the fishing ground, number of fishing hours per a day and per a month, CPUE of fish or shrimp and fishing mortality which depend on the surface area swept, speed of boat during fishing, length head rope of trawl net, the fractions equal to the effective width of the net and to the escapement of fishes and shrimps and the fishing ground area (Klima, 1976, Pauly, 1984 and Pauly and Palomares, 1987).

RESULTS

-Effecting parameters

Fishes catch per unit effort (FCPUE) varied from 2.7 kg/h in November to 22.1kg/h in April (Fig. 2) and shrimps catch per unit effort (SCPUE) ranged from 0.1 kg/h in December to 15.9 kg/h in July. The number of boats (fishing activity) ranging from six boats in January to hundred boats in June. Fish biomass fluctuated from ١٦٣ tons in November to 1321 tons in April (Fig. 3) and shrimps biomass varied from 3 tons in December to 161 tons in July.

-Fish abundance

A total of 3534 individuals of 13 fish species were collected. Fig. (4) shows that *Illisha megaloptera* has the most numerical abundance comprising 9.1% of the total catch, followed by *Cynoglosus arel* (8.0%) and *Johnieops sina* (5.8%). The lowest numerical constitution was by *Terapon theraps* forming 1.2% of the total catch. *Saurida tumbil* was dominating species by weights constituting 9.3% of the total catch (Fig. 4), followed by *C. arel* (6.6%) and *Polynemus sextarius* (4.7%). The lowest composition by weights was exhibited by *Johnius belangerii* comprising 1.3% of the total catch.

A.t.=*A. tinuispinis*, C.a.=*C. arel*, I. m.=*I. megaloptera*, J.s.=*J. sina*, J.b.=*J. belangerii*, O.r.=*O. ruber*, P.s.=*P. sextarius*, S.t.=*S. tumbil*, T.p.=*T. puta*, T.t.=*T. theraps*, T.h. = *T. hamiltonii*, T.m.=*T. mystax*, U.s.=*U. sulphureus*.

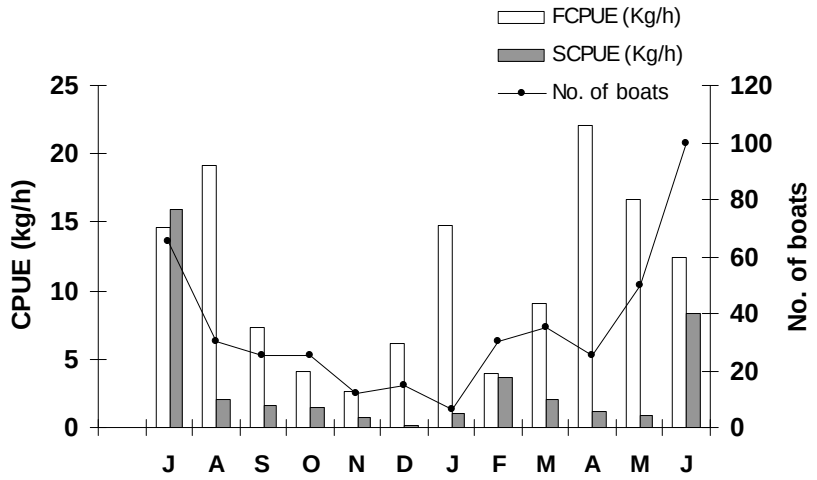

Fig. ٢. Monthly variations in CPUE of fishes and shrimp and number of fishing boats in the studied area.

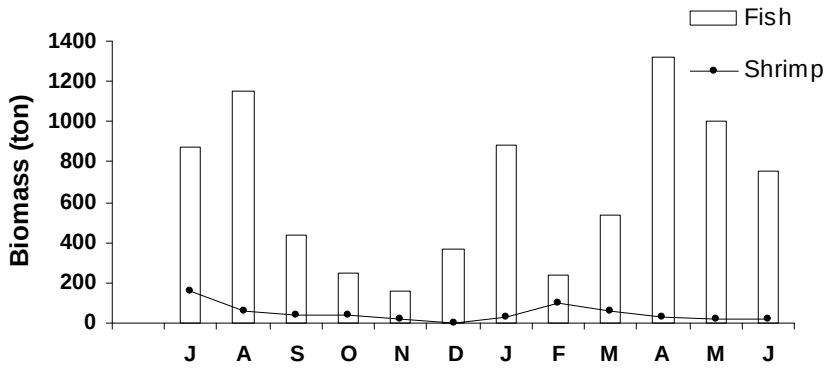

Fig. ٣. Monthly variations in biomass of fishes and shrimps in the studied area.

