Distribution and Composition of Benthic-Invertebrate Community at Fish Floating Cages in Tigris River Before Al- Kut Barrier/ Wasit Province, Iraq

Aseel G. Radhiy[1], Luay M. Abbas[2] ,
Abdelkareem J. Abu-Elheni[3] and Ali A. Al-Hasani [4]
E-mail: luaym294@yahoo.co.uk

Animal and Fisheries Resource Center /Agriculture Research Directorate [1,2,3]
Soil and Water Resource Center/ Agriculture Research Directorate [4]
Baghdad, Iraq

Summary

Seasonal study was done for the distribution and composition of benthic invertebrate community in three selected sites (S_1, S_2 and S_3) near a fish floating cages in Tigris river before Al-Kut Barrier south Baghdad, during the period from January to December 2014. Some of water quality parameters were measured as following: temperature ranged from 14°C in winter to 32 °C in summer, dissolved oxygen from 5.2 in summer and 9.8 mg/l in winter, pH values from 7.5 to 7.8, salinity from 0.5 in winter to 0.73 mlg/l in summer and water turbidity from 250 in spring to 900 NTU in autumn. The river bottom of study area was clay loan, silt clay, clay loan and clay for sites S_1, S_2 and S_3 respectively. A total of 19 benthic fauna species were identified. Of these 8, 6, 3, and 2 species belonged to Arthropod, Oligochaet, Mollusca and Nematode respectively. There were significant differences shown at S2 (inside cages) for the organic matter 4.7%, and for organic carbon 2.74%, 19 species, the abundance was 813.4 ind/ m^2 and benthic biodiversity was 2.86, compared with S_1 and S_3. Also, S_2 was shown the dominance for Arthropod: Insect (46.6%), followed by Oligochate, Mollusca and Nematode (32.9%, 16.5% and 4%) respectively of the total benthic invertebrate density. The results shown increment in benthic invertebrate density and biodiversity inside cages (site S_2) compared with the other two sites before and after cages respectively.

Key words: benthic invertebrate, distribution and composition, density , biodiversity

Introduction

Fish farming by using floating cages was once considered an environmentally benign practice, but is now viewed as a potential polluter of the fresh and marine ecosystems (Yucel-Gier *et al.*, 2007). Organic enrichment of the riverbed is the most widely encountered effect of fish culture (Karakassis *et al.*, 2002). Increasing organic loading sediments might have a strong effect on the structure of benthic communities (Klaoudatos *et al.*, 2006). Deposition of organic material under the cages may cause changes in the composition of basic benthic communities in terms of abundance, dominance and taxa richness (Yucel-Gier *et al.*, 2007). The effects described here tend to be localized around effluent discharge points and within 25 m of the perimeter of net-pen farms (Pearson and Black, 2001). From previous studies for fish farming using floating cages have addressed the effects of these fish on the dynamics of sediment accumulation beneath cages (Karakassis *et al.*, 2002), on benthic community structure (Klaoudatos *et al.*, 2006), on the biological and geochemical properties of muddy and sandy sediments (Maldonado *et al.*, 2005) and on the recovery process of benthos after cessation (Papageorgiou *et al.*, 2010). Most of the studies have addressed the environmental impact of fish farming without investigated its spatial and temporal extent. Karakassis *et al.* (2000) have indicated that the effects of aquaculture on the benthic environment are found within a short distance, normally not exceeding 25 to 30 m from the edge of fish floating cages; however, it is well known that it releases a substantial amount of nutrients into the river environment (Abu- Elheni, 2014). The objective of the current study is to assess the distribution and composition of benthic invertebrate at fish floating cages and the effect of aquaculture facilities on benthos structure in the river.

Material and methods

Study area

The density and distribution of benthic invertebrate community were studied at fish floating cages in Tigris River 5 km before Al-Kut Barrier at Wasit Province south of Baghdad during the period from January to December 2014 (Fig. 1). The part of this river within 150 m in width, 4 to 6 m in depth and a current rate 0.35 m/sec. Several aquatic plants were identified and recorded in the cage location such as *Ceratophyllum demersum* and *Phragmites* sp., *Vallisneria* sp. and *Nymphaya* sp. (Abu- Elheni, 2014). Small-sized fish of several species were recorded too, namely, common carp: *Cyprinus carpio*, Shilig: *Aspius vprax* and Gerri *Parasilurus triostegus* (Abbas *et al.*, 2015).

