Investigation of a parasitic outbreak of *Lernaea cyprinacea* Linnaeus (Crustacea: Copepoda) in Cyprinid fish from Choghakhor lagoon

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Abstract

The main objectives of this study were to study the parasitic infestation of *Lernaea cyprinacea* in 4 cyprinids from the Choghakhor Lagoon, Chaharmahal - Bakhtyari Province, west of Iran. A total of 180 cyprinids including *Cyprinus carpio* (n=101), *Carassius auratus* (n=47), *Capoeta aculeata* (n=10) and *Alburnus alburnus* (n=22) caught, and were studied for *Lernaea cyprinacea* infestation. Prevalence (*C. carpio* 61.4, *C. auratus* 87.2, *C. aculeata* 70 and *A. alburnus* 68.2), intensity of infection (*C. carpio* range 1 to 5, mean 2.1; *C. auratus* range 1 to 6, mean 1.9; *C. aculeata* range 1 to 5, mean 2.4; *A. alburnus* range 1 to 2, mean 1.1), and abundance (*C. carpio* 1.3, *C. auratus* 1.6, *C. aculeata* 1.7 and *A. alburnus* 0.8) varied with the fish species. A statistically significant difference was found between infestation by *L. cyprinacea* and fish species (p=0.01), although no statistically significant difference was found between infestation and weight, length and age of the studied fishes (p>0.05). The prevalence was also significantly different (p=0.0) in studying seasons. Population dynamics of *L. cyprinacea* on fish hosts was studied. The results show that the preferred site of the parasite was body lateral surfaces followed by caudal , dorsal , pectoral and anal fins (P=0.0).

Keywords: *Lernaea cyprinacea*, Fish parasite, Choghakhor Lagoon, Iran

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Introduction

Lernaea cyprinacea Linnaeus, 1758, also known as anchor worm, is an important freshwater fish parasite having a wide geographic range. *Lernaea* is a thermophilic organism developing successfully at high temperatures. In summer, in warm waters with temperatures ranging from 25 to 28 °C, this parasite finds excellent conditions for reproduction. Invasion by *L. cyprinacea* was described in more than 100 fish species belonging to 25 different families (Kabata, 1988). This parasite is one of the most commonly observed parasites in cyprinid fish feeding on host's blood and tissue. Invasion destroys scales, skin, muscles, and penetration of the fish body results in deep ulcers, abscesses or fistulas accommodating with serious economic loss. Heavy parasitosis could be the cause of mass mortalities of wild and cultured fish and also secondary bacterial or fungal infections (Woo, 2002). Moreover, the attached parasites may make the fish undesirable to anglers affecting fishery management goals. The parasite has been recorded in many countries around the world including Iran (Jazebizadeh, 1983; Goodwin, 1999; Khara et al., 2005; Jalali and Barzegar, 2006; Raissy et al., 2010). *L. cyprinacea* was accidentally introduced to Iran with exotic cyprinids and currently it can be found throughout the country, both in native and non-native fish (Jalali, 1997).

Choghakhor Lagoon, as Iran's 23rd international lagoon, is a small freshwater body in west Iran, Chaharmahal- Bakhtyari Province, with an area of about 1400 ha and average water depth of 4-6 m. The annual average temperature of the water has been reported in the range of 9.5 to 21.0 ˚C (Raissy et al., 2006). The existence of the lagoon is mostly dependent upon the quantity of water coming up through natural springs on the lagoon bottom. Introducing of exotic fish species to Choghakhor lagoon with the aim of improving commercial fishery activities was started by Iranian Fisheries Organization in 1992 and now the exotic species in the lagoon are mostly *Carassius auratus* and *Cyprinus carpio*, although the probability of being found is rarely for other fish species such as *Hypophthalmichthys molitrix*, *H. nobilis*, *Ctenopharyngodon idella*, *Pseudorasbora parva*, and *Gambusia affinis* are likely to be found rarely (Ghorbani, 1999).

Mass mortality of fish was reported by local anglers in April 2011, the observation and inspection of fishes implicated on the epizootic of *Lernaea* in fishes.

The aims of this study were to study the prevalence, intensity, and abundance of *L. cyprinacea* in 4 cyprinids' species from the Choghakhor Lagoon following the epizootic of the parasite. Relationship between infection levels and host species, size, age, and weight was studied. Population dynamics of the parasite on fish hosts was also analyzed.

Materials and methods

A total of 180 specimens from 4 species including *Cyprinus carpio* (n=101), *Carassius auratus* (n=47), *Capoeta aculeata* (n=10) and *Alburnus alburnus* (n=22) were collected from April to November 2011 during spring, summer and autumn (60 specimens in each season) and sampling was not possible in winter due to the alpine climate.

