Survey of Lernaeid in *Shizothorax zarudnyi* from Chahnimeh lakes in Sistan, Iran

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Abstract The Lernaeid parasites, *Lernaea* spp, are crustacean ectoparasites that occur in a variety of fishes worldwide. In the present study, *Shizothorax zarudnyi* ($n = 1,500$) were examined during August 2012 to 2013 to determine the prevalence of Lernaeid parasites at one Species fish of Chahnimeh lakes Sistan, Iran. Two species of the genus *Lernaea*; *L. cyprinacea* and *L. polymorpha*, were recorded. The overall prevalence rates of *L. cyprinacea* and *L. polymorpha* were 15.47 and 10.20 % respectively. The relationship between body weight and Lernaeid parasites showed that prevalence of *L. cyprinacea* and *L. polymorpha* was highest in weight group of 250–400 g and lowest in weight group of 500–700 g. The overall percentage of infestations in study was the highest (42.5 %) in summer, moderate (33.6 %) in spring and the lowest (17.25 and 6.62 %) in the autumn and winter season, respectively. The number of detected Lernaeid parasites and infested fish were 6,140 and 800 respectively. The mean intensity of infestation was 7.68. There was significant correlation between parasite prevalence and intensity with host weight ($P = 0.000$). Knowledge of the prevalence of Lernaeid parasites and current *Lernaea* species will help to minimize the economic losses in the fish industry, evaluate infestation potential and control programs, especially for other fishes.

Keywords Fish · *Shizothorax zarudnyi* · *L. cyprinacea* · *L. polymorpha*

Introduction

Fish provide valuable protein to the diets of people worldwide. They are also an important source of recreational activity, with many enjoying the sport of fishing and keeping ornamental fish as pets. As the population grows, there is increased pressure on the fishing industry to meet consumers' needs for this protein source and to make higher profits from this lucrative market. In response to these demands, aquaculture has developed as one way to gain greater control over the supply of the product and to tackle the problems posed by the parasites that attack these fish. Over the past few decades, aquaculture has paid more attention to parasitic infections in fish as it affects their productivity and reduces carrying capacity (Kennedy 1994). Fish play host to a number of different parasites, and their presence lowers their level of health; moreover, these infestations can also increase the risk of predator attacks if the fish's appearance, fitness, or behavior changes (Poulin et al. 2005). *Lernaea* spp are freshwater parasites that are one source of parasitic disease in fish. They are present in freshwater and commonly called 'anchor worms' due to their anchor-like heads which they attach under the skin of the fish, and they can be found in both wild-caught and cultured fish (Lester and Hayward 2006). Lernaeid copepods are extremely harmful parasites of freshwater fish, and young fish are particularly vulnerable as they can die even in the presence of low numbers of these organisms (Kabata 1981; Molnár 1987). Fish affected by these parasites have lower levels of health due to abnormalities in their metabolism, which in turn reduces their ability to grow and to provide industry profits. These financial losses result not only directly from the physical damage they afflict on the fish, but they can also affect fish growth and the appearance of the fish, which translates into significant

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damages for the fish industry. Large fish are particularly vulnerable to adult parasites, not only because of the size of these organisms, but also the way in which they attach themselves to their host and feed (Bhuiyan and Musa 2008). When small fish are infested with large numbers of lernaeids in the copepodid stages, these parasites destroy their gills, making it hard for the fish to breathe, and ultimately this kills them. Female parasites attach to the fish using an anterior anchor, and they embed themselves deeply into the fish. As a result, the area around the attachment site becomes red and swollen, in addition the attachment may become infected or bleed. Fish can tolerate small numbers of parasites without significant health problems; however, they are an irritant and do cause distress. A *Lernaea* infestation may result in an area of inflammation, and this often leads to a secondary bacterial infection as the skin barrier is broken (Bauer et al. 1973; Shariff et al. 1986; Jithendran et al. 2008). This parasite prefers a temperature range of between 26–27 °C for optimal development. At temperatures below 20 °C, egg incubation is delayed and juvenile *Lernaea* cannot complete their growth cycle (Woo 1995).

The present study was designed to investigate the prevalence and pathology of Lernaeid parasitic infestations in fish and their relationship with fish weights. In addition, special reference was also made to the control of this parasite.

Materials and methods

Chahnimeh lakes are a big, freshwater body in the far southeast of Iran, situated in the south Sistan and Baluchestan Province close to the city of Zehak near to border of Afghanistan. Stored water in these Cavities is used to Sistan earth and for providing drink water of Zabol and Zahedan Cities. The average water depth is 8–10 m. The volume of Chahnimeh lakes has been calculated to range from about 640–700 million cubic meters of water.

