RESEARCH PAPER
J. Inland Fish. Soc.India 2020 52 (2): 197-203
http://dx.doi.org/10.47780/jifsi.52.2.2020.109981

Occurrence of Dioctophymatid nematode of *Eustrongylides* species in *Glossogobius giuris* from Nagawara lake, Bengaluru

Sibina Mol S. · Hemaprasanth · Preetha Panikkar · Ramya V. L. · Krishna Rao D. S. · Vijaykumar M. E. · Karthikeyan M. · Sarkar U. K. · Das B. K.

Received: 06 November 2020 / Accepted: 18 December 2020

Abstract Larvae of the parasitic dioctophymatid nematode, *Eustrongylides* Jägerskiöld**,** 1909, infect various freshwater fishes. They prefer warm waters and are often found in water bodies that experience pollution and eutrophication. A total of 1180 samples of fish belonging to 12 species from Nagawara lake were examined for the occurrence of *Eustrongylides* larvae and among them, *Glossogobius giuris* of the family Gobiidae was found infested with the parasite. Prevalence of the parasite was highest (40%) during pre-monsoon season coinciding with the highest temperature and pH. However, mean intensity (4.88) and abundance (1.77) were highest in the post-monsoon. *Eustrongylides* sp. is zoonotic, and makes this study relevant and warns consumers from having raw or undercooked fish.

Key words: Nematode, Zoonois, Eutrophic lake, Freshwater fish, India

Introduction

Parasitic infestation in ichthyofauna of inland water bodies such as reservoirs, lakes, wetlands, and rivers are common (Shukerova, 2005; Dzika *et al.*, 2008; Baitha *et al.*, 2018). Nematodes are one of the numerous types of parasites found in freshwater fishes. *Eustrongylides* sp. Jägerskiöld, 1909 (Phylum - Nematoda, Family - Dioctophymatidae) (Kaur *et al.*, 2013) are common nematodes found parasitic on numerous fish species (Menconi *et al.*, 2020). They have a heteroxenous life cycle involving aquatic annelids, usually oligochaetes like *Tubifex tubifex*, *Limnodrilus hoffmeisten* as the first intermediate host. Fish, mainly planktivorous and benthivorous fish, act as the second intermediate host or paratenic host (Urdes *et al*., 2015; Kaur *et al*., 2013; Anderson, 2000; Karmanova, 1968; Moravec, 1994). They prefer warm waters (20-30 °C) and are often found in water bodies that experience large amounts of pollution and eutrophication (Friend *et al*., 1999). The larvae of the parasitic dioctophymatid nematode of the genus *Eustrongylides* have been reported from 17 orders of fish worldwide (Splading and Forrester, 1993). The larvae inhabit the connective tissue, body muscles, swim bladder, liver, intestine, ovaries, or the body cavity of various freshwater fish (Kaur *et al*., 2013; Abe, 2011). Adult nematodes inhabit the gastrointestinal tract of piscivorous birds and eggs laid by the nematodes are passed into the water bodies via bird droppings. These eggs are consumed by oligochaete worms and the larvae reach fish while feeding on these infected oligochaetes. The larvae normally mature and reproduce in the wading birds (definitive host) of the family Phalacrocoracidae, Ardeidae, Ciconiidae, Pelicanidae, etc. (Urdes *et al*., 2015). This parasite can stunt the fish growth and even shorten the life span of the fish (Kaur *et al*., 2013).

Sibina Mol S. · Preetha Panikkar · Ramya V. L. · Krishna Rao D. S. · Vijaykumar M. E. · Karthikeyan M.
Regional Centre, ICAR-Central Inland Fisheries Research Institute, Bengaluru – 560089
Hemaprasanth
Research Centre, ICAR-Central Institute of Freshwater Aquaculture, Bengaluru –560089
Sarkar U. K. · Das B. K.
ICAR-Central Inland Fisheries Research Institute, Barrackpore – 700 120
email: sibina.06bfsc@yahoo.com

Glossogobius giuris, the tank goby, is a wide-spread and common fish species that inhabits clear to turbid freshwaters. The species belongs to the Phylum Chordata, Class Actinopterygii, Order Perciformes and Family Gobiidae. It is a benthopelagic carnivore that usually feeds on small fishes and invertebrates. This study has examined the occurrence of *Eustrongylides* sp. larvae in *G. giuris* and several other fish species from Nagawara lake. Besides fish health, the study is also important because of the zoonotic importance of *Eustrongylides* sp.