Fish were transported to the laboratory in aerated tanks. In the laboratory, biometric characteristics including total and standard length, weight and age were determined (Table 1). Parasites were collected from the host with needle and preserved in 70% alcohol. They were cleared, stained, mounted and identified following Kabata (1988). Prevalence, intensity and abundance of infection were recorded. The parasites were ascribed to one of the 5 sites: pectoral fin, caudal fin, dorsal fin, body surface and head. The percentage of parasites on each site was calculated in order to study the site specifity of *L. cyprinacea*.

Data analyses of the parasites and hosts were done using SPSS Package, version 16 . An analysis of variance (ANOVA) among the sampling seasons, biometric characteristics, age and species of studied fishes was performed in order to test for the differences in parasite abundance, intensity and prevalence between different fishes.

Results

A total of 180 native and non-native fish were studied in 3 seasons and 125 fish (69.4%) found to be infested by *L. cyprinacea*. Sever lesions including ulcers, haemorrhages and fibrous nodules were found on the body surface of parasitized fish. The number of parasitized fish, number of parasites collected, prevalence, intensity and abundance of the parasite in different fish species are presented in Table 1. A statistically significant difference was found between infestation by *L. cyprinacea* and fish species (p=0.01). The highest prevalence of *L. cyprinacea* found on *Carassius auratus* (87.2%) while the lowest was found on *Cyprinus carpio* (61.4%). The prevalence of *L. cyprinacea* on *C. aculeata* was 70.0%, but on this host species the range and mean intensity and abundance were higher than the range and mean intensity found on other fish species.

The prevalence was also significantly different (P=0.0) in 3 studying seasons. The highest prevalence was observed in spring (93.3%) and the prevalence in summer and autumn was 51.6 and 53.3%, respectively.

To compare the infestation with *Lernaea* in fishes with different weight, length and age, they were divided into 3 groups including ≤100 g, 100-300 g and >300 g for weight, ≤20 cm and >20 cm for length and also 1, 2, 3 and 4 years of age. No statistically significant relation was found between infestation and weight, length and age of the studied fishes (P>0.05). Population dynamics of *L. cyprinacea* on fish hosts was studied to specify preferred attachment sites of the parasite. The results show that there is a

statistically significant difference between different surface areas of studied fish (P=0.0). The parasites were mostly found on body lateral surfaces followed by caudal fin, dorsal fin, pectoral fin and anal fin.

Table 1.Parasitism indices of *Lernaea cyprinacea* on 4 cyprinid species

Fish Species	No. of examined fish	No. of parasitized fish	prevalence	No. of parasites collected	Intensity of parasitism		Abundance
					mean	range	
Cyprinus carpio	101	62	61.4	131	2.1	1-5	1.3
Carassius auratus gibelio	47	41	87.2	76	1.9	1-6	1.6
Capoeta aculeata	10	7	70.0	17	2.4	1-5	1.7
Alburnus alburnus	22	15	68.2	17	1.1	1-2	0.8
Total	180	125	69.4	241	1.9	1-6	1.3

Table 2. Location of *Lernaea cyprinacea* on 4 cyprinid species; a= no. parasitized fish, b= prevalence, c= no. Parasites collected, d=% parasites collected.

Site	*Cyprinus carpio*				*Carassius auratus gibelio*				*Capoeta aculeata*				*Alburnus alburnus*			
	a	b	c	d	a	b	c	d	a	b	c	d	a	b	c	d
Head	12	11.9	14	10.7	3	6.4	3	39.5	0	0.0	0	0.0	0	0.0	0	0.0
Lateral surface	48	47.5	65	49.6	31	66.0	36	47.4	6	60.0	10	58.8	11	50.0	11	64.7
Pectoral fin	7	6.9	7	53.5	3	6.4	3	39.5	3	30.0	3	17.6	0	0.0	0	0.0
Dorsal fin	21	20.8	21	16.0	13	27.7	15	19.7	1	10.0	1	5.9	3	13.6	3	17.6
Caudal fin	17	16.8	17	13.0	15	31.9	15	19.7	2	20.0	2	11.8	2	9.0	2	11.8
Anal fin	7	6.9	7	53.5	4	8.5	4	5.3	1	10.0	2	5.9	1	4.5	1	5.9
Total			131	100			76	100			17	100			17	100

Discussion

Lernaea cyprinacea, the best known copepod parasite, has been widely distributed throughout the world, presumably through the translocation of cyprinid hosts such as *Cyprinus carpio* and *Carassius auratus* (Piasecki et al., 2004).

