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RESEARCH ARTICLE

RELATIONSHIP BETWEEN CONDITION FACTOR AND EXTERNAL PARASITE DENSITY OF GOLD FISH (*CARASSIUS AURATUS* (LINNAEUS, 1758)) AND KOI CARP (*CYPRINUS CARPIO* (LINNAEUS, 1758)) DURING DRY AND WET SEASONS

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ABSTRACT

Comparative study on relationship between condition factor and parasite density of gold fish (*Carassius auratus*) and koi carp (*Cyprinus carpio*) was carried out during wet and dry seasons. The study was conducted at the Rambadagalle Ornamental Fish Breeding and Training Center in Sri Lanka. A sample of 30 gold fishes and 50 koi carps in the same cohort were collected from two separated harvesting ponds. Standard length and weight were recorded and condition factor was estimated for each individual. Their gills, fins and skin were observed for external parasites. Among the recorded parasites, abundance of *Tricodina* sp. was high in gold fish during both seasons. *Tricodina* sp. was the most abundant parasite during the wet season in koi carp while it was *Apiosoma* sp. in the dry season. Correlation co-efficient was determined to investigate the strength of the relationship between condition factor and the total number of parasites. There was no significant correlation was observed between two factors for gold fish during two seasons (wet season = -0.287, dry season $r = -0.109$, $P > 0.05$). A weak negative relationship was observed between condition factor and the number of parasites infected the koi carp during the dry season ($r = -0.304$, $P = 0.032$) but no significant correlation was observed between two factors during the wet season ($r = 0.08$, $P = 0.580$). Information emerged from this study could be taken into consideration when implementing health management practices in ornamental fish culturing programs.

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INTRODUCTION

Host – parasite relationship is a general phenomenon which regulates at equilibrium level in the natural environment (Marcogliese, 2005). Environmental changes and anthropogenic actions directly affect the equilibrium level between host and the parasite in nature and finally resulting the disease conditions (Lafferty and Kuris, 1999). Parasites cause mechanical damage (fusion of gill lamellae, tissue replacement), physiological damage (cell proliferation, immunomodulation, altered growth, detrimental behavioral responses,) and/or reproductive damage (Buchman and Lindstrom, 2002, Knudsen et al. (2009), Al-Jahdali and Hassanine, 2010) on fish species. Length-weight relationship helps to determine the condition factor of a given individual or a population. Individual condition is an important component in determining performance, survivorship and reproductive success in a fish (Forseth et al., 1999). According to Neffa and Cargnelli, (2004), condition factor can be defined in energetic

terms as the amount of energy available to an individual which may be allocated to various life functions including reproduction, foraging and over-winter survival. Parasitic diseases are common among fish species (Khan et al., 1993), and it is one of the key threats to the production of the industry (Roberts and Janovy, 2000). Especially, in ornamental fishes, even low level of infections leads to major losses in the production thus reduces the profit of the industry (Thilakarathne et al., 2003). Between two main forms of parasites; ecto and endo parasites; ecto-parasites are the most harmful group that causes severe mortalities in culturing fish species (Shalaby and Ibrahim, 1988).

Ornamental fish Breeding and Training Center at Rambadagalle is governed by National Aquaculture Development Authority (NAQDA) in Sri Lanka which culture more than fifty ornamental fish varieties. Among them, gold fish *Carassius auratus* (Linnaeus, 1758), and koi carp (*Cyprinus carpio*) (Linnaeus, 1758) are two major fish species which gained high demand in the local and the export markets (Watson et al., 2004). Proper scientific studies reported on relationship between parasitic infections and the growth of

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ornamental fish species is limited in Sri Lanka. Therefore, this study aimed to determine the relationship between condition factor and the number of external parasite infected the gold fish and koi carp during two seasons. The results of the current study could be utilized when implementing health management practices of the fish culturing programs.

MATERIALS AND METHODS

A sample of 30 gold fishes and 50 koi carps (sample size was designed according to Naing et al., 2006) in the same cohort (45 days) were collected from two separated harvesting ponds in wet (February-July) and dry (August-November) seasons, and their length and weight data were recorded. Initially, external abnormalities were observed of each fish in the sample. Then a gill was randomly removed and observed for parasites. Skin scrape was taken from the end of the operculum to base of the caudal fin from each fish and were examined in the laboratory for ecto parasites. To keep the consistency throughout the study, skin scrape was taken once from each individual for examination. Caudal fin was taken and observed for parasites. For each individual, observed parasite species and the numbers were recorded. Condition factor was estimated using the formula: $K = W/L^3$, where K=condition factor, W=weight, L=standard length (Murphy et al., 1991). Graphs were plotted against condition factor and the total number of parasites. Pearson correlation coefficient (r) was estimated to determine the intensity of parasite infections on the growth (negative or positive) of the two fish species.

