ABIOTIC ECOLOGICAL CHARACTERISTICS OF THREE SELECTED FISH FARMS IN BABYLON AND BASRAH PROVINCES, IRAQ.

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Abstract

The study is part of a comprehensive work to investigate impact of fish enemies on cultivated species. It has taken in consideration some vital abiotic characteristics necessary for cultivated fishes. Three fish farms were selected in two provinces, namely Al-Manahel fish farm (presently called Al-Belad) in Babylon province; Basrah University fish farm (Marine Science Center) and Al-Mutawaa fish farm situated south to city of Basrah. Water samples were monitored on monthly basis for the period from January to October 2002. Several parameters namely, temperature, pH, salinity, total alkalinity and total hardness were measured. The highest water temperature (31ºC) was recorded in July and August from Al-Mutawaa fish farm and the maximum pH value 8.0 was encountered during January from Basrah university fish farm and the lowest pH= 7.2 in May from the same farm. Results indicate a notable rise in salinity in Al-Mutawaa fish farm and the highest (6.0 g/L) encountered in June and the lowest (2.8 g/L) in March. The maximum concentration of total alkalinity (172 mg/L) was from Al-Mutawaa as well recorded in September. Values of total hardness were almost similar in Al-Manahel and Basrah university fish farms, but the latter revealed a bit higher value in May (581 mg/L), whereas Al-Mutawaa fish farm showed, by no means, the highest concentrations all the year round, but the maximum (880 mg/L) was detected in March.

Introduction

Fish industry, in Iraq, apparently became more popular in the last two decades in particular in central sector of the country as there is little or no natural fishery to exploit in these sites. However, in general, there has been a marked awakening of interest in inland pisciculture. Inland waters vary widely at various parts of the country owing to several causes. Hence they vary in their productivity. It is obvious that ecological conditions play substantial role in fish production and the vital life-processes in the pond are at the optimum, when the physical and chemical parameters of water are normal. Such factors are essential for cultivated species at certain levels or it may be harmful or fatal at abnormal concentrations. Ecological factors may also interfere and magnified their negative effects.

Several workers including Weatherly and Rogers (1978); Linfield(1982); Salman *et al*. (1982); Weatherly and Gill (1987); Hussein *et al*. (1992); Hussein and Attee (2000); Hussein *et al*. (2000); Hussein *et al*. (2002) have studied abiotic conditions in natural environments, but no one of them has taken their levels or benefits in cultivation closed system or other fish ponds in consideration. It is therefore in the present work some important physico-chemical conditions, for survival and proper growth, were selected which also have great impact on fish production.

Materials and Methods

The present work has investigated some water quality criteria of three fish farms situated in two Iraqi provinces (Babylon and Basrah) namely, Al-Manahel fish farm (MF) (presently Al-Belad) in Babylon. It consist 57 fattening ponds of various sizes and 12 small ponds for post larval. The former used for cultivation of different carp species. The second farm is Basrah University fish farm (MSC) (BF). It consist of eight small ponds (area= 0.8-1.2 acre) and two very small ditches. The total area is 12 acre used for rearing fish from carp family and the farm run by a contractor. Finally Al-Mutawaa fish farm (MUF) situated southern of Basrah city at a distance 30 km from city centre. The three farms get their water from natural habitats, except MCS farm tend to use tap water as well. Most of the cultivated areas are populated with scattered aquatic vegetations except Al-Mutawaa that are distinguished with its dense growth of aquatics mainly *Phragmites australis* and *Typha domengensis*.

Water samples were collected on monthly basis from the three fish farms, but from those farms with several ponds the growing ponds were selected for collecting samples for analysis and a representative sample was taken. Several ecological parameters, closely related with the well being and growth of cultivated species, were measured, namely, water and air temperatures, pH, total alkalinity, salinity and total hardness. Water samples were collected during the day time from 10-12 A.M and preserved in plastic containers for further analysis in the laboratory. Air and water temperatures were measured in the field by simple thermometer. pH was determined by pH meter model D812. Digital conductivity meter was used to get conductivity value and the reading was multiplied by 0.64 to obtain the salinity level. Methods described in Lind (1979) were consulted to determine concentrations of both total alkalinity and total hardness.