The history of fish mortalities caused by *Lernaea* dates back to 1880, when in one of the lakes of the Masurian Lake District (presently in Poland), lernaeosis almost wiped out an entire population of the crucian carp (Kocylowski and Miaczynski, 1960). The parasite, as a cosmopolitan species, has been reported in many countries. A mass mortality of crucian carp was also reported in Karasiowe Lake, Poland (Kocylowski and Miaczynski, 1960). In Australia, heavy infections with *Lernaea* sp. resulted in mortality of golden perch, silver perch and murray cod broodstock in 1988 (Callinan, 1988). In America, unusual mortality in cultured fish caused by *L. cyprinacea* was reported by Goodwin (1999). During June and July of 1998, at least 3 Arkansas fish farms polyculturing bighead carp with channel catfish suffered major losses of channel catfish associated with massive infections by *L. cyprinacea*.

According to their results, the mortality in channel catfish was higher than it in bighead carp. Gabrielli and Orsi (2000) studied 8 fish species on 53 fish farms of the State of Parana, Brazil, for the presence of lernaeids. The prevalence of *Lernaea* found to be 100% in *C. carpio*, *Leporinus macrocephalus* and *Prochilodus lineatus* (Gabrielli and Orsi, 2000).

L. cyprinacea was introduced to Iran possibly through the release of infested introduced cyprinids into natural water bodies such as Choghakhor Lagoon (Ghorbani, 1999). The parasite was reported for the first time in *Gambusia* sp. in 1981 and in common carp and Chinese carps in 1981 and 1982 (Jalali, 1997) from north of Iran. An epizootic of *Lernaea* was reported in fishes in Zarivar Lake, west of Iran by Jazebizadeh (1983). Heavy infestations of different fish species by copepod and adult *Lernaea* have been also reported in Shorabil Lake and Amirkelayeh Lagoon (Sheykh Jabari, 1995; Khara et al., 2005). Epizootic of *Lernaea cyprinacea* in Choghakhor Lagoon was reported for the first time in 2010 as all the six studied fish species including *Cyprinus carpio*, *Carassius auratus*, *Capoeta aculeata*, *Capoeta damascina*, *Alburnus alburnus* and *Hypophthalmichthys molitrix* found to be infested by the parasite with mean prevalence of 75.3 % (Raissy et al., 2010).

In this study, 69.4% of the studied fish found to be infested by the parasite showing no noticeable difference comparing to the results obtained in 2010. The highest prevalence of the parasite found on *Carassius auratus* (87.2%) while the lowest prevalence found on *Cyprinus carpio* (61.4%) showing a significant statistical difference (P=0.01)

which is in a good agreement with Gutierrez-Galindo and Lacasa-Millan (2005). There are different views on the effect of length and weight of the fish on parasitic infection rate. In some studies, smaller fishes had more parasitic infection rate (Bazari Moghaddam, 2009; Pennycuick, 2009; Takemoto et al., 2009) while some other researchers believe infection rate increases with increasing weight and length (Bichi and Ibrahim, 2009; Imam and Dewu, 2010).

In this study no significant statistical difference was found between prevalence and weight, length and age of the studied fishes. Water temperature is known as the significant factor influencing the duration of life cycle of *Lernaea*. Although it proved that the development of the parasite increases with increasing water temperature, prevalence of the parasite in summer is lower than it in spring and autumn which may be due to releasing agricultural swages and pesticides into the lagoon that having negative effect on the parasite population. Although *Lernaea* is not host-specific and has a wide host range, it is proved that the parasite has preferred attachment site (Gutierrez-Galindo and Lacasa-Millan, 2005). Gutierrez-Galindo and Lacasa-Millan (2005) reported that the preferred attachment sites of *Lernaea* in *Barbus graellsii*, *Barbus haasi*, *Cyprinus carpio*, *Leuciscus cephalus* were fins, skin, gills, oral cavity and nasal cavities, respectively.

In the present study, the preferred site was body lateral surfaces followed by caudal, dorsal, pectoral and anal fins. The highest prevalence was observed for all 4 host species on lateral surface while the head was the least preferred attachment site. The highest mortality was observed in spring and mortality of fishes was observed until the end of summer. Since the life cycle is temperature dependent, prevalence and intensity decreases with decreasing water temperature in winter.

Comparing the results of this study with the results of our previous study (Raissy et al., 2009) show that the parasite has remained in the Lagoon's environment and it is expected that the infestation increases in next spring accompanied by great dangers for native fish population and also for fishery activities. Since there is no medicine for effective treatment of this parasite in natural water bodies, considering the environmental values of the lagoon, biological control seems to be more effective and environmentally responsible.

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