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Prevalence and Densities of *Contracaecum* sp. *Larvae in Liza abu* (Heckel, 1843) from Different Iraqi Water Bodies

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Abstract. In monthly samples *of Liza abu* collected, June 2001-May 2002 from three localities (Hilla river, Al-Furat fish farm and Al-Mahaweel drain), Babylon province in the middle of Iraq. Fishes were infected with the third larval stage of the nematode *Contracaecum* sp. The infection of *Contracaecum* sp. larvae were analyzed according to the season, sex, host length, and sampling localities. Its prevalence and intensity was 11.9% and 1.1 larvae per fish respectively for the Winter, and the Summer had 47.6% and 3.5 larvae per fish respectively. The incidences were increased greatly during the Summer season, being higher in the females than the males for both the seasons of the year. There were slightly significant differences ($p < 0.01$) between the infection of male and female fishes in the cases of the monthly variations of infection with *Contracaecum* sp. Infection with *Contracaecum* sp. larvae were positively correlated according to fish length, increased gradually in the larger fishes. Infection rates and mean intensity also varied with sampling stations ($p < 0.05$). Generally, the changes in the percentage prevalence coincided with the changes in the mean intensity of infection.

Introduction

Khishni or Abukhraiza (*Liza abu* Heckel, 1843) is a mugilid species and inhabits: Iraq, Syria, Iran, Pakistan (Mahdi, 1967; Coad, 1980) and Turkey (Kuru, 1979). It is found in rivers, streams, channels, drains, lakes, reservoirs, pond, and fish farms of Iraq, and neighboring countries. The species remains in freshwaters (Beckman, 1962; Naama *et al.*, 1986) but it has also been recorded in Iraqi brackish water and from the Khawr-Alzubeir (North-west of the Arabian Gulf) in a marine environment (Nasir and Naama, 1988). It usually occurs in schools; this was one of the most abundant species and an important food fish in Iraq. It forms about 29% of the total annual catches of freshwater fishes in southern Iraq, and about 7.4% of the total annual catch for the whole country despite its small individual size (Mhaisen and Al-Jaffery, 1989). *Liza abu* is exotic on fish farms in Iraq where it competes on food with cultured carp, and Mhaisen and Al-Jaffery (1989) believed it could be farmed successfully because of its high growth rate.

There are numerous studies carried on the meristic characters (Nasir and Naama, 1988), biological aspects (Mhaisen and Al-Jaffery, 1989; Unlu *et al.*, 2003), and Parasites (Mhaisen *et al.*, 1988; Ho *et al.*, 1996) of *L. abu.* Ecologically, parasites are an essential part of the aquatic community. However, most individual fish in wild or cultivated populations are infected with one or more parasite. One of the causes of this infection is biotic or abiotic changes in aquatic environment. If parasites have infected wild fish, the overall quality of food will be decreased enormously due to the possibility of human infection (Sakanari and McKerrow, 1989), and there is no safe preparation that could entirely avoid a risk for human health when consuming parasitized fish (Skirnisson, 2006).

It is known that nematodes from the super family Ascaridioidea (family: Anisakidae) are parasites of many water invertebrates and fish as intermediate or paratenic hosts, sea mammals or fish eating birds being definitive hosts. Low specificity in the choice of hosts, both intermediate and definitive, causes their geographical distribution is wide (Mhaisen, *et al.*, 1988). The most widespread genera, *Anisakis*, *Pseudoterranova* and *Contracaecum*, have similar life cycles. It is dangerous when ingested by humans, causing a condition known as Anisakiasis or helminthiasis in human (Mattiucci *et al.*, 1997). Adult *Contracaecum* are parasites of piscivorous birds and mammals associated with fresh, brackish and marine environments which are found in the stomach or small intestine of birds. This nematode use aquatic invertebrates and fish species as a second intermediate host (Anderson, 2000), a wide spectrum of invertebrates and many fish species have been reported to carry larval *Contracaecum* sp. (Norris and Overstreet, 1976). Eggs shed in the feces and larvae are ingested by an invertebrates (usually crustacean) intermediate or paratenic host. Eggs hatch within 2-3 days at 24°C; 5-7 days at 21°C, hatching is not simultaneous and is further delayed in some of the eggs. Free living infective (second) stage larvae can survive in water for several months, larvae become firmly attached by their posterior end to a substrate in the aquatic habitat. Small crustaceans are the first intermediate hosts (Paperna, 1974).