Results

Table (1) illustrates monthly values and yearly means with standard errors (S.E) of the selected ecological parameters in the three investigated fish farms. Notable variations were detected among localities.

Figure (1) shows monthly changes in air temperature in the studied farms. There was gradual increase in values, in all localities, to achieve peak in summer months. The highest values (39, 38 and 38 ºC) were encountered in August from MUF, BF and MF respectively. The lowest, however, were 24, 16 and 14 ºC measured from the above sites in the same order during March and January. It should be noted that the former farm was dried during January and February (Table1).

Figure (2) reveals monthly variations in water temperature in the three selected farms. It is evident it has the same trend of air temperature. The highest (30 ºC) was attained in July from MF and BF, but in July and August (31 ºC) in MUF. Temperatures of air and water started to depart from each other during the summer months to achieve maximum differences (9 ºC) in September. The minimal water temperature value, in

general, was 12 ºC in MF recorded in January. Statistical analysis indicates insignificant differences (P> 0.01) in water temperatures among farms.

Figure (3) shows monthly differences in pH values. It is evident that values fluctuate slightly. The highest were 8.0, 7.8 and 7.7 in BF, MUF and MF respectively recorded in March, May and March in the same order and the lowest (7.1) was in October from MF, and in May and October from (BF), but 7.4 in MUF. Abnormal and intolerable values affecting growth and appetite were not detected. Also, insignificant variations (P> 0.01) in pH values were found among localities.

Figure (4) shows monthly changes in levels of total alkalinity (ppm as CaCO3). It is evident that gradual rise in values in MF was clear to achieve the highest in May (170 ppm as CaCO3), then a notable decline occur to attain the lowest (90 ppm as CaCO3) in September. A monthly fluctuation in alkalinity was detected in BF and MUF and the maximum concentrations 155 and 172 were recorded in July and September respectively, whereas the minimal 72 and 100 were found in October and April in the same order as above. Statistical variations were not detected (P>0.01) in total alkalinity among the investigated farms.

Figure (5) indicates monthly variations in concentrations of water salinity (g/L) in the studied localities. It appeared that a relative increase in salinity in MF was evident when the highest (2.4 g/L) was recorded in April and May and the lowest (1.7 g/L) in September and January. The highest value in BF (1.8 g/L) was recorded in January and the lowest (1.1 g/L) in August and September. However, exclusively higher values were detected in MUF and the lowest concentration (2.8 g/L) was exceeding the highest in other farms. Then a gradual rise was detected in values to achieve highest (6.0 g/L) in June. Significant differences (P<0.01), however, were found in salinity values among the three farms.

Figure (6) reveals monthly differences in values of total hardness (mg/L as CaCO3) in the three studied farms. It is evident that MF and BF almost resembling each others. The highest value in MF (581 mg/L) was recorded in May and in BF (572 mg/L) was during September. MUF, however, exhibited higher values than others (880 mg/L) in March. The minimal values of total hardness in MF, BF and MUF were 438, 390 and 632 mg/L respectively recorded during January, February and September in the same ordered. Investigated farms were significantly differ (P<0.01), in their contents of hardness.

Discussion

Water used in fish culture should be under control from ecological point of view as continuous neglect often results in an overgrowth of undesirable of aquatic vegetations or nuisance conditions, leading to change in water quality and consequently a reduction in fish production.

Water temperature is one of the most vital environmental factors affecting occurrence, abundance, distribution and growth of aquatic organisms, in both natural and captive environments, along with their bio-physiological activities (Macan, 1974; Araujo *et al*., 2000; Power *et al*., 2000; Hussein *et al*., 2000; Hussein *et al*., 2002). The maximum values were encountered in July and August in the three farms (Fig. 1&2), but those values were within the tolerable limits of the cultivated species. It has been found that water temperature coincided with that of air and the minimal differences among them were recorded during the winter and the highest in summer months. This is in agreement with several workers including (Hussein *et al*., 1992; Al-Shamma *et al*., 1997; Hussein *et al*., 2000; Hussein *et al*., 2002). In warm waters biological production and growth

are much more rapid than in cold waters. This indicates that normal growth is much more retarded in winter time. It is therefore, the culturist has got to adopt some vital means of control if he wishes to continue rearing and keep the stock for extra growing period.

