Comparative ecological study of pathogens structure between wild and cultured common carp Cyprinus carpio L. in Basrah.

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Abstract:

Monthly samples of water and fish were collected from Qurna, Dayer and Abu Al-Khaseeb localities from the fish cages and from Shatt Al-Arab River outside them on the period from December 2012 to June 2013. The study aimed to investigate the influence of some environmental factors on parasites structure and its prevalence in Cyprinus carpio. The results revealed that Cyprinus carpio was infected with three species of parasites belong to the kingdom protista they are : Myxobolus pfeifferi (phylum Cnidaria), Ichthyophthirius multifiliis (phylum Ciliophora), and Trichodina domerguei (phylum Ciliophora), and four species of parasites belong to the kingdom Animalia they are: Contracaecum sp. (phylum Nematoda), Neoechinorhynchus iraqensis (phylum Acanthocephala), Lernaea cyprinacea (subphylum Crustacea), Ergasilus ogawai (subphylum Crustacea), and two species of fungi they are: Saprolegnia sp., Ichthyophonus hoferi in addition to the infection with fin rot disease. According to locality of infection, in the cages at both Qurna and Dayer, all of the infected fishes were infected with ectoparasites only while at Abu Al-Khaseeb, both ectoparasites and endoparasites were isolated. The statistical analyses showed the influence of environmental conditions upon infection of fish with parasites. The test of variance showed significant variations in percentage of infection ($P< 0.05$) between fish inside cages and outside them (at Shatt Al-Arab River environment), and between the localities ($P< 0.05$). Also, there were highly significant variations between the months ($P< 0.01$).

Key words: fish cages - parasites – prevalence of infection - environmental factors.

Introduction:

Fish farming in various parts of the world has increased many folds in the last decade. So, fish culture has now become commercially an important industry worldwide for supplying animal protein. Many commercial species, including bluegill, hybrid striped bass, carp, channel catfish, salmon, tilapia and trout have been cultured in cages (Beveridge, 1987). In Iraq, the fish Cyprinus carpio L. considered one of the economically fish because of its highly resistance to various

environmental conditions and its growth speed. It had been imported from Holland in 1955 and from Indonesia in 1956 and brought up in Za' faraniyah Fish Pond south of Baghdad (Al-Hamid, 1960). And the production of fish in cages has been practiced in 2008. One of the major issues in fish production through the aquaculture is loss associated with diseases. Improper and faulty management practices followed in fish culture system are often stressful to fish. Under stress condition, fish suppresses the immune responses and alternatively pathogen attack take place subsequently suffer from disease (Guquloth et al., 2013).

Parasitic infections often give an indication of the quality of water since parasites generally increase in abundance and diversity in more polluted waters (El-Naggar, 2012; Guquloth et al., 2013). So, the goal of ecologists is not only to document the distribution of parasites, but also to determine methods by which parasites can disperse to new areas. Through the determination of the groups of parasites that can establish themselves in a new environment, it is possible to determine which strategies of reproduction are favoured. Improved understanding of these mechanisms of dispersion can increase the chances of limiting the dispersion of certain parasites (Takemoto et al., 2009).

The present study is the first one in Basrah which deal with pathogens of fish's cages due to parasite infections. The objective of it was to demonstrate the affect of those environmental circumferences upon the prevalence of infections and their qualities for Cyprinus carpio raised in cages and that lived in wild.

Material and methods:

Sampling:

The present study was conducted on three fish cages located a long Shatt Al-Arab River at Al Qurnah, Al Dayr and Abu Al-Khaseeb (Saraifa, Dayr, Mheijran) villages during the period extended from December 2012 to June 2013 as shown below in figure 1. Monthly samples of water and vital fish were collected from the cages and from Shatt Al-Arab River outside them. A total of 50, 46 and 53 fish that specimens have been collected from the cages of Qurnah, Al- Dayr and Abu Al-Khaseeb respectively while 58, 77 and 69 fish specimens have been collected from the river of Qurnah, Al- Dayr and Abu Al-Khaseeb respectively. Fish samples were captured by both cast and gill nets and later examined in the laboratory within forty eight hours to avoid lose any parasite. Small fish were killed by damaging of spinal pith (pithing) while the large ones were killed by blow on their head.