In fact, several pathological conditions such as anthropozoonosis, allergy events, and anaphylactic reactions (Walker and Zun, 2005), could occur in some individuals whose main diet is composed of infected fish, like those living along water bodies that receive polluted wastes (Ensink *et al*., 2005). The problem might become severe when fish diversity has decreased to a point where few species are only available because of their low price and abundance, this is the case of *L. abu*. Especially, in Iraq, *L. abu* is one of the most abundant fish species and it represents a valuable resource not only because of its high presence during the whole year, but also because it is part of traditional dish especially in southern Iraq (Al-Zubaidy, unpubl.).

This study investigated *Contracaecum* sp. larvae in *L. abu* from the monthly variations of prevalence and intensity are according to host sex, length and sampling stations.

Materials and Methods

A total of 158 mugilid fish, *L. abu*, were collected monthly from three Iraqi inland water (Hilla river, Al-Furat fish farm, and Al-Mahaweel drain), during June 2001 to May 2002. Fish specimens were brought to the laboratory of Biology Department, College of Science, Babylon University. Each fish was measured, total length to nearest 0.1cm and the sex was determined internally, also fishes were divided into three classes depending on their lengths (cm). Fishes were classified depending on Mahdi (1967).

Fishes were examined only for endoparasites. Each fish was opened and its internal organs were fully examined for parasites. The entire digestive system was removed and placed in a Petri-dish with physiological saline, and the gut was divided into sections. The muscles, gonads, liver, and heart were also examined with the aid of a dissection microscope and a phase contrast light microscope at 10 and 40 magnifications. Parasites were preserved in 70% alcohol after individual treatments, and fixed with Glycerin-alcohol. Parasite identification, was based on morphological features (Habash, 1977). Prevalence and mean of intensity were calculated according to Bush *et al.*, (1997). Accordingly, T-test was applied to know the existence or nonexistence of statistical differences among the infections of the males and females during the months of the study. X^2-test was also used to reveal those differences in the infections of the various groups with their lengths according to the steps illustrated in Al-Rawi (1980).

Results

One hundred fifty-eight mugilid fish, *L. abu*, were collected monthly and analyzed for *Contracaecum* sp. larvae, 41 (25.9%) were infected with 126 of it (3.1 Larvae per fish). *Contracaecum sp*. larvae were found in several locations within the body of fish: Free in the body cavities, most often in the abdominal or pericardial cavity. Encapsulated on the external walls of stomach, intestine, liver, heart, and gonads of fishes.

The prevalence and intensity of infection in *L. abu* shown in Table 1 and Fig. 1&2. Infection disappeared in November 2001, January and February 2002 in the males, on the other hand, in November, December 2001 and January 2002, in the females. While in November 2001 and January 2002 in the total samples. The males' prevalence of 14.3% in March, increased to 33.3% in May 2002 and increased to maximum values of 50% in June and August 2001, followed by a sharp fall to lowest value of 9% in September with a gradually rise 16.6% in December 2001. The females' prevalence of 28.5% in February decreased to 20% in April 2002, and increased to 50% in May 2002 followed by a sharp rise to its peak of 75% in June 2001, also with a sharp fall to lowest value of 11% in September. The prevalence for the total samples 20% in February and April 2002, increased to 42.8% in May followed by a sharp rise to its value of 58.3% in July 2001, followed by a sharp fall to its lowest value of 11.1% in September, later by a rise to 20% in December 2001.

The intensity of *Contracaecum sp.* larvae is shown on Table 1 and Fig. 2. The males intensity of infection disappeared in November 2001, January and February 2002. The intensity of 1 larva per infected fish in March 2002 increased to 3.7 in June 2001, decreased to 1 in October and December. The females' intensity of infection disappeared in November, December 2001, and January 2002. The mean intensity of 2 larvae per fish in February increased to 3 in March, April and May 2002, followed by maximum value of 4.5 in July 2001, followed by a sharp fall to its value of 1 in September 2001. The intensity for the total samples was disappeared in November 2001 and January 2002. Its 2 larvae per fish in February increased to 2.5 in April 2002, followed by a gradual rise to its value 4 in July 2001, with a sharp fall to its lowest value of 1 in September 2001.

Table 1. Parasitological evaluation of *L. abu* infected by *Contracaecum* sp. larvae (2001-2002).