Values of pH in the three investigated fish farms were found to be on the alkaline direction (Fig. 3) and within the tolerable and most suitable range for aquatic organisms (6.5-8.5) as indicated by Svobodova *et al*., (1993). Such limits were recognized in several inland localities (Taher, 1986; Hussein *et al*., 1992; Al-Shamma *et al*., 1997; Hussein *et al*., 2000) that fed fish ponds. Al-Shawi (1998) recorded higher values of pH (8.2-9.1) in concrete tanks. However, Boyd and Lichtkoppler (1979) pointed out that values of pH fluctuate in fish ponds during the day time being higher during the night. Brown (1980) deduced that many factors may affect pH levels in natural habitats including free carbon dioxide, precipitation that serve to release hydrogen ion concentration (H+) by dissociation of carbonic acid (Hynes, 1970). There was no significant variations ($P>0.05$) in pH values of the three fish farms.

Ecological studies confirmed that salinity plays a substantial role in governing the magnitude of living populations and its spatial composition (Power *et al*., 2000). According to Reid (1961) classification, however, all investigated farms, were oligotrophic and this is in agreements with the majority of inland water bodies (Taher, 1986; Hussein *et al*., 1992; Hussein and Attee, 2000). However, salinity values recorded in the present work are tolerable by cultivated species and do not act as inhabiting factor to their normal growth (Hume *et al*., 1983) for fish ponds. MUF exhibited higher values of salinity compared to others (Fig.4). This could be attributed to source of water which probably affected by tides, drainage waters and domestic sewage. Taher (1986) encountered almost resembling values of MUF (3.4-6.6 g/L) in Al-Bahadriya fish pond. Boyd and Lichtkoppler (1979) deduced that higher concentrations of salinity should not exceed the range 8-12 g/L. Statistical analysis indicate significant differences ($P<0.01$) in salinity among the three fish farm.

All investigated fish farms are distinguished with their higher concentrations of total alkalinity (>40mg/L) according to Mairs (1966) and Sawyer and McCarty (1967), as the lowest recorded values were 72, 90 and 100 mg/L in BF, MF and MUF respectively (Fig.5). Such values are coincided with those monitored from natural inland waters (Taher, 1986; Hussein et al., 1992; Hussein and Attee, 2000) as the vast majority of our inland waters are alkaline. Alkalinity concentrations are affected with several parameters including free carbon dioxide, activity of microorganisms, composition of the substrate and content of bicarbonates (Reid, 1961). The latter (HCO-3) is dominant in natural waters Boyd and Lichtkoppler (1979) pointed out that waters of higher alkalinity and lower hardness are with higher pH and may cause some difficulties during the fast growing periods of phytoplankton. Statistical analysis reveals insignificant variations ($P>0.05$) in values of total alkalinity in the three farms.

The study shows that waters of the investigated farms are hard according to classification of both Sawyer and McCarty (1967) (>300 mg/L) and Lind (1979) (>181 mg/L). It has been deduced that values, of total alkalinity and total hardness, preferred by fishes are within the range 20-300 mg/L (Boyd and Lichtkoppler, 1979). Such values stimulate proper production of planktonic populations.

Statistical analyses revealed significant variations ($P<0.01$) in hardness among the investigated farms. Although all the monitored ecological criteria were

almost within the normal requirement of cultivated species, farmers in the investigated locations were found to pay little attention for improvement, as it is well known, for the successful rearing of fish, the water should be of the right quality and the large variety of inland waters can be exploited for fish cultivation with little efforts. All unpleasant conditions that may affect water quality and result in a reduction in growth of cultivated fishes should be kept in check.

