Prevalence of *Argulus foliaceus* in ornamental fishes [goldfish (*Carassius auratus*) and Koi (*Cyprinus carpio*)] in Kerman, southeast of Iran

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Abstract The genus *Argulus* (Crustacea: Branchiura), or fish louse, are common parasites of freshwater fish. This parasite have a direct life cycles and mature females leave the host and lay several hundred eggs on vegetation and various objects in the water. It caused pathological changes due to direct tissue damage and secondary infections. Besides the damage and stress caused by *Argulus* itself, one of the main worries for fish producers are the associated secondary infestations and infections that can result from infestation with this ecto-parasite. From 300 samples, only 20 (6.67 %) samples were infested with this parasite and 280 (93.33 %) not infested. In the present study, *Argulus foliaceus* was reported on goldfish and Koi which this was first recorded in Kerman, southeast of Iran. According to the presented study, it is clear that *A. foliaceus* can act as a potential risk factor for natural ecosystems and native fish population of Iran and other countries, that should be mentioned to prevent the burst of new parasitic fauna to Iran and different countries as well as stop direct economic losses caused by mortality derived from infestation with this ecto-parasite.

Keywords Prevalence · *Argulus foliaceus* · Kerman · Iran

Introduction

The genus *Argulus* (Crustacea: Branchiura), or fish louse, are common parasites of freshwater fish (Klinger and Floyd

1998; Thilakaratne et al. 2003). Many of the species are parasitic on marine fishes, and about 15 spp. are found on freshwater fishes (Noaman et al. 2010), these parasites are 5–10 mm in size and consist of a head, thorax and abdomen the head is covered by a flattened horseshoe-shaped carapace, maxillipeds, peroral sting and basal glands (Soulsby 1982; Yildiz and Kumantas 2002). The thorax contains four segments that each segment taking a pair of swimming legs and the abdomen has a simple bilobed segment (Soulsby 1982; Yildiz and Kumantas 2002). *Argulus foliaceus* have a direct life cycles that due to not require to the intermediate hosts for complete its life cycle and transports quickly among the fishes (Al-Dulaimi 2010). In its life cycle, fertilized females depart the host and lay several hundred eggs on vegetation and various objects in the water. Eggs are protected by a gelatinous capsule and are ovoid in shape. 40–100 days are needed for completion of the life cycle and this time is depended on the environment temperature (Mikheev et al. 2001). Adults may live free from the host for up to 15 days. *A. foliaceus* is an obligatory blood sucker and can survive for only a few days without the host fish, depending on size and ambient temperature (Koyun 2011). This parasite infected the skin, fins and gills of the freshwater fishes hosts (Yildiz and Kumantas 2002). It caused pathological changes due to direct tissue damage and secondary infections (Al-Dulaimi 2010). It feeds by piercing the skin of the host, with heavy infestations leading to serious skin damage, stress and death (Harrison et al. 2006). Feeding can take place on the skin or in the gills of the fish causing intense irritation and tissue damage (Al-Dulaimi 2010). Besides the damage and stress caused by *A. foliaceus* itself, one of the main worries for fish Producers is the associated secondary infestation that can result from infestations with this ectoparasite (Noaman et al. 2010). Many researches have been done on

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prevalence of *A. foliaceus* but the reseaches on prevalence of this ectoparasite in Iran are scanty (Al-Dulaimi 2010; Buchmann and Bresciani 1997; Ebrahimzadeh Mousavi et al. 2011; Harrison et al. 2006; Noaman et al. 2010; Pazooki et al. 2007; Thilakaratne et al. 2003; Yildiz and Kumantas 2002). Therefore, this study was aimed to determine the prevalence *A. foliaceus* of ornamental fishes (Goldfish and Koi) of Kerman, southeast of Iran. This is the first research on prevalence of *A. foliaceus* in Kerman, southeast of Iran.

Materials and methods

Three hundred ornamental fish (200 pieces gold fish and 100 pieces Koi) from 10 pet fish supply store in the Kerman, southeast of Iran, in the winter 2013 were randomly selected. Then, the fish caught by hand tour and were transferred to plastic container containing water. Samples were examined macroscopically, microscopically, clinically for presence of *A. foliaceus*. In the macroscopic method, contaminated fishes were brought out and their parasites were removed with forceps from different parts of the body. By microscopic method, the fish were examined by dissecting microscope. Collected parasites were fixed in 70 % ethanol and transferred to laboratory of parasitology in the School of Veterinary Medicine, Shahid Bahonar University of Kerman. Then parasites were identified using the diagnostic key.