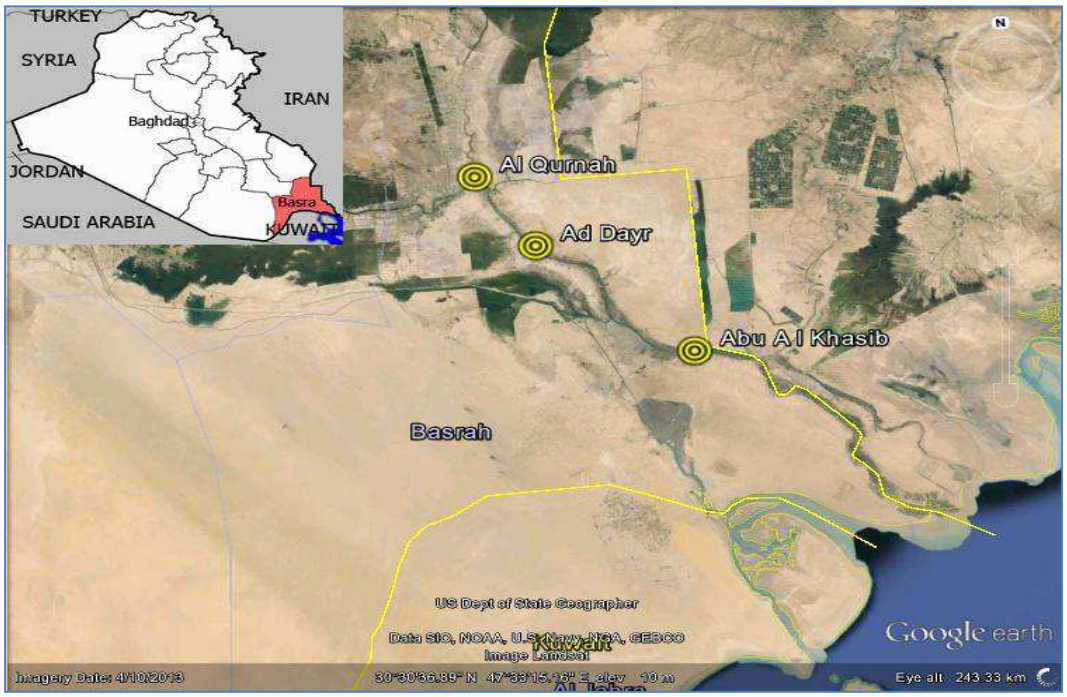

Figure 1: map illustrated the three localities of the studied fish cages at Basrah governorate.

Analytical methods:

Water temperature (W.T.), pH and electrical conductivity (EC) were measured in field with WTW multimeter. The analyses of Chlorophyll a (Ch.a), nitrite (NO_2^-), nitrate (NO_3^-), orthophosphate (PO_4^{-3}) were conducted by colorimetric methods according to APHA (2005). Total Suspended Solids (TSS) was determined gravimetrically according to APHA (2005).

Fish examination, isolation of parasites and slide preparation:

In the laboratory fish were examined for infestation with external parasites by Japanese Meiji dissecting microscope at magnification of 7-45 times, smears were taken from skin, fins and eyes with aid of spatula and fine needle.

Gills were removed by cutting gill arch and transported to petri dish with some tap water in order to examine them under dissecting microscope then slides made from them for later identification with compound microscope at magnification of 64-1600 times. Fish were dissected for detecting internal parasites in digestive tract and other viscera according to Amlacher (1970). Each fish was opened and its internal organs were inserted in petri dishes then isolated alone in petri dishes containing tap water in order to taken smears from them. The entire digestive system was removed and placed in a Petri-dish and opened with a fine needle for isolating internal parasites if present.

After isolating of parasites, different approaches were used for fixation and staining them on slides depending on their groups to whom they belong according to Robert (1982), Kudo (1971), Garcia & Ash (1979), Fernando et al. (1972) for fungi, protozoan, helminthes and crustacean respectively.

Methods of identification and analyses of parasites:

parasites were identified according to Kudo (1971), Kabata (1979), Khamees (1983), Al-Daraji (1986), Mhaisen et al. (1988), Mohamad (1989), Khamees (1996), Moravec et al. (1999), Moravec et al., (2003), Shwani (2009).Then Jaccard similarity index and the prevalence of infection were calculated monthly. Jaccard similarity index was calculated according to Jaccard (1921) and the prevalence of infection was calculated according to Margolis et al. (1982).