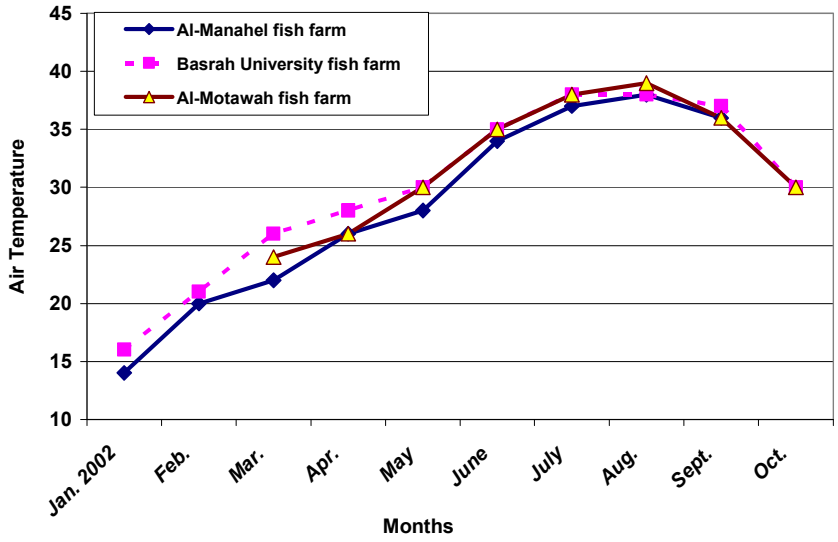

Fig. (1) Monthly changes in air temperatures in the three selected fish farms

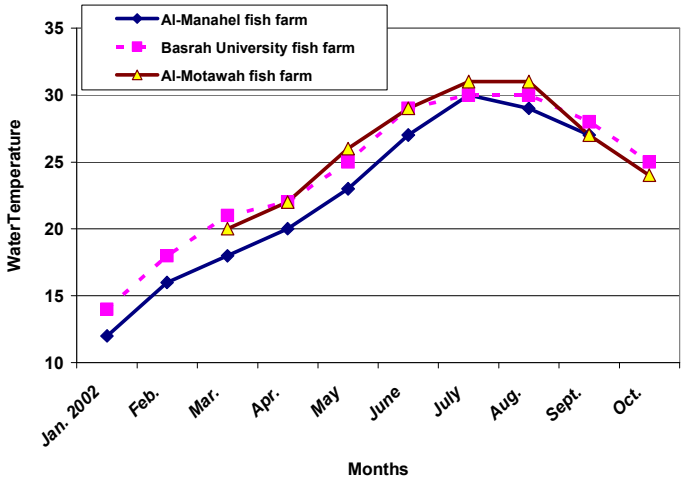

Fig. (2) Monthly variations in water temperatures in the three selected fish farms.

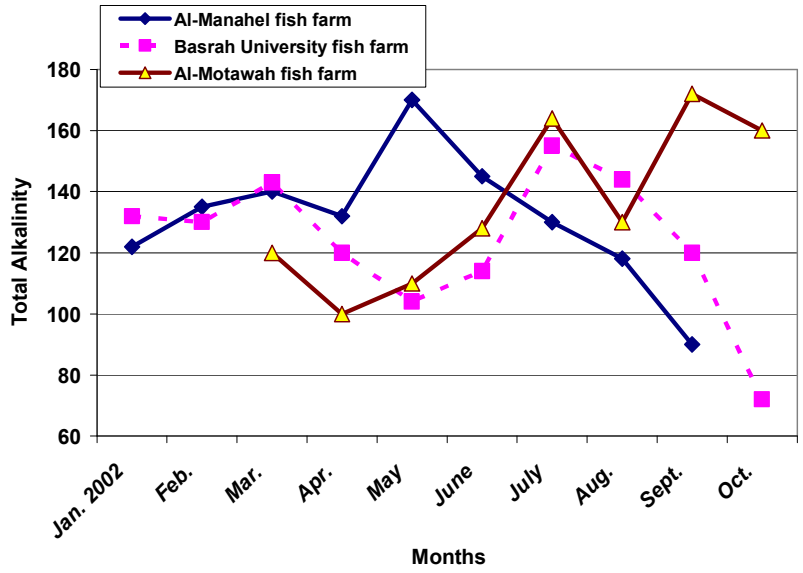

Fig. (3). Monthly variations in pH values of the three selected fish farms.