Month	EF/IF (P%)	M (range)	EM/IFM (P%) M (range)	EFM/IFFM (P% M (range)
June2001	12/7 (58.3)	3.7(3-4)	8.0/4 (50.0) 3.7 (3-4)	4.0/3 (75.0) 3.7 (3-4)
July2001	20/9 (45.0)	4.0 (3-6)	7.0/3 (42.5) 3.0 (3.0)	13/6 (46.1) 4.5 (3-6)
August2001	16/7 (43.7)	3.4 (2-7)	4.0/2 (50.0) 2.0 (2.0)	12/5 (41.7) 4.0 (2-7)
September2001	18/2 (11.1)	1.0 (1.0)	11/1 (9.0) 1.0 (1.0)	7.0/1 (14.2) 1.0 (1.0)
October2001	15/2 (13.3)	1.5(1-2)	6.0/1 (16.6) 1.0 (1.0)	9.0/1 (11.0) 2.0 (2.0)
November2001	4.0/0 (0.0)	0.0 (0.0)	4.0/0 (0.0) 0.0 (0.0)	0.0/0 (0.0) 0.0 (0.0)
December2001	15/1.0 (20.0)	1.0 (1.0)	6.0/1 (16.6) 1.0 (1.0)	9.0/0 (0.0) 0.0 (0.0)
January2002	8.0/ 0 (0.0)	0.0 (0.0)	2.0/0 (0.0) 0.0 (0.0)	6.0/0 (0.0) 0.0 (0.0)
February2002	10/2 (20.0)	2.0 (1-3)	3.0/0 (0.0) 0.0 (0.0)	7.0/2 (28.5) 2.0 (1-3)
March2002	16/3 (18.8)	2.3 (1-3)	7.0/1 (14.3) 1.0 (1.0)	9.0/2 (22.2) 3.0 (3.0)
April2002	10/2 (20.0)	2.5 (2-3)	5.0/1 (20.0) 2.0 (2.0)	5.0/1 (20.0) 3.0 (3.0)
May2002	14/6 (42.8)	3.0 (2-8)	6.0/2 (33.3) 2.0 (2.0)	8.0/4 (50.0) 3.0 (2-8)
Total	158/41(25.9)	2.4 (1-8)	69/16 (23.2) 1.7(1-4)	89/25 (28.1) 2.7 (1-8)

EF = examined fish, IF = infected fish, M = mean, EM = examined males, IFM = infected males, P% = prevalence, EFM = examined females, IFFM = infected females.

When analyzing the infection rate and intensity of *Contracaecum* sp. larvae by host sex shown on Table 2 and Fig. 3. Sixty-nine males examined 16 (23.2%) infected with 32 larvae (2 larvae per fish), on the other hand, eighty-nine females, 25 (28.1%) infected by 94 larvae (3.8 larvae per fish). There was a slight variation in mean intensity with sex of the host, where females showed heavier parasite burden, through this was no statistically significant ($P < 0.05$).

The prevalence and intensity of infection revealed an increasing tendency with fish length from 14.3% and 1.57 to maximum of 36.6% and 3.66 respectively shown in Table 3 and Fig. 4.

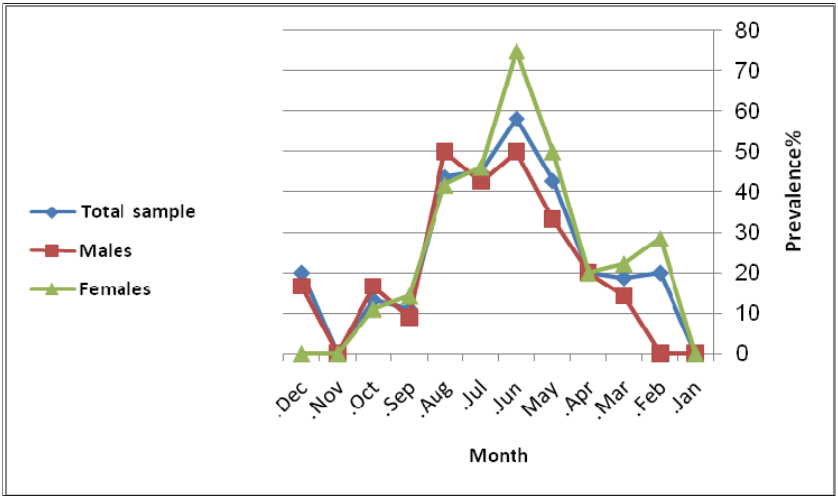

Fig. 1. Prevalence of *Contracaecum* sp. larvae in *Liza abu* from Iraq (2001-2002).