Statistical analyses:

For statistical analyses of the present study, Analysis of variance (ANOVA) was applies to find spatial and temporal variations for environmental factors and the prevalence of infections. T-test of variance was applied to find spatial variations in prevalence of infection between cages and river. Also, correlation coefficient was applied to find the correlation between the prevalence of pathogens and environmental factors.

Results and discussion:

Environmental analyses:

The results of ten parameters were illustrated below in table1. pH values were alkaline along the study period. According to Svobodova et al. (1993), the optimal pH range for fish is from 6.5 to 8.5 and pH values above 10.8 and below 5.0 may be rapidly fatal to cyprinids (especially carp and tench). Lower values of water temperature were registered in Winter months while higher values were registered in Spring and Summer months. Values of

chlorophyll a (Ch.a) according to Shmitt (1998) ranged from oligotrophic state (1-4 µg/l) to polytrophic state (50-100 µg/l). Values of total suspended solids (TSS) did not reach 200 mg/l which clogging fish gills (Abawi and Hassan, 1990) except at outside the cages in Al- Dayr. Electrical conductivity (EC), according to Ayers and Westcot (1985), ranged from slightly saline water (0.7-3 ms/cm) to highly saline (> 6 ms/cm and < 14 ms/cm). Values of nitrite (< 0.1 mg/l) and nitrate (< 1 mg/l) were classified according to Barndt and Bohn (1992) as nutrient poor.While values of orthophosphate were ranged between nutrient poor (< 0.015 mg/l) to nutrient rich (> 1.5 mg/l). Svobodova et al. (1993) noted that the COD maximum level for cyprinid culture is 20–30 mg/l and the present values ranged from below this level to higher than it. Svobodova et al. (1993) noted that the BOD_5 for cyprinids is 8 to 15 mg/l and the present values out of the latter range. The statistical analysis of variance (ANOVA) showed significant spatial variations only for electrical conductivity ($p < 0.001$) and pH ($P < 0.01$). Also, it showed significant temporal variations among the study months for pH ($p < 0.05$), water temperature ($p < 0.001$), total suspended solids ($p < 0.001$), nitrate ($p < 0.001$), nitrite ($p < 0.001$), total phosphate ($p < 0.05$), orthophosphate ($p < 0.001$), and biological oxygen demand ($p < 0.001$).

Table 1: the summery results of environmental analyses of the present study.

Area / Results		Al Qurnah		Al Dayr		Abu Al-Khaseeb	
		Cages	River	Cages	River	Cages	River
pH	(min-max) ± sd	(8.02 – 8.34) ± 0.11	(8.11 – 8.3) ± 0.07	(8.2 – 8.55) ± 0.13	(8.10 – 8.8) ± 0.22	(7.8 – 8.2) ± 0.21	(7.8 – 8.35) ± 0.26
W.T. (C°)	(min-max) ± sd	(18.9 – 25.9) ± 2.54	(17.7 – 26) ± 2.86	(18.3 – 27.5) ± 3.75	(18.4 – 27.5) ± 3.73	(18.28 – 23.1) ± 2.50	(18.1 – 23.2) ± 2.29
Ch.a (µg/l)	(min-max) ± sd	(0 – 7.42) ± 3.20	(0 – 10.21) ± 3.60	(0 – 39.52) ± 15.60	(0 – 8.96) ± 3.12	(0 – 14.85) ± 6.02	(0 – 57.77) ± 14.92
TSS (mg/l)	(min-max) ± sd	(42 – 154) ± 63.54	(8 – 178) ± 60.73	(20 – 56) ± 19.28	(4 – 252) ± 96.57	(42 – 86) ± 24.84	(20 – 70) ± 19.38
EC (ms/cm)	(min-max) ± sd	(1.23 – 2.5) ± 0.45	(1.20 – 2.94) ± 0.51	(1.09 – 2.83) ± 0.62	(1.09 – 2.4) ± 0.49	(2.74 – 8.15) ± 2.37	(2.73 – 8.12) ± 2.00
NO_3^- (µg/l)	(min-max) ± sd	(0.46 –15.88) ± 7.68	(5.90– 24.47) ± 8.33	(1.40 – 17.97) ± 8.18	(0.90 – 17.91) ± 5.48	(1.19 – 18.18) ± 8.91	(2.00 – 17.71) ± 6.21
NO_2^- (µg/l)	(min-max) ± sd	(3.23 – 188.72) ± 80.99	(0 – 183.56) ± 56.30	(0 – 6.39) ± 3.06	(0 – 184.40) ± 56.72	(1.90 – 197.96) ± 84.39	(0.53 – 311.93) ± 109.63
PO_4^{3-}(mg/l)	(min-max) ± sd	(0.01 – 1.85 ± 0.77	(0.05 – 2.09) ± 0.80	(0.03 – 0.95) ± 0.41	(0.023 – 1.65) ± 0.57	(0.04 – 2.73) ± 1.06	(0.01 – 3.51) ± 0.99
BOD_5^- (mg/l)	(min-max) ± sd	(3 – 13) ± 4.32	(2.9 – 24) ± 7.30	(4 – 15.4) ± 5.21	(3.4 – 17.4) ± 5.68	(3 – 14.2) ± 7.48	(2.2 – 11.4) ± 5.18
COD $^-$(mg/l)	(min-max) ± sd	(12 – 276) ± 132.02	(61 – 320) ± 129.08	(148 – 402) ± 129.63	(97 – 400) ± 114.23	(3.4 – 552) ± 310.68	(3.4 – 194) ± 82.70