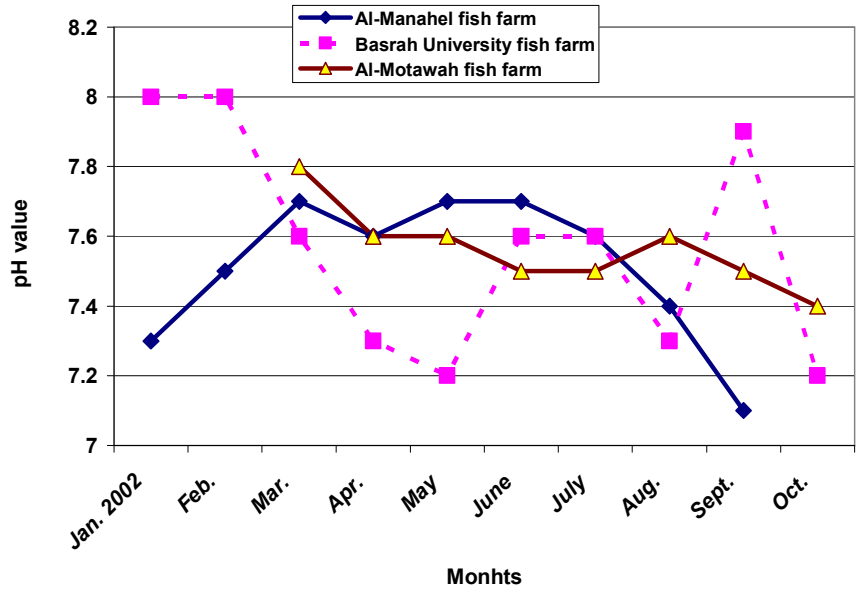

Fig. (4) Monthly variations in concentrations of total alkalinity (as ppm $CaCO^3$) in the three selected fish farms.

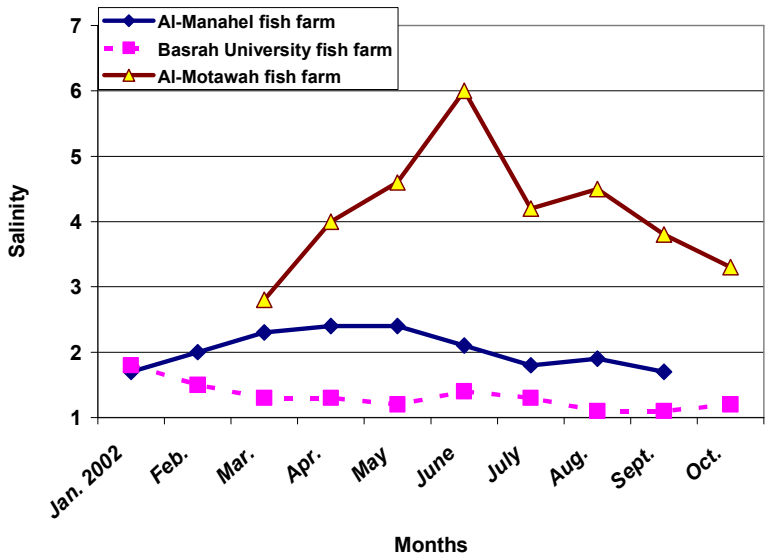

Fig.(5) Monthly variations in salinity (ppt) in the three selected fish farms.

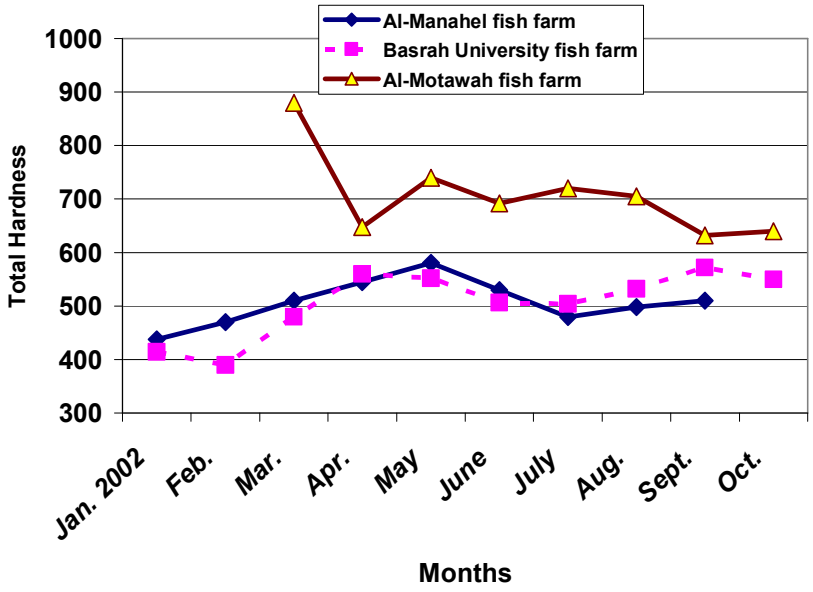

Fig.(6). Monthly changes in concentrations of total hardness (as mg/L $CaCO_3$) in the three selected fish farms.