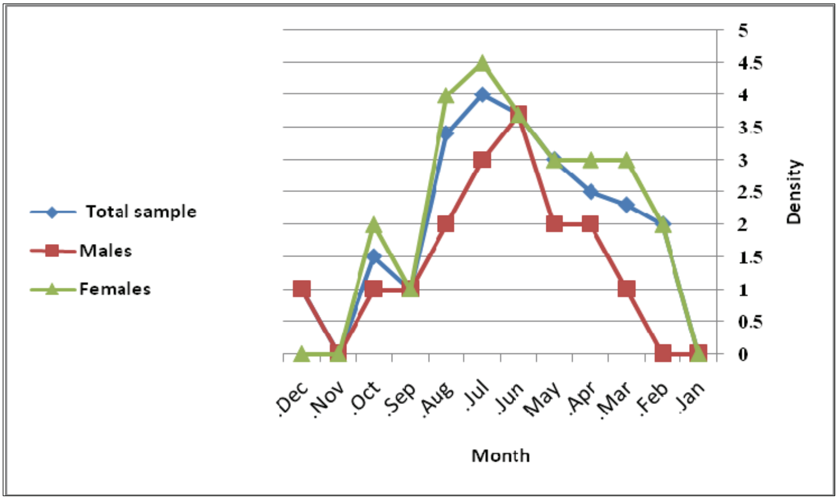

Fig. 2. Mean intensity of *Contracaecum* sp. larvae in *Liza abu* from Iraq (2001-2002).

Table 2. Variation in mean of intensity of *Contracaecum* sp. larvae by host sex.

Sex	No. F. exam.	No. F. inf.	M. int. (No. lar.)
Males	69.0	16.0	2.0 (32)
Females	89.0	25.0	3.76 (94)

No. F. exam. = Number fish examined, No.F.inf. = Number fish infected, No.lar. = Number larvae, M.int = Mean intensity.

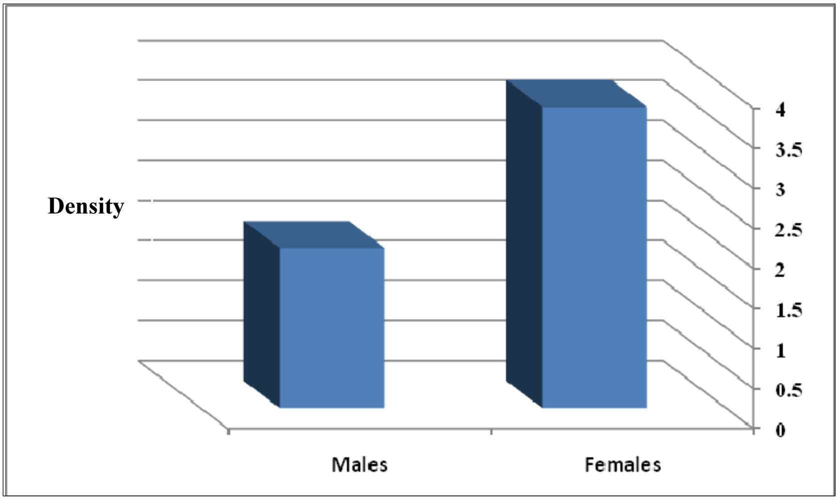

Fig. 3. Variation in mean of intensity of *Contracaecum* sp. larvae by host sex.

Table 3. The prevalence and mean intensity of larval *Contracaecum* sp. in *L. abu*, relative to fish length.