The parasites and its prevalence of infection:

The present results of the identified parasites, from inside fish cages and that from river, and their prevalence and the site of infection of each parasite were illustrated in table 2. They revealed that Cyprinus carpio was infected with three species of parasites belong to the kingdom protista they are: Myxobolus pfeifferi (phylum Cnidaria), Ichthyophthirius multifiliis (phylum Ciliophora), Trichodina domerguei (phylum Ciliophora), and four species of parasites belong to the kingdom Animalia they are: Contracaecum sp. (phylum Nematoda), Neoechinorhynchus iraqensis (phylum Acanthocephala), Lernaea cyprinacea (subphylum Crustacea), Ergasilus ogawai (subphylum Crustacea), and two species of fungi they are: Saprolegnia sp., Ichthyophonus hoferi in addition to the infection with fin rot disease.

According to the site of infection, these parasites were classified into ectoparasites and endoparasites. Ectoparasites were isolated from fins, gills, skin and the body surface while the endoparasites were isolated from digestive tract, liver and heart.

Inside cages at both Al Qurnah and Al Dayr, all of the infected fishes have been infected with ectoparasites only while at Abu Al-Khaseeb, both ectoparasites and the endoparasite, Ichthyophonus Hoferi, were isolated from the infected fishes. These findings were as a result to transmission of ectoparasites by contact between fishes due to high numeric density inside the cages (Awal et al., 2001). According to Pearse (1989), Ichthyophonus. Hoferi is an obligate internal parasite which may affect freshwater species, but usually only those on farms which have been fed diets contaminated with it.

For the study of similarity in the identified parasites inside cages and in river environment, Jaccard Simillarity Index was applied. Results of Jaccard similarity index, as shown in figure 2, ranged from 0% at Al Qurnah in April and May, at Al Dayr in February and at Abu Al-Khaseeb in May to 50 % at Abu Al-Khaseeb in February. Because, there is no contact between fish inside the cages and outside them for facilitated the transmission of infections with parasites. Also, carp fish, in side cages, were fed with a commercial food of a good quality. In addition to use drugs in medical treatments for carp fish inside cages such as oxytetracyclin and potassium permanganate.

Table 2: the identified parasites and their prevalence in infected carp fish.