Table (1): Monthly variation in some a biotic factors in Al-Manahel fish farm (1), Basrah University fish farm (2), and Al-Mutawah fish farm (3).

Ecological factors	Month / Farms	Jan. 2002	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Mean ± S.E
Air Temp.	1	14	20	22	26	28	34	37	38	36	-	28.3 ± 2.8
	2	16	21	26	28	30	35	38	38	37	30	29.9 ± 2. 4
	3	-	-	24	26	30	35	38	39	36	30	32.3 ± 1.8
Water Temp.	1	12	16	18	20	23	27	30	29	27	-	22.4 ± 2.1
	2	14	18	21	22	25	29	30	30	28	25	24.2 ± 1.7
	3	-	-	20	22	26	29	31	31	27	24	26.7 ± 1.3
pH	1	7.3	7.5	7.7	7.6	7.7	7.7	7.6	7.4	7.1	-	7.5 ± 0.07
	2	8.0	8.0	7.6	7.3	7.2	7.6	7.6	7.3	7.9	7.2	7.6 ± 0.04
	3	-	-	7.8	7.6	7.6	7.5	7.5	7.6	7.5	7.4	7. 6 ± 0.04
Salinity (‰)	1	1.7	2.0	2.3	2.4	2.4	2.1	1.8	1.9	1.7	-	2.03 ± 0.09
	2	1.8	1.5	1.3	1.3	1.2	1.4	1.3	1.1	1.1	1.2	1.3 ± 0.07
	3	-	-	2.8	4.0	4.6	6.0	4.2	4.5	3.8	3.2	4.1 ± 0.3
Total Alkal.(ppm)	1	122	135	140	132	170	145	130	118	90	-	13.4 ± 7.2
	2	132	130	143	120	104	114	155	144	120	72	123.4 ± 7.5
	3	-	-	120	100	110	128	164	130	172	160	135.5 ± 8.8
Total Hard.(ppm)	1	438	470	510	545	581	530	480	498	510	-	506.8 ± 14.1
	2	414	390	480	560	552	506	504	532	572	550	506.0 ± 19.6
	3	-	-	880	648	740	692	720	705	632	640	707.1 ± 26.5

References

Al-Shawi, S..A. K (1998). Effect of fertilization on growth of kishni *Liza abu* (Heckel,1843) in concrete tanks. PhD thesis, Coll. Agriculture, Basrah Univ. PP.70 (in Arabic)

Al-Shamma, A.A. ; Ahmed, M. A. A.; Saleh, K. I.; Mohamed, M. A.; Khadhim M. J. (1997). Cultivation of common carp depending on natural food components in middle region of iraq. Ibaa J. for Agricultural researches 7(1) 32-49. (in Arabic)

Araujo, F. G.; William, W. P. and Bailey, R. G. (2000). Fish assemblages as indicators of water quality (1980-1989). Estuarine, 23 (3): 305-317.

Boyd, C. E. and Lichtkoppler, F. (1979). Water quality management in pond fish culture. Res. Develop. Ser. No. 22: 30 pp.

Brown, S. L. (1980). Ecology of freshwater. Heinemann Educ. Books, Ltd. London: 78 pp.

Hume, D. J.; Fletcher, A. R. and Morison, A. K. (1983). Carp program. Arthur Rylah Institute for Environmental Research. Fisheries &Wildlife Division, Victoria. Final report, No. 10: 213pp.

Hussein, S. A. and Attee, R. S. (2000). Comparative studies on limnological features of the Shatt Al-Arab estuary and Mehejran canal. 1: Monthly variation in a biotic factors. Basrah J. Agric. Sci., 13 (1): 49-59.