Results

The study demonstrated that only 20 out of those 300 samples were infested with *A. foliaceus*, meaning a 6.67 % prevalence. The highest infestation rate was in gold fish (9.5 %) and lowest in Koi fish (1 %) (Table 1). All collected parasite were *A. foliaceus* (Fig. 1).

In this study, all fish had generalized symptoms including lack of appetite and abnormal swimming. Bloody spots were also observed on skin and fins. In the present study, The distribution of *A. foliaceus* contamination on different body regions was examined. Results showed that

Table 1 Prevalence of *A. foliaceus* infection in two species of ornamental fish (Goldfish, Koi)

Species fish	Number of studied fish	Number of infested fish	Prevalence (%)
Gold fish (<i>Carassius auratus</i>)	200	19	9.5
Koi (<i>Cyprinus carpio</i>)	100	1	1
Total	300	20	6.67

Fig. 1 *Argulus foliaceus* magnification (×4)

Fig. 2 Distribution of *A. foliaceus* infection in fins and other organs of fish

10 (27.78 %) parasites were found on dorsal fins, 3 (8.33 %) on anal fins, 4 (11.11 %) on pelvic fins, 9 (25 %) on pectoral fins, 8 (22.22 %) on caudal fins and 2 (5.56 %) in other organs as mouth and gill (Fig. 2).

Discussion

The propagating and rearing of ornamental fish have a remarkable situation in the World and plays a valuable role in exchange income of some countries and in Occupation. The world trade share of these fish which was estimated about 900 million dollar, has given an important insight into it (Meshgi et al. 2006). Because of the economic importance of these aquatics, many researchers have paid attention the different factors threatening their health. Gold fish is one of the main ornamental fish for which more than 100 varieties have been produced with selective hatching and many people are interested in their propagating and rearing. Besides their propagating in different fish farms in Iran, different species of goldfish are imported annually

from Southeast Asian countries. Researches carried out on goldfish and Koi confirms the *Argulus* as the most prevalent parasite (Noga 2010). A few parasites species like protozoa are seemingly non-host specific species and have been found in a large-scale of fresh or brackish water fish species throughout the world. *A. foliaceus* were reported from different fish's species worldwide and reported with some of the goldfish in Turkey Sarieyyupoglu and Saglam (Buchmann and Bresciani 1997). In the present study, *A. foliaceus* was reported on goldfish and Koi which this was first recorded in Kerman, southeast of Iran. The lice fish is a dangerous parasite lacking specificity, so that it can probably infested all freshwater fishes and occurring in estuarine or coastal and marine water habitats (OKtener et al. 2007). Al-Dulaimi (2010) in Babylon province of Iraq reported cases of the infection with *A. foliaceus* lice in different goldfish species in the earthen ponds (Al-Dulaimi 2010). Notash (2012) studied on the goldfishes in east Azerbaijan province of Iran and reported that they were infested with at least one species of crustacean (Notash 2012). Also Ebrahimzadeh Mousavi et al. (2011) studied on the 10 different ornamental fishes farm in Iran and reported that 230 pieces of the goldfishes were infested with three species of this ectoparasite (Ebrahimzadeh Mousavi et al. 2011). In this research, it was observed that infected fishes have generalized symptoms including lack of appetite and abnormal swimming and blood points were also observed on the skin and fins. Also sometimes opportunistic bacteria had infected these damaged areas leading to skin ulcer. According to our results, the mean number of *A. foliaceus* from each infested goldfish was 1–3, while Yildiz and Kumantas (2002) and Noaman et al. (2010) reported the isolation of at least 3 ectoparasites on infested goldfish. This difference can be relevant to the stages of infestation, related to the early stage of infestation and life cycle of the ectoparasite (Noaman et al. 2010; Yildiz and Kumantas 2002). In the present study, *A. foliaceus* was reported on goldfish and Koi which this was first recorded in Kerman, southeast of Iran. According to the presented study, it is clear that *A. foliaceus* can act as a potential risk factor for natural ecosystems and native fish population of Iran and other countries, that should be mentioned to prevent the burst of new parasitic fauna to Iran and different countries as well as stop direct economic

losses caused by mortality derived from infestation with this ecto-parasite.

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