RESULTS

Identified protozoan and metazoan parasite species and their abundance on gold fish and koi carp during two seasons are tabulated in Table 1 and Table 2. The relationships between condition factor and the total parasite number in koi carp and gold fish are given in the Figure 1 and Figure 2.

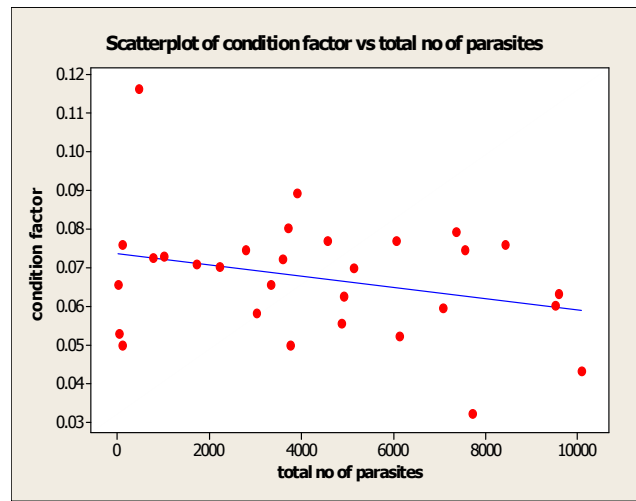
Table 1. Identified protozoan parasite species and their abundance in gold fish and koi carp during two seasons

Protozoan Parasite species	Total no of parasites collected in koi carp		Total no of parasites collected in gold fish	
	wet	dry	wet	dry
1 <i>Apiosoma</i> sp.	301	75516	288	1532
2 <i>Tricodina</i> sp.	365	833	128172	173752
3 <i>Trypanthella</i> sp.	ND	175	ND	33
4 <i>Ichthyobodo necatrix</i>	3	ND	ND	ND
5 <i>Chilodonella</i> sp.	ND	ND	ND	19181
Total number of parasites	669	76524	128460	194498

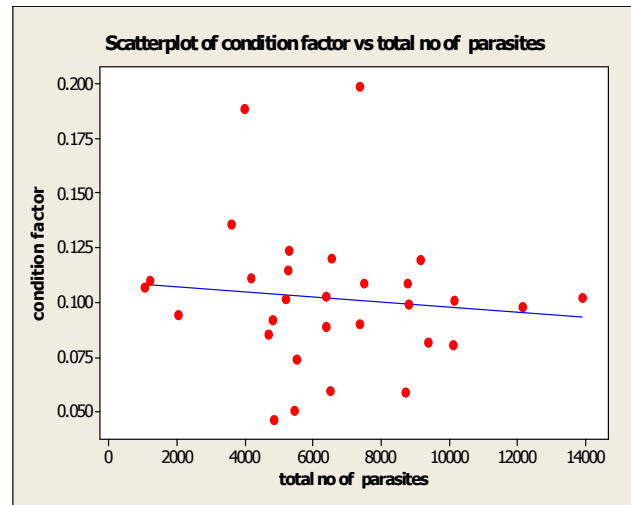
Table 2. Identified metazoan parasite species and their abundance in gold fish and koi carp during two seasons

Metazoan Parasite species	Total no of parasites collected in koi carp		Total no of parasites collected in gold fish	
	wet	dry	wet	dry
1 <i>Centrocestus</i> sp.	50	55	536	649
2 <i>Argulus</i> sp.	1	4	ND	ND
3 <i>Dactyrogyrus</i> sp.	32	43	32	41
4 <i>Gyrodactylus</i> sp.	9	18	2	28
5 <i>Posthodiplostomum cuticola</i>	ND	ND	544	630
Total number of parasites	92	120	114	1348

ND=Not Detected

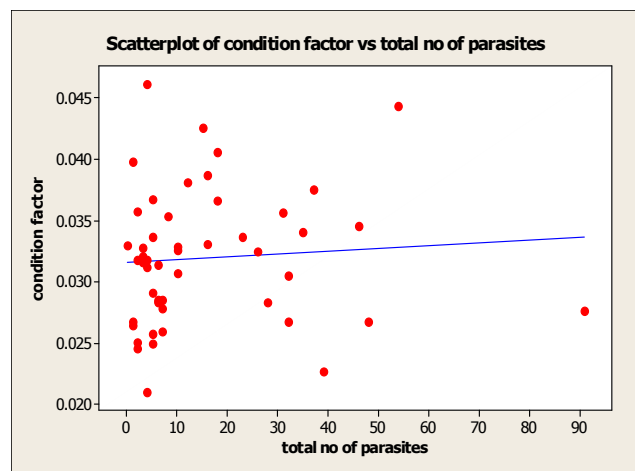


(i)