Hussein, S. A.; Ahmed, H. A. and Abed, J. M. (1992). Seasonal variation in some ecological conditions in Shat Al-Arab river and Al-Hammar marsh. Mar. Mesopot., 7 (2): 175-194.

Hussein, S. A.; Al-Essa, S. A. and Al-Manshad, H. N. (2000). Limnological investigation to the lower reaches of Saddam River. 1: Environmental characteristic. Basrah J. Agric. Sci., 13 (2): 25-37.

Hussein, S. A.; Al- Essa, S. A. and Al-Sewech, A. R. (2002) Comparative studies on ecological features of Khora canal and the Shatt Al-Arab estuary, Southern Iraq. Basrah J. Agric. Sci., 15 (4): 27-41.

Hynes, H. B. (1970). The ecology of running waters. Liverpool University Press: 555 pp.

Lind, O. T. (1979). Handbook of common methods in limnology. 2nd ed. London: 199 pp.

Macan, T. T. (1974). Freshwater ecology. 2nd ed. Longman Group Ltd., London: 343 pp.

Mairs, D. F. (1966). A total alkalinity atlas for marine lake water. Limnol. Oceanogr., 11: 68-72.

Power, M.; Attrill, M. J. and Thomas, R. M. (2000). Environmental factors and interactions effecting the temporal abundance of juvenile flatfish in the Thames estuary. J. Sea Res., 43: 135-149.

Reid, G. K. (1961). Ecology of inland waters and estuaries. D. van Nostrand Co., New York: 375 pp.

Salman, N. A.; Hussein, S. A. and Zowar, J. K. (1982). The effect of hydrogen ion concentration on survival of khishni *Liza abu* (Heckel). Zanco, Ser. A., 8(2): 121-128.

Sawyer, C. N. and McCarty, P. L. (1967). Chemistry for salinity engineers. Mc Graw-Hill Book Co., New York: 518 pp.

Svobodova, Z.; Lioyd, R.; Machova, J. and Vykusova, B. (1993). Water quality and fish health. EIFAC Tech. Pap. 54: 67pp.

Taher, M. M. (1986) Growth of common carp (*Cyprinus carpio* L.) fingerlings in various areas of Basrah governorate. Msc thesis Coll. Agricul., Basrah Univ. PP. 88 (in Arabic).

Weatherly, A. H. and Gill, H. S. (1987). Biology of fish growth. Academic Press, London.

الخصائص البيئية اللاحياتية في ثلاث مزارع سمكية منتخبة في محافظتي بابل والبصرة، العراق

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الخلاصـــــة

تناولت الدراسة قياس الخصائص البيئية الفيزيائية والكيميائية في ثلاث مزارع سمكية وهي مزرعة المناهل (البلاد حالياً) في محافظة بابل، ومزرعة جامعة البصرة / مركز علـوم البحـار، ومزرعة المطوعة في محافظة البصرة. وجمعت العينات على أساس شهري للمدة مـن كـانون الثاني ولغاية تشرين الأول 2002. إذ تناولت الدراسة الخصائص اللاحياتية المهمة في حياة اسماك المستزرعة، وهي درجة الحرارة والأس الهيدروجيني والملوحة والقاعدية الكلية والعسرة الكليـة. وكانت أعلى درجة حرارة للماء 31 °م سجلت في تموز وآب من مزرعة المطوعة، أما أعلـى القيم للأس الهيدروجيني (pH) فكانت 8 سجلت خلال كانون الثاني من مزرعة جامعـة البـصرة وأدناها 7،2 في أيار في نفس المزرعة. وأظهرت التحاليل أن هناك ارتفاعا ملحوظـا فـي قـيم الملوحة في مزرعة المطوعة وكان أعلى تركيز في حزيران (6.0غم/لتر) وأدناه (2.8 غم/لتـر) في آذار. وسجلت أعلى القيم للقاعدية الكلية (172 ملغم/لتر) كذلك من مزرعـة المطوعـة فـي أيلول.وكانت قيم العسرة الكلية متقاربة في مزرعتي المناهل وجامعة البصرة وكانت أعلاها فـي المناهل (581 ملغم/لتر) وأظهرت مزرعة المطوعة أعلى القيم على مدار السنة على الإطلاق وكانت أعلاها (880 ملغم/لتر) في آذار.