No. Lar.	M. int.	P%	No. F. inf.	No. F. exam.	Length class (cm) of fish
11.0	1.57	14.3	7.0	49.0	6-10
60.0	3.15	27.9	19.0	68.0	11-15
55.0	3.66	36.6	15.0	41.0	>16
126	2.8	26.2	41.0	158	Total

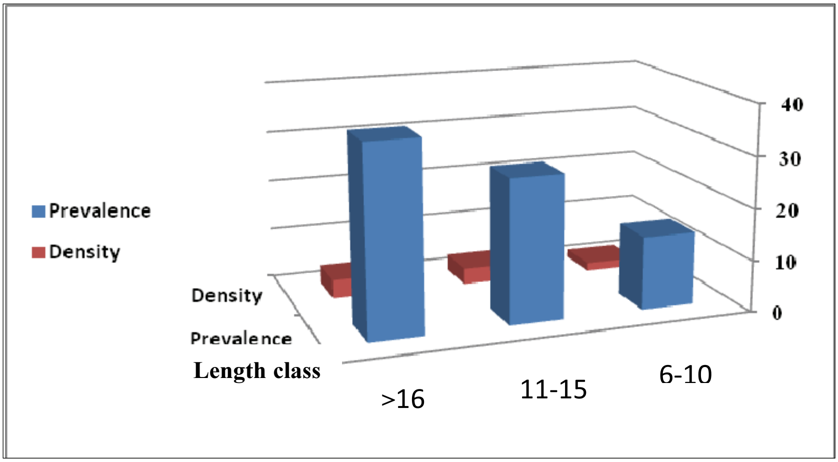

Fig. 4. Variation in prevalence and mean of intensity of larval *Contracaecum* sp. in *Liza abu*, relative to fish length from June 2001 to May 2002.

Infection rates and mean intensity also varied with sampling stations (Table 4 and Fig. 5). Prevalence was 41.6% in Hilla river, 23% in Al-Furat fish farm and 8.7% in Al-Mahaweel drain. In a average, fish host from Hilla river and Al-Furat fish farm were infected with a mean intensity 3.2 and 2.9 respectively, whereas in Al-Mahaweel drain this value was 2.5. Fish from Hilla river has a higher prevalence than those from other stations ($P < 0.05$).

Table 4. The prevalence and mean intensity of *Contracaecum* sp. larvae in different sampling station.

No. Lar.	M. int.	P%	No. F. inf.	No. F. exam.	Station
35.0	2.9	23.0	12.0	52.0	Al-Furat fish farm
81.0	3.2	41.6	25.0	60.0	Hilla river
10.0	2.5	8.7	4.0	46.0	Al- Mahaweel drain

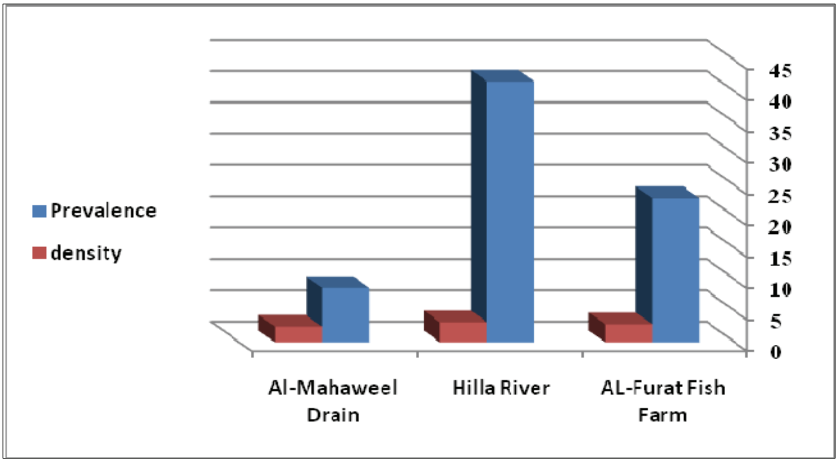

Fig. 5. Variation in prevalence and mean of intensity of *Contracaecum* sp. larvae in different sampling stations.