Month	Area	cage	Position of infection	River locality	Site of infection
Dec-12	**Al Qurnah**	**Fin rot Saprolegnia sp. I. multifiliis M. Pfeifferi**	**Fins Body surface Body surface gills**	**N. iraqensis Contracaecum sp Saprolegnia sp**	**Digestive tract Digestive tract Body surface**
Dec-12	**Al Dayr**	**Fin rot Saprolegnia sp. T. Domerguei I. multifiliis**	**Fins Body surface Body surface Body surface**	**L. cyprinacea Contracaecum sp Saprolegnia sp M. Pfeifferi**	**Skin Digestive tract Body surface gills**
Dec-12	**Abu Al-Khaseeb**	**I. hoferi Fin rot Saprolegnia sp.**	**Liver Fins Body surface**	**Fin rot Contracaecum sp T. domerguei**	**Fins Digestive tract Body surface**
Jan-13	**Al Qurnah**	**Fin rot Saprolegnia sp. I. multifiliis**	**Fins Body surface Body surface**	**E. ogawai Contracaecum sp Saprolegnia sp**	**Gills Digestive tract Body surface**
Jan-13	**Al Dayr**	**Fin rot Saprolegnia sp. M. pfeifferi**	**Fins Body surface gills**	**L. cyprinacea Contracaecum sp Saprolegnia sp. I. multifiliis**	**Skin Digestive tract Body surface body surface**
Jan-13	**Abu Al-Khaseeb**	**I. hoferi Fin rot Saprolegnia sp.**	**Liver Fins Body surface**	**E. ogawai N. iraqensis Contracaecum sp**	**Gills Digestive tract Digestive tract**
Feb-13	**Al Qurnah**	**Fin rot Saprolegnia sp. I. multifiliis**	**Fins Body surface body surface**	**N. iraqensis Contracaecum sp Saprolegnia sp**	**Digestive tract Digestive tract Body surface**
Feb-13	**Al Dayr**	**Fin rot Saprolegnia sp. M. pfeifferi**	**Fins Body surface gills**	**N. iraqensis Contracaecum sp I. multifiliis**	**Digestive tract Digestive tract Body surface**
Feb-13	**Abu Al-Khaseeb**	**I. hoferi Fin rot Saprolegnia sp.**	**Heart Fins Body surface**	**Fin rot Contracaecum sp Saprolegnia sp.**	**Fins Digestive tract Body surface**
Mar-13	**Al Qurnah**	**Fin rot Saprolegnia sp. I. multifiliis**	**Fins Body surface Body surface**	**N. iraqensis Contracaecum sp I. multifiliis**	**Digestive tract Digestive tract Body surface**
Mar-13	**Al Dayr**	**Fin rot Saprolegnia sp. T. domerguei I. multifiliis**	**Fins Body surface Body surface Body surface**	**L. cyprinacea Contracaecum sp T. domerguei**	**Skin Digestive tract Body surface**
Mar-13	**Abu Al-Khaseeb**	**I. hoferi Fin rot Saprolegnia sp.**	**Liver Fins Body surface**	**E. ogawai Contracaecum sp M. pfeifferi**	**Gills Digestive tract gills**
Apr-13	**Al Qurnah**	**Fin rot Saprolegnia sp. I. multifiliis L. cyprinacea**	**Fins Body surface Body surface skin**	**E. ogawai Contracaecum sp M. pfeifferi**	**Gills Digestive tract gills**
Apr-13	**Al Dayr**	**Fin rot Saprolegnia sp. T. domerguei**	**Fins Body surface Body surface**	**N. iraqensis Contracaecum sp T. domerguei M. pfeifferi**	**Digestive tract Digestive tract Body surface gills**

Apr-13	**Abu Al-Khaseeb**	**I. hoferi Fin rot Saprolegnia sp. T. domerguei**	**Heart Fins Body surface Body surface**	**Fin rot L. cyprinacea E. ogawai T. domerguei**	**Fins Skin Gills Body surface**
May-13	**Al Qurnah**	**Fin rot Saprolegnia sp. I. multifiliis**	**Fins Body surface Body surface**	**Fin rot N. iraqensis Contracaecum sp**	**Fins Digestive tract Digestive tract**
May-13	**Al Dayr**	**Fin rot Saprolegnia sp. T. domerguei I. multifiliis**	**Fins Body surface Body surface Body surface**	**Fin rot L. cyprinacea E. ogawai Contracaecum sp T. domerguei Saprolegnia sp.**	**Fins Skin Gills Digestive tract Body surface Body surface**
May-13	**Abu Al-Khaseeb**	**I. hoferi Fin rot Saprolegnia sp.**	**Liver Fins Body surface**	**E. ogawai N. iraqensis Saprolegnia sp.**	**Gills Digestive tract body surface**
Jun-13	**Al Qurnah**	**Fin rot Saprolegnia sp. T. domerguei**	**Fins Body surface Body surface**	**L. cyprinacea T. domerguei I. multifiliis**	**Skin Body surface Body surface**
Jun-13	**Al Dayr**	**Fin rot Saprolegnia sp. L. cyprinacea**	**Fins Body surface skin**	**Fin rot L. cyprinacea N. Iraqensis I. multifiliis**	**Fins Skin Digestive tract Body surface**
Jun-13	**Abu Al-Khaseeb**	**I. hoferi Fin rot Saprolegnia sp. L. cyprinacea**	**Liver Fins Body surface skin**	**I. multifiliis L. cyprinacea N. Iraqensis Saprolegnia sp. M. pfeifferi**	**Skin Digestive tract Body surface gills**