In this study, Specimens of *Shizothorax zarudnyi* were accidentally collected with a fish net from the Chahnimeh lakes Sistan during August 2012 to 2013 and examined for the presence of *Lernaea* spp. Weight of fishes were recorded and they considered in two weight groups (250–400 g and 500–700 g). The body surface, eyes, skin, fins, gills and mouth of fish were thoroughly examined with the help of magnifying glass and ectoparasites were isolated and preserved in 70 % ethanol (C₂H₅OH). The captured fishes were released back into the lake after measuring the weight and removed lerneid parasites. The collected parasites were transferred to the Parasitology Research Laboratory of Shahid Bahonar University, Kerman, Iran. In the laboratory, the copepods were examined

whole on Light microscop (Olympus Tokyo Japan). Copepod identification was based on morphological features according to Woo (1995). According to Bush et al. (1997), the prevalence (number of infested fishes/number of examined fishes × 100 %) and the mean intensity (total number of Lernaeid parasites/number of infested fishes) were calculated (Bush et al. 1997).

Statistical analysis was performed using SPSS software (version 16) (SPSS, Inc, Chicago, IL), in addition, a Chi square test was used to check for differences between the percentages.

Results

Out of 1,500 fishes, 800 (53.33 %) were infested with two species of Lernaeid parasites *L. cyprinacea*, *L. polymorpha*. 700 of the 1,500 fishes (46.67 %) were negative for Lernaeid infestation. The overall prevalence of lernaeid ectoparasites was calculated and according to these results *L. cyprinacea* and *L. polymorpha* had the overall prevalence of 15.47 % (n = 232) and 10.20 % (n = 153), respectively. Mixed infestations were found in 27.67 % (n = 415) of the specimens. The total number of detected Lernaeid parasites was 6,140 and the mean intensity of infestation was 7.68 (Table 1). The minimum and maximum of detected Lernaeid parasites per fish were 4 and 13 respectively. The present study revealed that *L. cyprinacea* was the most prevalent (9.60 %) in the 250–400 g fish group, while the parasite had the lowest level (5.87 %) in the 500–700 g group. *L. polymorpha* was the most prevalent (7.40 %) in the 250–400 g group, while the lowest level was found (2.80 %) in the 500–700 g fish group (Table 2). There was significant correlation between parasite prevalence and intensity with host weight ($P = 0.000$). The Lernaeid parasites were removed from different sites on the body of the fishes. *L. cyprinacea* were from the skin, fins, gills and anal and *L. polymorpha* from skin, fins, gills (Fig. 1). The fishes had higher prevalence of double infestation (27.67 %) compared to single (25.67 %) infestations but, this differences was not significant ($P > 0.05$) (Table 2). Out of 800 infected fishes, 340

Table 1 Relationship between fish body weight and detected lernaeid parasites and mean intensity of infestation on *Shizothorax zarudnyi* in Chahnimeh lakes, Sistan, Iran

	Total number	Body weight range	
		500–700 g	250–400 g
Infested fishes	800	249	551
Detected parasites	6,140	1,039	5,101
Mean intensity of infestation	7.68	4.17	9.26

Table 2 Relationship between fish body weight and Prevalence of lernaeid parasites and Sites of parasites on *Shizothorax zarudnyi* in Chahnimeh lakes, Sistan, Iran

Name of parasite	No. of infested fishes (Prevalence)	No. of infested fishes based on body weight range (Prevalence)		Site of parasite
		50–700 g	250–400 g	
<i>L. cyprinacea</i>	232 (15.47 %)	88 (5.87 %)	144 (9.60 %)	Skin, fins, gills and anal
<i>L. polymorpha</i>	153 (10.20 %)	42 (2.80 %)	111 (7.40 %)	Skin, fins and gills
Mixed infestation	415 (27.67 %)	119 (7.93 %)	296 (19.73 %)	Skin, fins, gills and anal
Total	800 (53.33 %)	249 (16.60 %)	551 (36.73 %)	–

Fig. 1 Fishes (*Shizothorax zarudnyi*) infested by *Lernaea cyprinacea* and *Lernaea polymorpha***Table 3** Seasonal prevalence of the lernaeid parasites of *Shizothorax zarudnyi* in Chahnimeh lakes, Sistan, Iran

Season	Number	Prevalence (%)
Spring	269	33.6
Summer	340	42.5
Autumn	138	17.25
Winter	53	6.62

(42.5 %), 269 (33.6 %), 138 (17.25 %) and 53 (6.62 %) fishes were infected in summer, spring, autumn and winter seasons by Lernaeosis, respectively (Table 3).