Discussion

L. abu is taking an important role as food source, its species are suitable for being an intermediary host parasites. In fact, several studies have shown (in Iraq) the presence of several parasite species in this fish, for instance, Protozoa, Cnidisporidia, *Myxobolus pfeifferi*, ciliate, peritricha, *Trichodina domerguei*, holotricha, *Ichthyophthirius multifilis* and flagellate, *Trypanosoma* sp**.** (Shamsuddin *et al*., 1971; Fattohy, 1975; Khalifa *et al.*, 1978, Khalifa, 1982, 1989; Ali and Shaaban, 1984; Ali *et al*., 1989; Mhaisen *et al*., 1989 and Al-Zubaidy, 2007); Monogenea, *Gyrodactylus elegans*, *Dactylogyrus cornu* and *D. vastator* (Ali and Shaaban, 1984; Ali, 1985; Ali *et al.*, 1986 and Mhaisen unpubl.); Cestodes, *Gryporhynchus cheilancristrotus* (Ali *et al.*,1987); Nematodes, *Contracaecum microcephalum* larvae, *Contracaecum.* sp. larvae and *Cucullanus* sp. (Habash,1977; Al-Hadithi and Habash, 1977; and Mhaisen *et al.,* 1988); Acanthocephalan, *Neoechinorhynchus agilis, N. rutili*, and *N. iraqenis* (Herzog, 1969; Habash and Daoud, 1979; Mhaisen *et al*., 1989 and Amin *et al*., 2001); and Crustaceans, *Ergasilus sieboldi, E.mosulensis, Lernaea cyprinaecea, Lamproglena pulchella* and *Paraergasilus inflatus* (Fattohy, 1975; Rahemo, 1977; Ho *et al.*, 1996; Khamees, 1996, 1997; Al-Zubaidy, 2007 and Mhaisen unpubl.).

The *Contracaecum* sp. larvae found in fish host here, had the same morphological features with those reported by Al-Hadithi and Habash (1977) and Mhaisen *et al*., (1988) in the same fish host in south of Iraq and also same with it reported from other fish species from different Iraqi water bodies. Since the *Contracaecum* sp. is not host specific at the larval stage, it was found in a wide range of different available fish host species, to date, 25 fish species have been reported parasitized by *Contracaecum* sp. Larvae (Al-Zubaidy, 1998; Mhaisen unpubl.), and this may result in a higher probability of transmission. Moreover; *Contracaecum* sp. larvae appear to be naturally occurring, probably because of migratory birds (definitive host). Paperna, (1974) mentioned that the *Contracaecum* is linked with migration of piscivorous birds, particularly (or even only) Pelicans.

Larvae of this parasite occurring in the vital organs of their host such as liver, heart, and gonads may affect their functioning. Rohde (1993) stated that the main effects of parasites on their host organs are: 1) intestinal parasites inhibit the digestive activity of the host and indirectly inhibit vitamin and blood sugar metabolism and growth, 2) parasites in the liver affect glycogen metabolism and growth, and 3) parasites of the gonads and coelomic cavity may lead to complete castration, reductions in egg numbers have so far been found to be due only to parasites of the body cavity.

Stromnes and Andersen (2000) mentioned that the general seasonal variation may be a determining factor as to whether parasites occur in a cyclic pattern throughout the year. And Polyanski (1961) stated that the 1) diet of the host, 2) life span of the host, and 3) mobility of the host throughout its life including the variety of habitats which it encounters, its population density and the size attained, are the main factors determining the fish parasites as well as prevalence and intensity of infestation in aquatic environments.

The present study indicates of interest a seasonal variation exist in the occurrence of *Contracaecum* sp. larvae in the *L. abu*. The prevalence and intensity of infection for males, females and total samples recorded high levels in May-August and their trends are about the same for males, females and total samples since all of them had falls in September-April. Mhaisen *et al*., (1988) claimed that the changes in the percentage prevalence coincided with the changes in the mean intensity of infection. And Stromnes and Andersen (2000) mentioned that in the few parasites, including *Contracaecum* sp. larvae a decrease was registered during the winter period.

There was slightly significant ($p < 0.01$) difference between the infection of males and females in the monthly variations of infection, but females are more frequently infected with parasite than males (Table 1). This means that differences, in parasitic load with sex, are due mainly to habitat and/or physiology. This observation agreed with the finding of Mhaisen *et al*., (1988) that females fishes were generally more liable than males to infections with nematodes, cestodes, acanthocephalan, crustacean and copepod parasites.