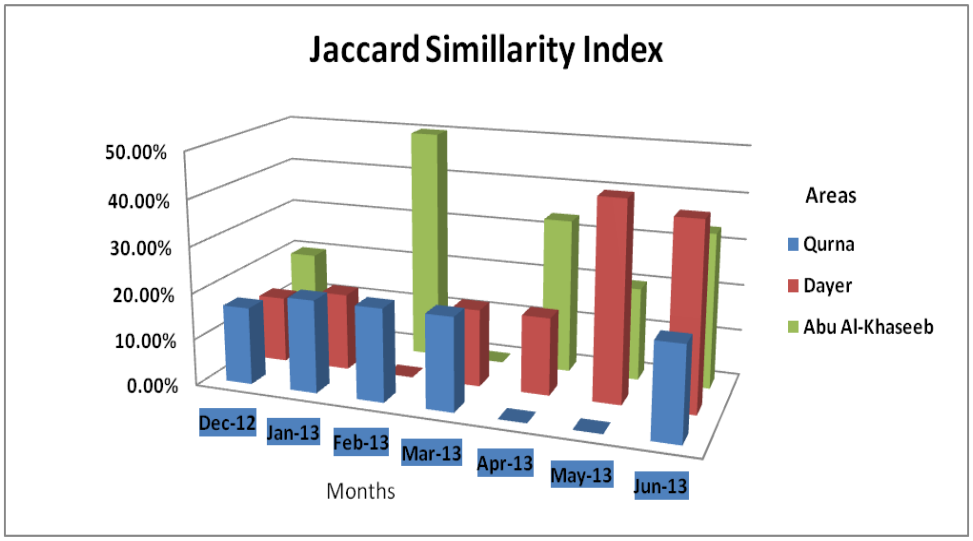

Figure 2: Values of Jaccard similarity index based on the monthly variation for the prevalence of pathogens.

As shown in table 3, the prevalence of infections inside cages were higher than in the river, with the exception of Abu Al-Khaseeb in March and Al-Dayer in May whose prevalence of infections were 45% in both localities. Whereas, in February at Al-Dayer, the prevalence of infection in the cages was 32% lower than 35 % outside them.

Table 3: The monthly data of prevalence of infection for carp.

locality	Months	Cage	River
Al Qurnah	Dec-12	40%	30%
Al Dayr	Dec-12	35%	32%
Abu Al-Khaseeb	Dec-12	50%	36%
Al Qurnah	Jan-13	38%	25%
Al Dayr	Jan-13	36%	27%
Abu Al-Khaseeb	Jan-13	43%	32%
Al Qurnah	Feb-13	41%	27%
Al Dayr	Feb-13	32%	35%
Abu Al-Khaseeb	Feb-13	40%	37%
Al Qurnah	Mar-13	45%	32%
Al Dayr	Mar-13	40%	37%
Abu Al-Khaseeb	Mar-13	45%	45%
Al Qurnah	Apr-13	50%	40%
Al Dayr	Apr-13	46%	43%
Abu Al-Khaseeb	Apr-13	56%	52%
Al Qurnah	May-13	57%	42%
Al Dayr	May-13	45%	45%
Abu Al-Khaseeb	May-13	60%	56%
Al Qurnah	Jun-13	63%	45%
Al Dayr	Jun-13	50%	47%
Abu Al-Khaseeb	Jun-13	77%	58%

The affect of environmental circumferences on prevalence of infection:

The parasites community of fish shows considerable variation with the environmental conditions in which fish's live (Hossain et al., 2008). In an unpolluted environment with only the normal fluctuations in ambient conditions, there will be a natural balance between host fish, pathogens and environmental factors, leading to sporadic outbreaks of the disease. However, a reduction in the quality of environmental factors will lead to a marked increase in the frequency and severity of diseases, mainly by reducing the resistance of the host organisms to the diseases. Also, an increase in the population density of the host fish inside fish farm will increase the risk of disease outbreaks (Svobodova, 1993; Awal et al., 2001).