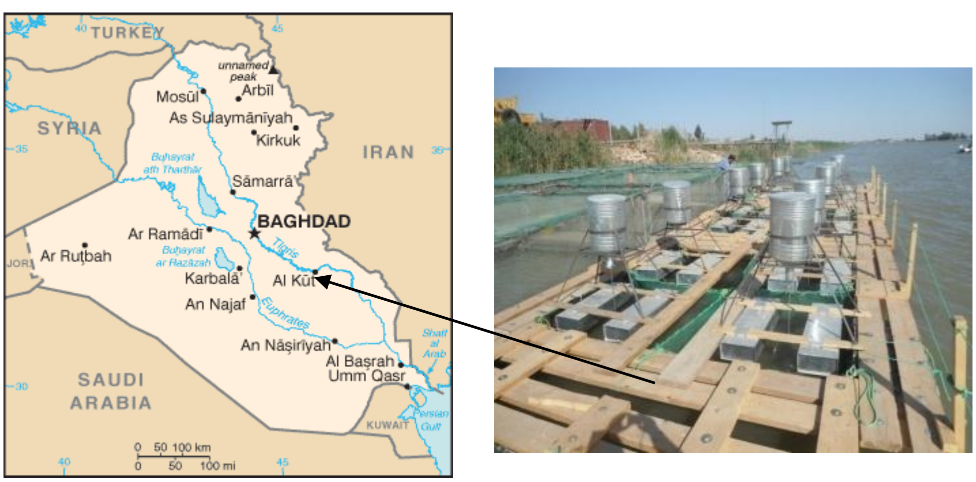

Figure (1): Map of Iraq show Part of Tigris River include study area

Sampling methods

Distribution and Composition of Benthic-Invertebrate Community

Seasonal assemblage were collected for one year started from winter 2014 (Jan, Feb and Mar), spring (Apr, May and Jun), summer (Jul, Aug and Sep) and autumn (Oct, Nov and Dec). The area of fish floating cages of three sites was sampled, the first site S_1 before 10 meters of cages, site S_2 inside cages and S_3 after 10 meters of cages. At each site, some of annual water quality parameters were investigated using Horiba Water Quality Meter (W-2000S/ Japan) these including water temperature (°C), dissolved oxygen (mg/l), pH, values, salinity (mg/l) and turbidity (NTU). Sediment samples per m^2 were collected at depth of 10 cm from bottom using a small shovel (Five samples per m^2 with 3 replicate for each site). These sampling were used to analyze the organic carbon, organic matter, and benthic community parameters. A grain-size analysis was performed at all sites using standard sieving and settling procedures (Stewart *et al.*, 1998). The sediment type bottom of this part were investigated at Soil and Water Resource Center/ Agriculture Research Directorate/ Baghdad/ Iraq depending on the relative percentages of clay (<0.002 mm), silt (0.002 to 0.063 mm) and sand (0.063 to 2 mm) (Karakassis *et al.*, 2002). The analyzing of organic matter was used 2 to 5 g (dry weight) sediment sub-samples, after homogenization and drying at 60 °C to constant weight, sediment was combusted in a furnace (Nabertherm L9) at 500 °C for 4 h. The amount of organic matter in a sample was estimated as the difference between dry and ash weight (ASTM, 2006). Total organic carbon was measured according to the inexpensive titration method described by Gaudette *et al.* (1974) using potassium dichromate and sulphuric acid as the oxidant.