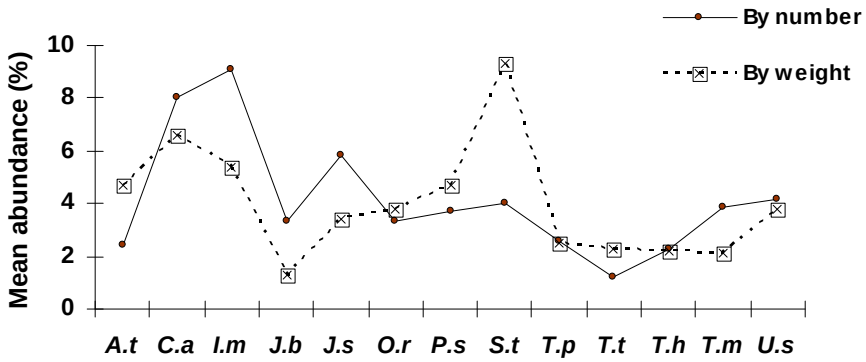

Fig. ٤. Mean monthly abundance of studied species by number and weight.

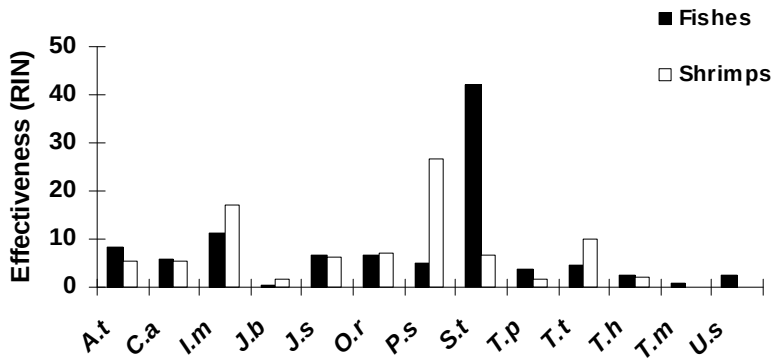

Fig. 5. Effectiveness of the studied species (RIN) on fishes and shrimps resources.

-Diet composition

The feeding activity and percentage of diet importance (IRI%) of various fish species are given in Table (1). The feeding activity values were ranging from 43.8% for *Thryssa mystax* to 78.0% for *C. arel.*

Five modes of diets can be distinguished. The first include three species (*S. tumbil, Arius tenuispinis* and *Terapon puta*) which fed mainly on fishes. The second mode included three species (*P. sextarius, T. mystax* and *T. hamiltonii*) fed on shrimps. The third mode included three species (*J. belangerii, U. sulphureus* and *I. megaloptera*) which fed on shrimps and fishes. The fourth mode included three species (*Otolithes rubber, J. sina* and *T. theraps*) which fed on fishes and shrimps. The last mode includes one species *C. arel* which fed mainly on bivalves.

Table 1. Feeding activity and % of relative importance (IRI) of various trophic groups ingested by different fish species.

Species	No. of fish	Total length (mm)	Feeding activity %	Trophic groups (IRI)				
				Shrimp	Fish	Crabs	Planktonic Crustacean	Bivalves
Arius tenuispinis	288	55-282	75.1	31.8	64.6	0.3	-	3.3
Cynoglossus arel	239	82-243	78.0	1.8	0.3	6.0	-	91.9
Johnius belangerii	245	41-223	71.8	63.6	3.8	21.5	-	11.1
Ilisha megaloptera	409	63-315	62.5	75.0	9.1	-	15.4	-
Thryssa mystax	212	53-161	43.8	98.9	0.8	-	0.3	-
Upeneus sulphureus	272	67-136	70.2	76.5	0.7	0.03	22.7	-
Polynemus sextarius	212	88-251	68.1	89.5	2.3	0.4	5.8	-
Johnieops sina	473	51-254	65.6	76.7	22.7	0.2	0.4	-
Terapon puta	212	57-187	73.2	36.9	59.2	3.9	-	-
Terapon theraps	252	48-192	76.4	79.8	19.1	1.1	-	-
Otolithes ruber	193	101-324	69.0	66.7	33.3	-	-	-
Saurida tumbil	288	69-354	75.8	3.8	96.2	-	-	-
Thryssa hamiltonii	239	43-217	56.3	95.1	4.9	-	-	-

-Effectiveness on food resources

Relative importance of fish species (RIN) effectiveness on both food resources (fishes and shrimps) were illustrated in Fig. (5).