In the present study, the affect of environmental circumferences on both the type of infection and its prevalence have been demonstrated statistically. Some of the identified parasites appeared a correlation with some of the environmental analyses. An ectoparasite copepod L. cyprinacea, which isolated and identified from Cyprinus carpio skin, showed highly significant correlation (r = 0.585) between its prevalence and water temperature. It identified in infected fish in March at Al Dayr inside and outside cages and in April at Al Qurnah inside cages while at Abu Al-Khaseeb outside them. In May at Al Dayr outside cages, in June at Al Dayr and Abu Al-Khaseeb inside and outside cages while at Al Qurnah outside them. A similar result was investigated by Yassin (2010) who isolated and identified the same parasite from Liza abu and C. carpio in Al-Shenafya River and he demonstrated that the percentage of infection with this parasite was increased during Summer months due to elevated of water temperature.

Myxobolus pfeifferi, which isolated and identified from gills, is an unicellular protozoan belong to myxozoan parasites but recent evidence clearly indicates that myxozoans are true metazoans (Takemoto et al., 2009). The genus Myxobolus are regarded as host specific parasites for the carp, Cyprinus carpio, by many authors in China, Aumer basin, Russia, Japan (Molnár, 2009). In the present study, the recorded infections were in December at Al Qurnah inside cages and at Al Dayr outside cages. In January at Al Dayr inside cages, in February in Al Dayr inside cages. In March at Abu Al-Khaseeb outside cages. In April at Al Qurnah and Al Dayr outside cages. In June at Abu Al-Khaseeb

outside cages. The statistical analysis showed significant positive correlation (r = 0.541) between its prevalence and chemical oxygen demand. Water pollution reduces a fish's immno-ability allowing attacking microorganisms (Pearce, 1989). Increased organic matters that are often resulting from added access diet which consider good substrate for the parasites. An increased in organic matters leads to organic pollution and their decomposition affect fish gills making them more sensitive to pathogens and parasites (Raskovic et al., 2010).

Trichodina domerguei belong to the Trichodinid parasites showed a weak and negative significant correlation (r = - 0.357) with orthophosphate .Trichodinids are a widely dispersed group of ectoparasites in freshwater, marine and euryhaline environments about 70 species were identified in marine fishes and more than 112 from freshwater fishes worldwide (Özer, 2003). In the present study, the recorded infections with Trichodina domerguei were in March at Al Dayr inside and outside cages, in April at Al Dayr and Abu Al-Khaseeb inside and outside the cages, in May at Al Dayr inside and outside cages and in June at Al Qurnah inside and outside the cages. Ath an assopou lou et al. (2009) demonstrated in their overview study that trichodinid parasites have a direct life cycle which is difficult to treat. They can cause high mortality in fish cages, especially in areas with deterioration of the water quality and high temperatures.

Saprolegnia a fungus belong to the group of fungi called Oomycetes. This genus is not species specific and it is capable of attacking any tissue in a wide range of fish species (Pearce, 1989). Saprolegnia species are opportunistic facultative parasite either ecrophs or saprotrophs. It causes substantial mortality among freshwater fish and mostly associated with environmental stresses such as overcrowding, rough handling, transport, low dissolved oxygen, temperature fluctuation, osmotic shock and water pollution (Zaki et al., 2008). In the present study, the infection was registered at all studied areas. Inside cages, it registered in all months while outside cages, it registered in most of them. According to the statistical analysis, its prevalence showed a weakly significant negative correlation (r = - 0.321) with nitrate and a highly significant negative correlation (r = - 0.592) with chlorophyll a.