Benthic- invertebrate species were collected and sieved through a 0.5 mm mesh size. Each sample was placed in a plastic vial in 5% formaldehyde. Samples were sorted by hand into major species namely: Annelid, Arthropod, Mollusca and Nematode at Fish Research Center/ Agriculture Research Directorate/Baghdad/Iraq. The benthic- invertebrate were identified to its species depending on Brinkchurst (1984) and Pennak (1978) using stereomicroscope (Kruss/ Germany). Density (ind/ m^2) was determined for each species. Benthic- invertebrate biodiversity was measured using Shannon- Wiener index (H) as the equation: $H= - \Sigma$ Pi Lo Pi Whereas Pi: number ratio of taxes from samples (Shannon and Weaver 1949). Analysis of a variance (ANOVA) One-way classification was used and less significant difference (LSD) to determine the differences between parameters means at significance of ($P \leq 0.05$). All statistics were carried out using Statistical Analysis System (SAS) Program (SAS, 2010).

Results

During the study some of physical and chemical of water characteristics were measured (Table 1). Water temperature ranged from 14 °C in January to 32 °C in August 2014. Water pH values were slightly fluctuated and ranged from 7.5 to 7.8. Salinity values were ranged between 0.5 mg/ L in January to 0.73 mg/L in August 2014. Water dissolved oxygen values ranged between 9.8 mg/L in

February 2014 to 5.2 mg/L in August 2014. From table (2), the sediment texture of sites S1 , S2 and S3 were mainly clay loam, silt clay and clay respectively ,and, the contents of organic matter values were 0.91%, 4.72 % and 2.74% respectively, and the organic carbon were 0.53%, 2.74%, 1.08% respectively.

Table 1. Some of seasonal water quality values of Tigris River near the fish floating cages before Al–Kut barrier during the period from January to December 2014

Parameters	Winter 2014	Spring	Summer	Autumn	Mean value ± SD
Water Temp. (ºC)	14	22	32	28	24± 6.5
D. O. (mg/L)	9.8	8.9	6.9	8.5	8.2 ± 2.4
pH	7.8	7.6	7.5	7.7	7.7 ± 0.5
Sal. (mg/l)	0.5	0.67	0.73	0.69	0.65 ± 0.08
Turb. (NTU)	320	250	760	900	557.5± 347

Table 2. The sediment texture for Tigris River bottom near the fish floating cages before Al- Kut barrier during the period (January to December 2014)

Sites	Soil texture	Sediment composition			Organic Contents	
		Silt %	Clay %	Sand %	Organic matter (%)	Organic carbon (%)
S_1	Clay Loam	36.43	38.43	25.14	0.91	0.53
S_2	Silt Clay	39.5	35.5	25.0	4.72	2.74
S_3	Clay	32.49	56.55	10.96	2.52	1.08

The total density of benthic invertebrate was 936 ind/ m^2, belonged to 19 species were identified from Tigris river before Al- Kut Barrier (tables 3 and 4) . The maximum number and abundance of taxa were encountered at S_2 (19 species and density of 813 ind/ m^2), followed by S_3 (6 species and density of 89 ind/ m^2) and less shown at S_1 (3 species and density of 334 ind/ m^2). According to table (4), the highest values of benthic invertebrate biodiversity were recorded at S_2 of 2.86, followed by S_3 and S_1 of 1.9 and 1.04 respectively. The community structure, inside fish floating cages showed a pattern of spatial change with distance from the cages. From table (5), seasonally clear fluctuation values were founded between the composition of benthic invertebrate within different sites, however, significant differences ($P \leq 0.05$) were shown at site S_2 (inside floating cages) between sampling parameters sites and seasons.

Table 3. The density (ind/m^2 and the percentage %) of benthic invertebrates species near the fish floating cages before Al–Kut barrier during the period (January-December 2014)

Species	Sites					
	S_1		S_2		S_3	
	ind/m^2	%	ind/m^2	%	ind/m^2	%
Arthropod	12.1	35.7	378.7	46.6	33.3	37.5
Mollusca	10.3	30.4	134	16.5	11.1	12.5
Nematode	-	-	33.3	4.0	-	-
Oligochaeta	11.5	33.9	267.4	32.9	44.4	50
Total	33.9		813.4		88.8	

Table 4. Benthic invertebrate abundance (%), species number and biodiversity near the fish floating cages before Al–Kut barrier during the period (January to December 2014)