Fishes

According to RIN, *S. tumble* was the most species impose depletion on fish resources accounted for 42.1%, followed by *I. megaloptera* (11.1%) and *A. tenuispinis* (8.2%). Other studied species were arranged in descent order to their importance of effectiveness on fish resources are *J. sina*, *O. rubber*, *C. arel*, *P. sextarius*, *T. theraps*, *T. puta*, *T. hamiltonii*, *U. sulphureus*, *T. mystax* and *J. belangerii*.

Shrimps

P. sextarius was the most effecting species on shrimp resources comprising 26.8% followed by *I. megaloptera* (16.9%) and *T. theraps* (10.2%). Other examined species are arranged according to their importance of effectiveness on shrimp resources are *O. rubber, S. tumbil, J. sina, U. sulphureus, A. tenuispinis, C. arel, T. mystax, T. hamiltonii, J. belangerii,* and *T. puta.*

DISCUSSION

One of the major challenges of fish ecology is to understand the ecological mechanisms by which large number of species are able to coexist in the same community and the manner in which resources are shared (Esteves and Galetti Jr., 1995). The Iraqi marine water characterized by it's richness in shrimps and small fishes as indicated by other authors (Ahmed and Hussain 2000, Mohamed *et al.* 2002). Accordingly attracted several species to inhabit the area to thrive on these resources (Ali *et al.* 1993; Hussain and Ahmed, 1995).

It seems that specialization is common trend among predator species in Iraqi marine water. They mainly depend on shrimps and small fishes. The same was noticed by Ali *et al.* (1993). Ali (1995) added that these predators are specialized feeder on preys of small sizes and no case of generalized feeder for size selection. It seems that feeding specialization is clear among studied species, indicating a clear partitioning of food resources between predators species in the area.

Two main factors control the species effectiveness on food resources, the species abundance or proportion in the assemblage (high or low) and

the feeding activity on certain trophic groups (Yousif, 2001). The most effective species on shrimp resources was *P. sextarius*, found to feed entirely on shrimps and S. *tumbil* feed largely on fishes, these two species with high predation activity on shrimps and fishes, becomes the most effective species on these trophic resources.

I. megaloptera was the most abundant species in number of individuals, but score moderate effectiveness on shrimp and fish resources, opposite to *S. tumbil* and P. sextarius, both species had low individual abundance, with high effectiveness on fishes and shrimps respectively.

Certain species were more effective on shrimps, like *J. belangerii, J. sina, P. sextarius, T. mystax* and *U. sulphureus* and other on fishes, like *S. tumbil , T. puta* and *A. teniuspinis ,* which could related to the position and shape of mouth consequently play major role in effectiveness on shrimp or on fish resources. However shrimps seem to be more important food than fishes and other items, this accordance with Mohamed, *et al.* (2002) that shrimps form more than 20% of the total catch in the region.

C. arel has low effectiveness on shrimp and fish resources, because it is benthic feeder feeding mainly on bivalves. Feeding activity of *O. ruber* was correlate negatively with fish CPUE because this species is surface feeder i.e. was not caught largely by trawl net.

In spite of increase in number of monthly fishing hours as expressed in number of boats, no substantial increase in catch of fishes and shrimps, it seem that there is seasonal increase in biomass (weight) of fishes and shrimps, according with productivity cycles in the region.

REFERENCES

Ahmed, H. A. and Al-Mukhtar, M. A. 1982. Some studies on the food of *Ilisha elongata* (Bennett) and *Otolithes argenteus* (Cuvier and Valenciennes) in the Arab Gulf. Marina Mesopotamica. 1:25-33.