Ergasilus ogawai a copepod which, in the present study, isolated and identified from gills. Adult Ergasilus parasites are usually found on gill filaments but

can attach to gill rakers or some other external location as well (Hoffmann 1998). They will rarely attach to any other surface than the gill filaments swimming. They like to feed on surrounding tissue and mucous secreted by fish and can cause enough damage (cause harm to their fish host by damaging the gills and decrease the amount of oxygen that the fish is able to obtain from the gills) to allow a secondary infection of bacteria or virus (Lasee 1995). Ergasilus ogawai showed a negative highly significant correlation ($r = - 0.513$) with pH and this result lead us to conclusion that the infection with Ergasilus ogawai was due to the prevalence of spatial variations ($p < 0.01$) and temporal variations ($p < 0.05$) in pH values. In the present study, the recorded infections with Ergasilus ogawai were outside cages, in January at Al Qurnah and Abu Al-Khaseeb, in March at Abu Al-Khaseeb, in April at Al Qurnah and Abu Al-Khaseeb, in May at Al Dayr and Abu Al-Khaseeb.

The prevalence of infection with parasites, according to T-test of variance showed significant variations ($p < 0.05$) between environment inside cages and river environment outside the cages. These results due to highly numeric density of fish inside cages.

The statistical analysis of variance (ANOVA) showed a highly significant variations ($p < 0.01$) in prevalence of infection among different months where high prevalence of infections has been recorded in Summer months (June and May) followed by Spring months (April and March) then by Winter months (December, February and January) and the statistical analysis of correlation for prevalence of infection showed a highly positive significant correlation ($r = 0.661$) with water temperature due to the impact of water temperature upon fish immunity towards parasitic diseases (Guquloth et al., 2013). Also, the statistical analysis of correlation showed an influence of other environmental factors on prevalence of infection. Where it showed a positive significant correlation ($r = 0.406$) with nitrate. While it showed a negative significant correlation with biological oxygen demand ($r = - 0.473$) and orthophosphate ($r = - 0.427$).

Also, there was significant variations ($p < 0.05$) in prevalence of infection among the studied areas where the highest percentage was recorded in Abu Al-Khaseeb and the least one was recorded in Al Dayr which significantly different from Abu Al-Khaseeb. These spatial variations belong to the variance in environmental circumferences at each locality.

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دراسة بيئية مقارنة لتركيب الممرضات بين أسماك الكارب الأعتيادي المستزرعة والبرية في البصرة.

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المستخلص: جمعت عينات شهرية للمياه والأسماك من مناطق القرنة والدير وأبو الخصيب من داخل أقفاص الأسماك ومن مياه نهر شط العرب خارج هذه الأقفاص للفترة الممتدة من شهر كانون الأول 2012 الى شهر حزيران 2013. كان هدف الدراسة هو توضيح تأثير بعض العوامل البيئية على تركيب الطفيليات وتواجدها في أسماك الكارب الأعتيادي. وقد أوضحت النتائج أصابة أسماك الكارب الأعتيادي بثلاثة أنواع من الطفيليات تعود الى مملكة الأبتدائيات هي: Myxobolus pfeifferi (phylum Cnidaria), Ichthyophthirius multifiliis (phylum Ciliophora), Trichodina domerguei (phylum Ciliophora) وأربعة أنواع تعود الى المملكة الحيوانية هي: Contracaecum sp. (phylum Nematoda), Neoechinorhynchus iraqensis (phylum Acanthocephala), Lernaea cyprinacea (subphylum Crustacea), Ergasilus ogawai (subphylum Crustacea). ونوعان من الفطريات هما : وSaprolegnia sp. Ichthyophonus hoferi . أضافة الى مرض تآكل زعانف. وتبعا" لموقع الأصابة، فأن جميع الأسماك المصابة داخل أقفاص كلا" من القرنة والدير كانت بطفيليات خارجية فقط بينما عزلت في أبو الخصيب كلا"من الطفيليات الخارجية والداخلية وقد أظهر التحليل الأحصائي تأثير الظروف البيئية على أصابة الأسماك بالطفيليات. وأظهر أختبار التباين وجود تغايرات معنوية في نسبة الأصابة بالطفيليات ($P< 0.05$) بين الأسماك داخل وخارج الأقفاص (في بيئة مياه شط العرب) . وبين المواقع ($P< 0.05$). و هناك تغايرات عالية المعنوية بين الأشهر ($P< 0.05$) أيضا".

الكلمات المفتاحية: أقفاص الأسماك – الطفيليات – تواجد الأصابة – العوامل البيئية.