Species	Sites		
	S_1	S_2	S_3
Arthropod (Insect) %			
Chironomidae pupa	-	4.1	12.5
Chironmous sp.	33.3	8.3	12.5
Cryptochironmous sp.	-	8.3	-
Collembola	-	5.4	-
Glyptotendipes paripes	-	4.1	-
Isotomus palustris	-	4.1	-
Paralauterbroniella sp.	-	5.4	-
Tabanidae Larvae	-	5.5	12.5
Mollusca			
Corbicula fluminalis	33.3	8.3	12.5
Lymnaea auricularia	-	5.5	+
Physa gyrina	-	2.7	+
Nematode			
Aphanolaimus sp.	-	2.7	-
Dorylaimus sp.	-	1.4	-
Oligchaeta			
Branchiura sowerbyi	+	2.7	+
Chaetogaster diastropus	-	4.1	-
Cocoon of Oligochaeta	-	2.7	-
Limnodrilus hoffmeisteri	33.4	20.6	25
Immature Oligochaeta	+	4.1	25
Limnodrilus clapridianus	−	5.6	-
Number of Species	3	19	6
Density (ind/m²)	33.9	813.4	88.8
Total Biodiversity	1.04	2.86	1.9

Macro faunal Species, Absence less than > 1% and presence more than < 1%.

Table 5. The statically comparisons values between sediment and benthic community parameters for all sampling sites* near the fish floating cages before Al –Kut Barrier during the period (January to December 2014)

Site	Variable	df	Site		Season		Site x Season	
			F	p-level	F	p-level	F	p-level
S_1	Oc	35	82.21	**	0.17	Ns	11.08	**
	Om	35	37.4	**	0.09	Ns	13.01	**
	S	35	0.52	ns	1.39	Ns	15.30	ns
	N	35	1.16	ns	9.03	**	1.29	ns
	H	35	0.38	ns	1.11	ns	1.20	ns
S_2	Oc	35	30.90	**	7.02	**	20.23	**
	Om	35	21.10	**	9.0	**	15.92	**
	S	35	25.02	**	7.78	**	18.44	**
	N	35	19.86	**	11.9	**	17.42	**
	H	35	172.43	**	20.15	**	15.47	**
S_3	Oc	35	39.8	**	9.46	**	7.70	**
	Om	35	20.07	**	0.16	ns	10.65	**
	S	35	22.27	**	6.83	**	9.09	**
	N	35	1.5	ns	33.03	**	11.23	**
	H	35	140.6	**	5.51	**	19.19	**

*Sampling sites of Oc: Organic carbon, Om: Organic matter, S: number of species, N: number of individuals and H: biodiversity, ns: no significant, ** significant ($P \leq 0.05$)

Discussion

The results in table (1) showed that the values of some of water quality were agreed with some previous studies about Iraq inland waters, seasonal fluctuation in water temperature, slight alkalinity or neutral, increment in water salinity towards south and within good aeration (Al-Temimy, 2004; Abbas *et al.*,2011). These ambient with the available food are performance and comfortable for aquatic organisms, for fishes and benthic invertebrates, and the benefits for aquatic organisms with its distribution, occurrence, growth and spawning. (Pouilly *et al.*, 2006; Orrego *et al.*, 2009).

The differences in sediments composition depending on the differences in organic matter and organic carbon (Al-Rubaie, 2001; Al-Temimy, 2004) and the fluctuation of sediment contents may due to the accumulation of fish diet sum which using inside floating cages and the faces of the fish. These results are nearby of studies in other areas which reported that the accumulation of organic matter can extend from 145 to 205 m down-current from the perimeter of net pen facilities (Brooks and Mahnken, 2003), although other scientists conclude that significant effects are usually restricted to less than 60 m from the perimeter (Nash *et al.,* 2005). All the potential environmental impacts of salmonid net-pen aquaculture, changes the sediment beneath net pens are considered to represent the greatest risk to the environment (Brooks and Mahnken, 2003), although these changes are temporary and largely reversible. Organic carbon can be used as an indicator of the health of the benthic ecosystem, since it is correlated to benthic diversity (Kalantzi and Karakassis, 2006).