Ahmed, S. M. and Hussain N. A. 2000. Abundance and distribution of eggs and larvae of clupiforme in the Northwestern Arabian Gulf .Basrah J. Sci., 18(1): 159-164.

Albadran, B. 1995. Lithofacies of recent sediments of Khor Abdullah and the Shatt Al-Arab delta, NW Arabian Gulf. Iraqi J. Sci. 36(4): 1133-1147.

Ali, T .S. 1995. Prey selection based on predator/prey weight ratios for common fishes of northwest Arabian Gulf. Acta Ichthyologica Pisctoria xxv: 89-94.

Ali, T. S.; Mohamed, A. R. M. and Hussain, N. A 1993. Trophic interrelationships of the demersal fish assemblage in the northwest Arabian Gulf, Iraq. Asian Fisheries Science, 6: 255-264.

Al-Daham, N. K. and Mohammed, M. H. 2000. Food of the flatfish *Pseudorhombus arsius* in the North West Arabian Gulf. Marina Mesopotamica 15(1):225-234.

Al-Zubaidi, A. M. H. 1998. Distribution and abundance of the zooplankton in the Shatt Al-Arab estuary and northwest Arabian Gulf. Ph. D. thesis, College of Sci., University of Basrah, 135 pp.

Bibik, J. A. 1970. Results of the investigation of the third research expedition of the Arabian Gulf. Black Sea Research Institute of Marine Fisheries, 121p.

Bulgakova, T.; Vasilyev, D. and Daan, N. 2001. Weighting and smoothing of stomach content data as input for MSVPA with particular reference to the Barents Sea. ICES J. Mar. Sci. 58: 1208-1218.

Christensen, V. and Pauly, D. 1993. A guide to the ECOPATH II software system (version 2.1). ICLARM, Manila, Philippines.

Cortés, E. 1997. A critical review of methods of studying fish feeding based on analysis of stomach contents: application to elasmobranch fishes. Can. J. Fish. Aquat. Sci. 54:726-738.

Duffy, J. M. and Hay, M. E. 2001. The ecology and evolution of marine consumer prey interaction, p. 131-157. ***In:*** M. D. Bertness, S.D. Gaines and M.E. Hay (eds.) Marine community ecology. Sinauer Associates, Inc., Sunderland.

Esteves, K. E. and Galetti Jr, P. M. 1995. Food partitioning among some caracids of small Brazilian flood plan lake from the Parana River basin. Env. Biol. Fish. 42: 375-389.

George, E. L. and Hadley, W. F. 1979. Food and habitat partitioning between rock bass (*Ambloplites rupestric*) and small mouth bass (*Micropterus dolomieui*) young of the year. Trans. Am. Fish. Soc., 108: 253-261.

Hartman, K. J. and Brandt, S. B. 1995. Trophic resource partitioning, diets and growth of sympatric estuarine predators. Trans. Amer. Fish. Soci. 124: 520-537.

Helfman, G. S. 1978. Patterns of community structure in fish: summary and overview. Environ. Biol. Fish 3:129-148.

Hussain, N. A. (in press). Food partitioning among coastal fish on the mudflats of Khor Al-Zubair estuary, Northwest Arabian Gulf, Iraq. Karachi Univ. J. Sci.

Hussain, N. A. and Ahmed, S. M. 1995. Seasonal composition, abundance and spatial distribution of ichthyoplankton in an estuarine subtropical part of the North western Arabian Gulf. Marine Research, 4(2): 135-146.

Hussain, N. A.; Naama, A. K. and Ali, T. S. 1993. Feeding relationships of subtropical water fish assemblage of Khor Al-Zubair, Iraq. Marina Mesopotamica 8(1): 11-24.

Hussein, S. A.; Mohamed, A. R. M. and Jabir, A. A. 2001. Feeding ecology of large *Polydactylus sextarius* (Block & Schneider, 1801) from northwest Arabian Gulf, Iraq. Iraqi J. Biol. 1(1): 51-58.

Hussein, S. A.; Mohamed, A. R. M. and Jabir, A. A. 2002. Composition and seasonal variations in diet of young *Polydactylus sextarius* (Block & Schneider, 1801) from the Iraqi marine waters, northwest Arabian Gulf. Marina Mesopotamica 17(1): 89-100.

Hyslop, E.J. 1980. Stomach contents analysis, a review of methods and their application. J. Fish. Biol. 17:411-429.