Material and methods

Study area

Nagawara lake (13° 02? 41" N; 77° 36? 24" E) is an urban eutrophic lake in Bengaluru, India (Fig. 1). The fish species in this lake having high consumer preference are the Indian Major Carps (*Labeo catla*, *L. rohita*, *Cirrhinus mrigala*), *Cyprinus carpio*, *Hypophthalmichthys molitrix* and *Oreochromis niloticus*. In 2015-16 the total catch from the lake was 2.92 tonnes comprising 26.6 % *L. catla*, 22.7% *L. rohita*, 19.1 % *C. carpio*, 18.4 % *C. mrigala* and 13.2 % other species.

Collection of fish and parasite samples

Fish samples belonging to different species were collected from the Nagawara lake by conducting experimental fishing using gill nets of mesh size 20-220 mm during 2016-17. The sampling was carried out in the littoral and limnetic zones of the lake on monthly basis. The length (in mm) and weight (in g) of the fish samples were recorded before dissection to examine the presence of the parasite inside the body. The number of parasites in each infected fish and the length of the parasites were noted. These parasites were collected

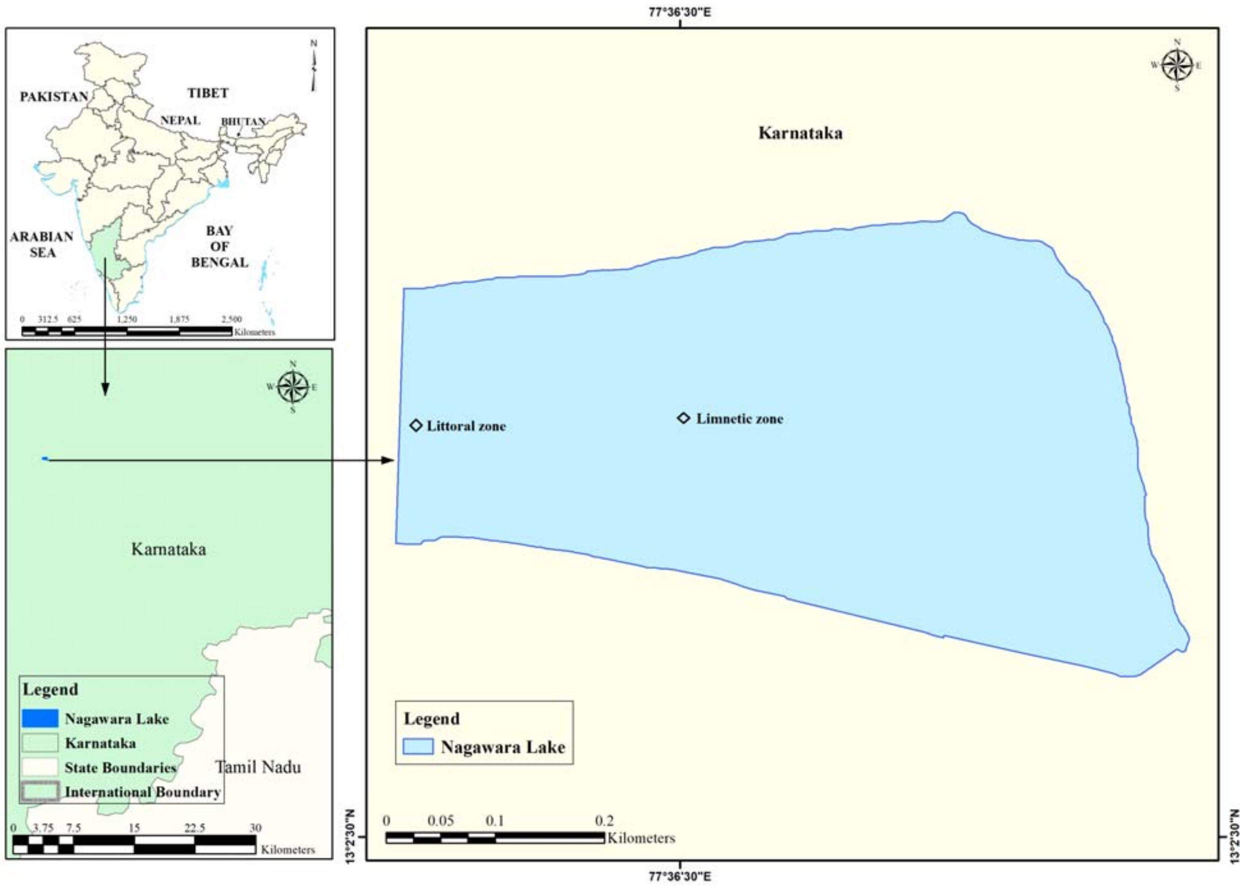

Fig. 1 Location of Nagawara lake

and preserved following Cribb and Bray's (2010) approaches to the effective collection, fixation, and preservation of trematodes of fishes. The parasites were first fixed with hot water to prevent shrinkage. For this, near-boiling water was poured into the vial containing the parasites and left undisturbed for a minute. The water was then discarded. The parasites were taken and placed between glass slides and stored in containers with 5% formalin. The formalin-solid ratio was maintained higher than 5:1 following Schmidt (1986), and Cribb and Bray (2010). The specimens preserved in formalin were brought to the laboratory and observed under a compound microscope (Motic BA 310). The specimens were identified following Melo *et al*. (2016).
The prevalence, mean intensity, and abundance of occurrence of the parasite were calculated using the formulae below (Margolis *et al*., 1982):

Prevalence % = (Total number of fish samples infected / Total number of fish samples examined) * 100

Mean intensity = Total number of parasite / Total number of fish samples infected

Abundance = Total number of parasite / total number of fish samples examined

Physico-chemical analysis of water

Water quality parameters viz. temperature (°C), pH, transparency (cm), conductivity (mS/cm), dissolved oxygen (mg/l), and alkalinity (mg $CaCO_3$/l) were analysed during the study period. The water sampling and analysis were conducted between 07:00 hrs and 10:00 hrs. The water temperature was recorded on-site using a centigrade thermometer, pH with a standard pH meter (pH testr 30, Eutech instruments), conductivity using a standard conductivity meter (Cond6+, Eutech instruments), and the transparency using Secchi disc. The dissolved oxygen and alkalinity were measured following the APHA method (APHA, 1998). The statistical analysis was carried out using SPSS ver. 16 and MS Excel 2016.