The current results for benthic invertebrate's density and species indicated that our study sites are not polluted zone (ASTM, 2006). Furthermore, the increment in the abundance and diversity index of the benthic invertebrate inside fish floating cages sites may due to the comfortable circumstances for its life (Tessa *et al.*, 2013). According to Papageorgiou *et al.* (2010) this is more obvious for oligotrophic systems, where under normal conditions we observed low abundance and high diversity. It is generally expected that benthic assemblages respond to organic disturbance in terms of decreased species diversity for a selection of a few opportunistic species

(Nikos *et al.*, 2010) but reduced density and biomass (Tessa *et al.*, 2013), partially offset by the increased abundance of opportunistic species. The additional food resource is likely to be exploited by opportunistic species. The dominant species of our study sites were naimly, *Limnodrilus hoffmesteri* (oligochaete), *Chironmous* sp. (arthropoda) and *Corbicula fluminalis* (mollusca). However, the current results dont agree with Karakassis *et al.* (2000), whom, noticed that these dominated taxa which is an opportunistic macro fauna are commonly found in polluted river sediments. However, other authors have been reported present of this species under fish floating cages (Klaoudatos *et al.* 2006). Nikos *et al.* (2010) also suggested that the presence of large numbers of *L. hoffmesteri* is an indicator of polluted and semi-polluted conditions. However, In the present study, *L. hoffmesteri* did not exceed 50% of the total abundance (S_2). In the past few decades, freshwater habitats have received significant remediation (ASTM, 2006) as a result of the clean water Act´s call for greater ecological integrity. In particular, their biodiversity has increased. Lake Erie´s levels of dissolved oxygen are increasing in the water bottom, and *Chironmous* sp. are beginning to return to sediments in the shallow western basin that was once thought to be dead. The return of *Chironmous* sp. means that nutrients are again rapidly converted from long-term storage in river sediments into prey that are available to many species of fishes and other consumers rather than accumulating in the mud's, without these benthic insects, many nutrients would reach high concentrations in the sediments and will don't available to consumer species (Yucel-Gier *et al.*, 2007), and these may are nearby the present results. However, the ecosystem is being modified now by the spread of invasive non-native species that have altered the flow of energy within the benthic community (Stewart *et al.,* 1998). These invasive mollusca *Corbicula fluminalis* alter food webs in several ways. First, filter feeding by these species removes suspended organic materials in overlying waters and can enrich sediments for use by other benthic species. Second, *C. fluminalis* shells provide hard surfaces for colonization by various benthic invertebrates (Nikos *et al.*, 2010). Finally, these shells also serve as structural refugee for prey so that many types of benthic invertebrates may avoid fish predators. From available information it is not possible to predict precisely how the addition and persistence of these invasive mollusca will ultimately change energy flow and influence water quality (Papageorgiou *et al.*, 2010) .

The results of correlation between benthic invertebrate with the other factors during study period, were provided our investigate which shown that fish floating cages were done a role in this site. On the other hand, benthic invertebrate were affected in composition and distribution by the activity of this methodology of fish raring. Certainly may be due to decrease of water flow inside and under the floating cages, as well as increased deposition of fish feces and output of untaken feed, which provide a suitable and comfortable niches for the presence of these aquatic organisms.

References

Abbas, L.M. ; Abu-Elheni, A.J. and Aseel G.R. (2015). Fish Community of Tigris River before Al-Kut Barrier, Southern Baghdad, Iraq. Journal of Chemical, Biological and Physical Sciences 5(2): 1639-1645.

Abbas, L.M.; Abu-Elheni, A.J.; Ruhaij, A.M.; Hassan, H.A.; Fadhel, A.A. and Neamah, Y.J. (2011). Fish Farming Using Floating Cages in Iraq, the Experiment and Application".The 3rd International Symposium on Cage Aquaculture in Asia *(CAA3),* from 16 th – 19 th November 2011, Kuala Lumpur, Malaysia, 7pp

Abu-Elheni, A.J. (2014). Effect of Stocking Density and Partitioning of Rearing Period on Growth and Production of Common Carp *Cyprinus carpio* L. in Floating Cages near Al-Kut Barrage/Tigris River. Ph. D Thesis Collage of Agriculture, Tikrit University:127 p. (in Arabic).

