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Short Communication

Prevalence of Asian fish tapeworm *Bothriocephalus* in grass carp in Dongting Lake of Hunan province, subtropical China

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Abstract. We investigated the prevalence of Asian fish tapeworm *Bothriocephalus* infection in grass carp in Dongting Lake of Hunan province, subtropical China between August 2014 and October of 2015. A total of 2534 fish samples from four representative administrative regions in Hunan province, subtropical China were examined for the presence of *Bothriocephalus* using helminthological approach. The overall prevalence of *Bothriocephalus* in grass carp was 6.6% (167/2534). The prevalence of *Bothriocephalus* in grass carp was higher in summer (10.0%) and spring (7.0%) than in autumn (6.0%) and winter (3.3%) ($P<0.01$). The highest prevalence of *Bothriocephalus* was found in grass carp with body weight 0.5<Weight<1.5 group with 1-91 infected intensity. The highest intensity of infection was in summer (23–104), and least in winter (1–32). The present survey revealed the prevalence of *Bothriocephalus* in grass carp in Dongting Lake of Hunan province, subtropical China. To our knowledge, this is the first report of *Bothriocephalus* prevalence in grass carp in China.

INTRODUCTION

Bothriocephalus Rudolphi, 1808 (Eucestoda: Bothriocephalidea), known as the Asian fish tapeworm, is a cosmopolitan fish parasite (Salgado-Maldonado *et al.*, 2015). Fish infected with *Bothriocephalus* causes many clinical signs, such as blockage and perforation of intestine, distended abdomen, inflammation and haemorrhaging (Zargar *et al.*, 2012). The majority of *Bothriocephalus* are found in freshwater fish (including grass carp *Ctenopharyngodon idellus*). It can cause major economic loss to fish farm industry worldwide due to severe impact on growth and condition of fish (Scholz, 1999; Choudhury *et al.*, 2006; Brabec *et al.*, 2015).

In China, grass carp is the most widely produced and consumed meat. Grass carp has a long history in aquaculture and is one of the most important species cultured in inland water bodies in China. Although *Bothriocephalus* are considered as important pathogens of grass carp, limited information is available regarding *Bothriocephalus* infection in grass carp (Dove and Fletcher 2000; Salgado-Maldonado *et al.*, 2015). In spite of the high prevalence of *Bothriocephalus* reported in other fish species (e.g., *Cyprinus carpio*, *Opsariichthys bidens* and *Squaliobarbus curriculus*) in China (Wang *et al.*, 2006; Xi *et al.*, 2013), little or no information is available for *Bothriocephalus* infection in grass carp. Investigation of

Bothriocephalus infection in grass carp is important in order to prevent and control bothriocephalusis in grass carp in China.

The objective of this study was to determine the prevalence of *Bothriocephalus* in grass carp in Dongting Lake of Hunan province, subtropical China. The results can be used provide base-line data and recommendations with regards to prevention and control of bothriocephalusis in grass carp in this region and elsewhere.

METERIALS AND METHODS

The survey took place between August 2014 and October of 2015. Grass carp in local fish market in Dongting Lake of Hunan province, subtropical China (Table 1) were sampled and the individual organs were removed from the carcasses. The small and large intestines were separated, opened and washed, and macroscopic examinations of the washings and organs were performed.

Counts of *Bothriocephalus* per fish were performed on all washings or a proportion of the total washings depending on the total number of tapeworm present. For *Bothriocephalus*, the specimens were fixed in 70% ethanol, stained with carmine, differentiated in acid-alcohol, dehydrated in serial concentrations of ethanol, cleared in xylene, mounted in Canada Balsam, and then identified morphologically to species according to existing descriptions and keys (Schmidt, 1986). A fish was recorded as infected with a certain *Bothriocephalus* species if at least one *Bothriocephalus* was found in that fish. Prevalence, mean intensity of *Bothriocephalus* are descriptors based on previous study (Rózsa *et al*., 2000).

The data were analyzed statistically using the PASW Statistics 18 (IBM Corporation, Somers, NY, USA). The Fisher exact test was used. The value of $P<0.05$ differences between levels within factors and interactions were considered to be statistically significant.

RESULTS AND DISCUSSION

Bothriocephalus was detected in 167 of 2534 (6.6%) grass carp, which is significantly lower than that of previous studies (Wang *et al*., 2006; Xi *et al*., 2013). Differences in *Bothriocephalus* prevalence are likely due to differences in fish species. Results of the present and previous investigations (Wang *et al*., 2006; Xi *et al*., 2013) indicated that *Bothriocephalus* infection was widely spread in fish in China. The *Bothriocephalus* prevalence varied in grass carp from different regions, ranging from 4.2% to 9.7% (Table 1). Seasonal prevalence of *Bothriocephalus* infection was higher in summer (10%) and spring (7%) than in autumn (6%) and winter (3.3%), and the differences were statistically

Table 1. Details of abundance and intensity of infections of this tapeworm in grass carp in Dongting Lake of Hunan province

Factor	Category	No. tested	No. positive	Intensity	Abundance	Prevalence (%)
Season	Spring	525	37	15–79	0–79	7.05
	Summer	730	73	23–104	0–104	10.00
	Autumn	548	33	11–66	0–66	6.02
	Winter	731	24	1–32	0–32	3.28
Weight kg	0.5<weight<1.5	892	81	1–91	0–91	9.08
	1.5≤weight<2.5	849	57	31–73	0–73	6.71
	2.5≤weight<3.5	525	25	19–54	0–54	4.76
	weight≥3.5	268	4	1–15	0–15	1.49
	Total	2534	167	1–104	0–104	6.59

significant (P<0.01) (Table 1). The tendency of intensity of different season and different body weight were corresponded with prevalence. The increased prevalence in the summer and spring may be due to metabolism as well as feeding activity of grass carp, which increases after winter starvation. The results from the present study shows that weight of a grass carp has significant influence on the intensity of infection (P<0.01) (Table 1), indicated that young grass carp have more opportunities to contact with *Bothriocephalus*. Over the last years, there has been considerable debate as to the specific taxonomic status of *Bothriocephalus*. Identification and differentiation of *Bothriocephalus* from different fish hosts have traditionally been based on morphological features (Luo & Nie, 2002). However, it is not always possible to accurately identify and differentiate *Bothriocephalus* from different fish hosts and geographical origins based on morphological descriptions (Luo & Nie, 2002). Therefore, further studies are necessary to employ molecular marker (e.g., mitochondrial DNA and nuclear ribosomal DNA) for specific identification and differentiation of *Bothriocephalus*.

In conclusion, the results of the present investigation revealed that *Bothriocephalus* infection in grass carp is prevalent in Hunan province. This is the first report of *Bothriocephalus* prevalence in grass carp in China.

Conflict of interest: The authors declare that they have no competing interests.

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