Jones, D. A. 1986. A field guide to the shores of Kuwait and the Arabian Gulf. Kuwait University. Bland Ford Press.191p.

Klima, E. F. 1976. A review of the fishing resources in the Western Central Atlantic. WECAF stud., (3): 77p.

After Garcia, S. and Le Reste, L. 1981. Life cycles, dynamics, exploitation and management of coastal penaeid shrimp stocks. FAO Fis. Tach. Pap 203, 215pp.

Mohamed, A. R. M. and Ali, T. S. 1994. Food habit of silver pomfret *Pampus argenteus* (Euphrasen) in the northwestern Arabian Gulf . IPA Agric. Res. 4: 38-44.

Mohamed, A. R. M.; Hussein, S. A. and Saleh, J. H. 2000. Food habits of *Liza carinata* in the Iraqi Marine Waters. Marina Mesopotamica 15(1): 275-284.

Mohamed, A. R. M.; Hussain, N. A. and Ali., T. S. 2001. Estuarine components of the ichthyofauna of the Arabian Gulf. Marina Mesopotamica 16(2): 209-224.

Mohamed, A. R. M.; Ali, T. S. and Hussain, N. A. 2002. The assessment of Iraqi marine fisheries during 1995-1999. Iraqi Agric. J. 17(1): 127-136.

Mohamed, A. R. M.; Mutlak, F. M. and Saleh, J. H.. 2003. Food habit of *Sillago sihama* in Iraqi marine waters, north west Arabian Gulf, Iraq. Marina Mesopotamica 18(1): 35-42.

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

Newell, G. E and Newell, R. C. 1977. Marine plankton, a practical guide. 5th ed., Hutchinson, London. 244pp.

Pauly, D. 1984. Fish population dynamics in tropical waters. A manual for use with programmable calculators. ICLARM 8. Manila, Philippines, 325 pp.

Pauly, D. and Palomares, M. L. 1987. Shrimp consumption by fish in Kuwait waters. A methodology, Preliminary results and their implications for management and research. Kuwait Bull. Mar. Sci. 9: 101-126.

Pinkas, L.; Oliphant, M. S. and Iverson, I. L. K. 1971. Food habits of albacore, fin tuna and bonito in California waters. Department of fish and Game, California Fish . Bull. 152: 1-105.

Sparre, P. and Venema, S. C. 1998. Introduction to tropical fish stock assessment. FAO. Fish. Tech. Pap. 306/1. 407pp.

Wright, J. M. 1988. Recruitment patterns and trophic relationship of fish in Sulaibikat Bay, Kuwait. J. Fish Biol. 33: 671-687.

Yousif. U. H. 2001. Feeding relationships of the abundant carnivorous fishes and their effectiveness on food resources in the North West Arabian Gulf. Ph. D thesis, Basrah University, 90pp.

تأثير الأسماك لحمية التغذية على مورد الغذاء في المياه البحرية العراقية، شمال غرب الخليج العربي، العراق

عبدالرزاق محمود محمد و نجاح عبود حسين* و أسامة حامد يوسف **

قسم الأسماك والثروة البحرية، كلية الزراعة، جامعة البصرة، العراق

*قسم علوم الحياة، كلية العلوم، جامعة البصرة، العراق**

*** مركز علوم البحار، جامعة البصرة، العراق*

الخلاصة

درس تأثير ثلاثة عشر نوعا من اسماك لحمية التغذية على مورد الغذاء في المياه البحرية العراقية، شمال غرب الخليج العربي للمدة من تموز١٩٩٨ إلى حزيران ١٩٩٩. كشفت النتائج شيوع نزعة التخصص بين أنواع الأسماك المدروسة باعتمادها الرئيسي على الروبيان وصغار الأسماك في التغذية. أشارت التغذية المتخصصة لأنواع الأسماك بوضوح إلى توزيع مصادرِ الغذاءِ فيما بينها. كان أكثر الأنواع تأثيرا" على الروبيان هو اسماك الغزال السداسي *Polynemus sextarius* وعلى الأسماك هو اسماك أبو الهيل *Saurida tumbil*. يبدو إن للروبيان أهمية غذائية أكثر من الأسماك والعناصر الأخرى في منطقة الدراسة.