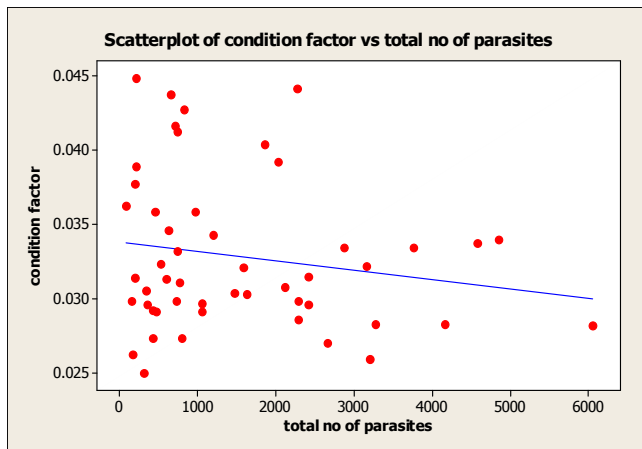


(ii)

Figure 1. The relationship between condition factor and the total number of parasite on gold fish (i) wet season (ii) dry season



(i)



(ii)

Figure 2. The relationship between condition factor and the total number of parasite on koi carp (i) wet season (ii) dry season

Results indicated that protozoan parasites were high in both fish species (Table 1 and 2) and the total number of parasites infected were significantly higher in dry season than wet season in both fish species ($P=0.001$ and $P=0.007$ for koi carp and gold fish respectively). According to the figure 1 (i) and (ii), when the total number of parasites increases, the condition factor decreased indicating the negative relationship between parasite infection and the growth of the gold fish species (wet season $r = -0.287$, $P=0.124$, dry season $r = -0.109$, $P=0.565$). But there was no significant relationship among two factors ($P > 0.05$), therefore it can be suggested that the growth of the gold fish may not be affected by the parasite density in both seasons. But in koi carp (Figure 2 (i) and (ii)) when the total number of parasites increased, the condition factor increased during wet season revealing that there was no significant relationship between the growth of the koi carp and the number of total parasites infected the fish ($r= 0.08$, $P= 0.580$). In contrast to that, during dry season, the total number of parasites increased, the condition factor decreased indicating that there was a significant negative relationship on the growth of the koi carp and the infection of total parasites ($r= -0.304$, $P=0.032$).

DISCUSSION

According to the studies of Pennycuik (1971) and Rahman *et al.* (2007) the intensity of fish parasite occurrence is greatly influenced by seasonality. By proving that, result in this study also showed the parasite load is significantly high (gold fish-0.007 koi carp- < 0.001) in dry season than wet season in both fish species. When environmental parameters change fishes become stressed (Nnadi *et al.*, 2011) which facilitates parasites to reach to a host for their survival. Also parasites species which obtain favorable conditions for their survival become increased. Parasites infection differs with the susceptibility of fish. The swimming pattern may be another point responsible for the infection rate which in this study, gold fish, a slow moving fish showed the high parasite infection level while koi carp, a fast moving fish showed low infection levels.

Among the infected parasites, abundance of *Tricodina* sp. was high in gold fish during both seasons. Although, a significant correlation between condition factor and parasite load was not observed for gold fish in both seasons (wet season $r= -0.287$, $P=0.124$ dry season $r = -0.109$, $P=0.565$), results indicated that there was a negative impact on fish condition due to parasite infection. Koi carp was highly infected in *Tricodina* sp. during wet season while it was *Apiosoma* sp. during dry season. According to the results, the parasite load has affected to the condition factor of koi carp only during dry season but with a weak correlation ($r= 0.08$, $P= 0.580$) and during wet season, it shows positive correlation ($r=-0.304$, $P=0.032$). The main water body that supplies water for Rambadagalle Fish Breeding Center is Daduru Oya. Mud ponds are filled with this water where fishes are stocked for 45 days. Fluctuations of parasite density of both fish species during two seasons indicated that there could be a relationship between water quality parameters in the culture system and the parasite density. According to this study, high total numbers of parasites have been recorded in dry season than the wet season. Therefore, the dry season could be considered as the season with favorable conditions for most of the parasite species. Current study indicated the basic relationship between the number of parasites and the condition factor of two host fish species. Further studies are important to investigate the influence of environmental parameters on the fluctuation of parasite densities on fish species which helps to provide more important information for health management practices of the ornamental fish farming industry.

Conclusion

The results revealed that although gold fish (*Carassius auratus*) and Koi carp (*Cyprinus carpio*) species belong to the same family (cyprinidae), their host-parasite relationship is different. According to the results both fish are more susceptible for parasites in dry season. And also it was revealed that the infective parasite species and the densities are different according to the fish species. *Tricodina* sp. was recorded as the main parasite species on gold fish in both seasons and on koi carp it was in wet season. During the dry season in koi carp, *Tricodina* sp. was replaced by *Apiosoma* sp. indicating the influence of environmental conditions on parasite species which also affected the condition factor of koi carp. Finally, these findings imply, when applying controlling measures for parasites in fish culturing systems more attention should be paid on the seasonal and environmental changes and then suitable treatment methods should apply accordingly.

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