The prevalence of infection and intensity were positively correlated with host length ($p < 0.01$). This means that as fish grows, chances of infection increase for this parasite, because a long period of exposition to infective stages, and the amount of food it consumes, which including the larval stages of this parasite increased (Polyanski, 1961; Mashego, 1989 and Rohde, 1993). Larger fish have lived longer (as fish grow during all their life) and, therefore, have a higher probability of encountering parasites during their life span than smaller and shorter lived fish species. Moreover, feeding habits and wide diet put fish into contact with potential intermediate hosts of nematodes, cestodes, digenea, and acanthocephalan. Aho and Bush (1993) stated that the parasite species might accumulate among food chains, this could be particularly the case for endo-parasites. Szalai and Dick (1990) mentioned that the *Contracaecum spp*. larvae were absent in age 0 and age 1 bass (*Micropterus salmoides*) but prevalence and mean intensity increased with age, for bass age 2 or older. Poulin (2006) stated that the increase in prevalence and intensity with the host length, could be related, not only to accumulation of parasites in the host during its life, but also to change of diet. According to Luque and Alves (2001), correlation between the host total length and parasite prevalence and intensity is a pattern widely recorded in marine fish and documented with numerous cases in freshwater and marine fishes. But Poulin (2000) stated that this pattern can not be generalized because in many host-parasite species systems the correlation is positive but weak and non-significant. Nevertheless, some quantitative and qualitative differences detected in the size classes studies for fishes.

This study shows that smaller *L. abu* have got fewer parasite numbers, than larger individuals, the smallest infected fish was 9.5 cm. Al-Zubaidy (unpubl.), in this host captured in the Hilla river and Al-Furat fish farm, observed a certain selection of the prey according to its size. In addition to that the smallest fish are consuming eggs in large quantities, diatoms and algae are the most important food for fish 4-7.5 cm long followed by organic detritus, while copepods, cladocerans, and rotifers are important food with small quantities of mollusks, insect larvae, and worms in older specimens.

The percentage of infection and intensity varied among sampling stations (localities). At Hilla river the fish have high infection rate by *Contracaecum* sp. Larvae (and other nematode, 2 cestodes unpublished data). This is probably due to the effect of pollutants from Hilla town which might stress the fish and at the same time enhance the increase in parasites, also could be attributed to a greater density of fishes at this site. Moller and Anders (1986) stated that the fish in polluted water tended to harbor more endo-parasites than those of less polluted. Moreover, many birds such as fish eating-birds shown make nests in the Hilla river and Al-Furat fish farm, some of these birds are cormorant, *Phalacrocorax carbo*; white stork, *Ciconia ciconia*; Duck, *Anas* spp.; Grey heron, *Ardea cinerea*.; Slenderbilled gull, *Larus genei*; Great black headed gull, *L. ichthyaetus*; Common gull, *L. canus*; White pelican, *Pelecanus onocrotalus*; Pied king fisher, *Ceryle rudis*; White breasted king fisher, *Halcyon smyrnensis*. Furthermore, many snails and crustacean (Copepods, Amphipods and Decapods) are frequent in these sites. Low rate of infected fish from Al-Mahaweel drain as compared with those from Hilla river and Al-Furat fish farm. This observation at this site could be the result of increased salinity.

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نسبة وشدة إصابة أسمـــاك الخشني (هيكل ١٨٤٣) بيرقات الدودة الخيطيـــة *Contracaecum* sp. من مسطحات مائية مختلفة في العراق

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المستخلص. جمعت أسماك الخشني شهريًا خلال المدة المحصورة بين حزيران/يوليو ٢٠٠١م ولغاية مايس/مايو ٢٠٠٢م من ثلاث مسطحات مائية (نهر الحلة، مزرعة أسماك الفرات ومبزل المحاويل) وسط العراق. كانت الأسماك مصابة بيرقات (الطور الثالث) الدودة الخيطي *Contracaecum* sp. درست نسبة وشدة الإصابة طبقًا للأشهر، والجنس، وطول المضيف السمكي، ومواقع جمع الأسماك وأظهرت النتائج الآتي:

كانت نسبة وشدة الإصابة ١١,٩٪ و ١,١ يرقة/السمكة على التوالي في فصل الشتاء، بينما بلغت ٤٧,٦٪ و ٣,٥ يرقة/السمكة على التوالي في فصل الصيف، وكانت إناث الأسماك أعلى إصابة من ذكورها في كلا الفصلين.

هناك فرق معنوي ضعيف عند مستوى احتمالية ($p<0.01$) بين إصابة ذكور وإناث الأسماك وفقًا لأشهر الدراسة. وكانت الإصابة وشدتها تزداد بزيادة طول الأسماك. وكان هناك تباين كبير عند مستوى احتمالية ($P< 0.05$) في معدل نسبة وشدة الإصابة بيرقات الطور الثالث طبقًا لمواقع جمع الأسماك. وبصورة عامة كانت التغيرات في نسبة الإصابة تتطابق مع التغيرات في شدتها خلال مدة الدراسة.