Al-Rubaie, A.G. (2001). Comparative Ecological Study for Benthic Invertebrates in Gradiant Salinity Surface Water, Middle of Iraq. M.Sc. Thesis, College of Science, University of Al-Mustansiriyah, 87 pp.

Al-Temimy, L.M. (2004). Ecology, Biology and Assessment of fish Community in Euphrates River near Al-Mussaib Power Station. Ph. D. Thesis. Agriculture College., Basrah University: 147 p. (in Arabic).

ASTM: American Society for Testing and Materials. 2006. Standard guide for conducting acute toxicity tests on test materials with fishes, macroinvertebrates, and amphibians. E729-96 (2002). In Annual Book of ASTM Standards, Vol 11(06). Philadelphia, PA, :79 – 100.

Brinkchurst, R. O., (1984) Aquatic Oligochaeta of the World: Supplement Oligoghaeta of the New freshwater Description and Revision, Canadian Tech.Rep. of Hydrography and Ocean Sci., 44 pp.

Brooks, K.M. and Mahnken, C.V. (2003). Interactions of Atlantic salmon in the Pacific northwest environment. II. Organic wastes. Fish Res 62:255–293

Gaudette HE, Flight WR, Toner L & Folger DW. (1974). An inexpensive titration method for the determination of organic carbon in recent sediments. J Sediment Petrol 44: 249 –253.

Kalantzi, I. and Karakassis, I. 2006. Benthic impacts of fish farming: meta-analysis of community and geochemical data. Mar. Pollut. Bull., 52:484–493

Karakassis, I.; Tsapakis, M.; Hatziyann, E.; Papadopoulou, K.N. and Plaiti, W. (2000). Impact of cage farming of fish on the seabed in three Mediterranean coastal areas. ICES J. Mar. Sci. 57:1462–147.

Karakassis, I.; Tsapakis, M.; Smith, C.J. and Rumohr, H. (2002). Fish farming impacts in the Mediterranean studied through sediment profiling imagery. Mar. Ecol. Prog. Ser., 227: 125–133.

Klaoudatos, D.S.; Smith, J.; Bogdanos, K. and Papageorgiou, E. (2006). Assessment of site specific benthic impact of floating cage farming in the eastern Hios island, Eastern Aegean Sea, Greece. J. Exp. Mar. Biol. Ecol. 338: 96–111

Maldonado, M.; Carmona, M.C.; Echeverría, Y. and Riesgo, A. (2005). The environmental impact of Mediterranean cage fish farms at semi-exposed locations. Helgol. Mar. Res., 59:121–135.

Nash, C.E.; Burbridge, P.R. and Volkman, J.K. (2005). Guidelines for ecological risk assessment of marine fish aquaculture. US Dept of Commerce, National Oceanic and Atmospheric Administration (NOAA) Tech Memo NMFS-NWFSC-71. Available at http://aquaculture.noaa.gov/pdf/afs_07_nash.pdf

Nikos, N.; Dimitries, V. and Spyros, K. (2010). Spatial and temporal effects of fish farming on benthic community structure in semi-enclosed gulf of the Eastern Mediterranean.Aqua. Environ. Interact., vol. 1: 95-103.

Orrego, R.; Adams, S.M.; Barra, R.; Chiang, G. and Gavilan, J.F. (2009). Patterns of Fish Community Composition Along a River Affected by Agriculture and Urban Disturbance in South- Central Chile. Hydrobiologia; 620:35-46.

Papageorgiou, N.; Kalantzi, I. and Karakassis, I. (2010). Effects of fish farming on the biological and geochemical properties of muddy and sandy sediments in the Mediterranean Sea. Mar. Environ. Res., 69:326–336.

Pennak, R. W., (1978) Freshwater invertebrates of the United State. 2nd, John. Wiley and Sons. New York, 213 pp.

Person, T.H. and Black, K.D. (2001). The environmental impacts of marine fish cages culture. In environmental impacts of aquaculture. (ED. K.D. Black). Sheffield Academic Press. Sheffield Biological Science. 31pp.

Pouilly, M.; Barrera, S. and Rosales, C. (2006). Changes of Taxonomic and Trophic Structure of fish Assemblages along an Environmental Gradient in the upper Beni Watershed (Bolivia). Fish Biology J.,68 (1):137-156.