Discussion

During this study two species of *Lernaea*; *L. cyprinacea*, *L. polymorpha* were recorded from *Shizothorax zarudnyi*. 53.33 % fishes (n = 800) were infected with *Lernaea* which supported the findings of Kanwal et al. (2012) who recorded 52.36 % prevalence of *Lernaea* in fishes in Pakistan (Kanwal et al. 2012). But, the present finding is found lower prevalent rate than that of Tasawar et al.

(2007), who reported 80 % *Lernaea* infestation in fishes in Pakistan (Tasawar et al. 2007). In Pakistan, Tasawar et al. (2007) reported 4.2 % infestation with Lernaeosis in affected fishes and identified four *Lernaea* species (*L. cyprinacea*, *L. polymorpha*, *L. lophiara* and *L. oryzophila*). In a study in Brazil by Medeiros and Maltchik (1999), *Lernaea cyprinacea* reported as predominant infective species in fishes (Medeiros and Maltchik 1999). In Pakistan, reported species of Lernaeid were *L. cyprinacea*; *L. polymorpha*; *L. oryzophila* and *L. ctenopharyngodonis* (Iqbal et al. 2012). In study of Iqbal et al. (2012), *L. cyprinacea* and *L. polymorpha* were the most predominant in *C. idella* fishes. Similar to the present study *L. cyprinacea* was the most commonly species in affected fishes. In Egypt, three parasites species [*Trichodina* (15 %), Monogenetic trematodes (5 %) and *Lernaea cyprinacea* (60 %)] were recovered from the Silver Carp (*Hypophthalmichthys molitrix*) by Shagar and El-Refae (2012) that the most frequently occurring species in Silver Carp were *Lernaea cyprinacea* (Shagar and El-Refae 2012). In agreement with our report, the common pathogenic *Lernaea* species was *Lernaea cyprinacea*.

In the present research, the prevalence of *L. cyprinacea* and *L. polymorpha* was highest in weight group of 250–400 g and lowest in weight group of 500–700 g. There was significant correlation between parasite prevalence and intensity with host weight ($P = 0.000$). Our results are not similar with Kanwal et al. (2012), reported the highest prevalence in fish group with higher body weight and lowest prevalence in fish group with lowest body weight at *Catla catla* in Southern Punjab, Pakistan (Kanwal et al. 2012). Thus Barson et al. (2008) reported that there was no significant correlation between parasite prevalence and intensity with host size. There are different views on the effect of weight of the fish on parasitic infestation rate. It has been noted in several studies that smaller fish had higher parasitic infestation rates (Bazari Moghaddam et al. 2010; Takemoto et al. 2009), however, other researchers have found that infestation rates increase in larger fish (Bichi and Ibrahim 2009; Imam and Dewu 2010). Furthermore, as fish increase in size they may be

able to adapt more easily to the presence of these parasites, due to their greater ability to compete for food and other resources (Khan et al. 1993). In small fish, adult parasites easily penetrate vital organs and cause death (Marcogliese 1991; Piasecki et al. 2004). In this study, highest parasite density was observed on the fins and anal regions of host fish, while other studies reported *Lernaea* preferential attachment to ventral, caudal and head (Barson et al. 2008; Kabata 1981; Rameshkumar and Ravichandran 2012). Some studies have reported more frequent attachment to the ventral than to the dorsal aspects of host fish (Amin et al. 1973; Durham et al. 2002). During the study period the Prevalence of the lernaeid parasites were recorded in summer, spring, autumn and winter Season, (42.5 %), (33.6 %), (17.25 %) and (6.62 %), respectively. But, different finding was recorded in Bangladesh, where Bhuiyan and Musa (2008) reported the major inroads of the parasites occurred during winter and autumn seasons (Bhuiyan and Musa 2008). Various factors may influence the prevalence of *Lernaea* species in a variety of fish, including; age, size, nutritional status, overcrowding, and the fish's ability to resist a parasitic attack. The capacity of *Lernaea* species to adapt themselves to prevailing water conditions, such as; temperature, pH level, mineral content, salinity, and oxygen levels, also need to be taken into account (Baker et al. 2008; Bhuiyan and Musa 2008; Jafri and Mahar 2009; Martins et al. 2002; Tasawar et al. 2007). Fish species also differ in the arrangement and composition of their scales and these may prevent the parasite from gaining easy access to the delicate underlying skin layers of the fish (Kabata 1981).

The prevalence of Lernaeid parasites in fish in Sistan have not been reported previously. In this study, we demonstrated that the Lernaeid parasites are relatively widespread in *Shizothorax zarudnyi* fish in Chahnimeh lakes, Sistan, Iran. Knowledge of the prevalence of Lernaeid parasites and current *Lernaea* species will help to minimize the economic losses in the fish industry, evaluate infestation potential and control programs, especially for other fishes.

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Conflict of interest The authors declare that they have no conflict of interest.

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