SAS Institute Statistical Analysis System. (2010). Users Guide. Statistical Version 12th ed. SAS. Inst., Inc., Cary. N.C. USA.

Shannon, C.E. and Weaver, N. 1949. The mathematical theory of communication. University of Illinois Press, Urbana, IL

Stewart, T.W.; Miner. J.G. and Lowe, R.L. (1998). An Experimental analysis of Cryfish (*Orconestes rusticus)* Effects on a *Dreissena*- dominated Benthic Macroinvertebrate Community in western Lake Eri. Canadian Journal of Fisheries and Aquatic Science 55:1-7.

Tessa, C.V.; Marja, A.V. and Jeroen, P.V. (2013). Macro-Invertebrate Decline in Surface Water Polluted with Imidacloprid. PLoS One, Published online, PMCID: PMC 3641074 ; 8(5): 62-74

Yucel-Gier, G.; Kucuksezgin, F. and Kocak, F. (2007). Effects of fish farming on nutrients and benthic community structure in the Eastern Aegean (Turkey). Aqua. Res., 38:256–267.

توزيع وتركيب مجتمع لافقريات القاع عند الاقفاص العائمة لتربية الاسماك في نهر دجلة قبل سدة الكوت في محافظة واسط/ العراق

اسيل غازي راضي[1] ، لؤي محمد عباس[2]، عبد الكريم جاسم ابو الهني[3]، علي عباس الحسني[4]

[1، 2، 3] مركز الثروة الحيوانية والسمكية/ دائرة البحوث الزراعية

[4] مركز التربة والموارد المائية/ دائرة البحوث الزراعية/ بغداد العراق

e-mail: luaym294@yahoo.co.uk

الخلاصة

اجريت دراسة فصلية لتوزيع وتركيب مجتمع لافقريات القاع في ثلاثة مواقع عند الاقفاص العائمة لتربية الاسماك في نهر دجلة قبل سدة الكوت في محافظة واسط/ العراق للمدة من كانون الثاني لغاية كانون الاول 2014. قيست بعض خواص نوعية المياه وتراوحت المديات الفصلية لدرجة حرارة المياه من 14 °م في الشتاء الى 32 °م في الصيف وتركيز الاوكسجين بين 5.2 ملغم/ لتر في الصيف الى 9.8 ملغم في الشتاء وقيم الاس الهيدروجيني للمياه بين 7.5 الى 7.8، وتركيز الملوحة بين 0.5 غم/لتر في الشتاء الى 0.73 غم/لتر في الصيف وقيم الكدرة بين 250 في الربيع الى 900 وحدة كدرة نفثالين في الخريف. كانت طبيعة القاع في موقع الدراسة بين طينية، وغرينية وطينية غرينية.

تم تشخيص 19 وحدة تصنيفية من اللافقريات القاعية مثلت منها 8 انواع لمفصلية الاقدام و 6 انواع للديدان قليلة الاهلاب و 3 انواع للنواعم ونوعين للديدان الخيطية. سجلت فروقات معنوية $P \leq 0.05$ في الموقع S_2 (داخل الاقفاص) للمادة العضوية بنسبة 4.7 % وللكاربون العضوي 2.74% ولعدد الانواع 19 نوعا وللكثافة 813.4 فرد/م^2 وللتنوع الاحيائي للافقريات القاع 2.86 مقارنة بالموقعين S_1 و S_3. شهد كذلك الموقع S_2 سيادة للمفصليات (الحشرات) بنسبة 46.6% تلتها ديدان قليلة الاهلاب والنواعم والديدان الخيطية بنسب 32.9% و16.5% و4% على التوالي من الكثافة الكلية للافقريات القاع. يستنتج من الدراسة الحالية زيادة في الكثافة الكلية للافراد والتنوع الاحيائي للافقريات القاع في الموقع S_2 داخل الاقفاص العائمة مقارنة بالموقعين الاخرين S_1 و S_3 قبل وبعد الاقفاص العائمة على التوالي.

الكلمات المفتاحية: لافقريات القاع، التوزيع والتركيب، الكثافة، التنوع الاحيائي