Results

A total of 1180 fish samples belonging to twelve fish species viz. *Chanda nama* (16) of Ambassidae, *Oreochromis mossambicus* (93) and *O. niloticus* (711) of Cichlidae, *Labeo catla* (04), *L. rohita* (52), *Cirrhinus mrigala* (107), *C. reba* (03), *Cyprinus carpio* (43), *Hypophthalmichthys molitrix* (81), *Amblypharyngodon mola* (06) and *Puntius sophore* (03) of Cyprinidae and *Glossogobius giuris* (61) of Gobiidae from Nagawara lake were examined for the occurrence of the parasite. Among them, only *G. giuris* was found infected by the parasite while all other species were free from the infestation.

Nagawara lake is a eutrophic urban lake and *G. giuris* is an important gobiid fish species contributing to the ichthyofaunal diversity of the lake. Parasites were spotted extruding from the gill chamber (Fig. 2) and anal opening of *G. giuris* (Fig. 3). On dissecting the fish specimens, parasites were also found freely moving in the body cavity of the fish (Fig. 4). A view of the parasite under a compound microscope is shown in Fig. 5 and Fig. 6.

A total number of 61 specimens of *G. giuris* were obtained from the Nagawara lake, out of which 12 were found infected by the parasitic larva. The length of fish specimens ranged from 9-12 cm (average: 10.03 cm) and weighing from 10-22g (average: 9.84 g). The larvae were bright red in colour measuring around 30.1- 30.8 mm in length, identified as the larvae of nematodes belonging to the genus *Eustrongylides* of the family Dioctophymatidae. The number of larvae in the infested fish was found to vary from 1-8 in the abdominal cavity of each fish sample.

The highest prevalence of the Eustrongylid infection in

Table 1 Water quality parameters (mean ± standard deviation) of Nagawara lake

Season/ Parameter	Temperature (°C)	pH	DO (mg/l)	Alkalinity (mg$CaCO_3$/l)	Transparency (cm)	Conductivity (mS/cm)
Pre-monsoon	27.00±2.121	7.93±0.601	6.08±0.0566	90.00±14.142	25.00±0	1.75±0.15
Monsoon	25.88±0.479	7.58±0.05	5.02±1.141	82.50±26.502	27.50±2.887	1.93±0.05
Post-monsoon	24.27±2.113	7.83±0.208	7.47±1.913	81.90±65.175	28.33±5.774	2.33±0.015

Fig. 2 *Eustrongylides* sp. larvae extruding from the gill opening of *G. giuris*

Fig. 3 *Eustrongylides* sp. larvae extruding from the anal opening of *G. giuris*

Fig. 4 *Eustrongylides* sp. larvae found in the the abdominal cavity of *G. giuris*

Fig. 5 A view of *Eustrongylides* sp. larvae under a compound microscope (10X)

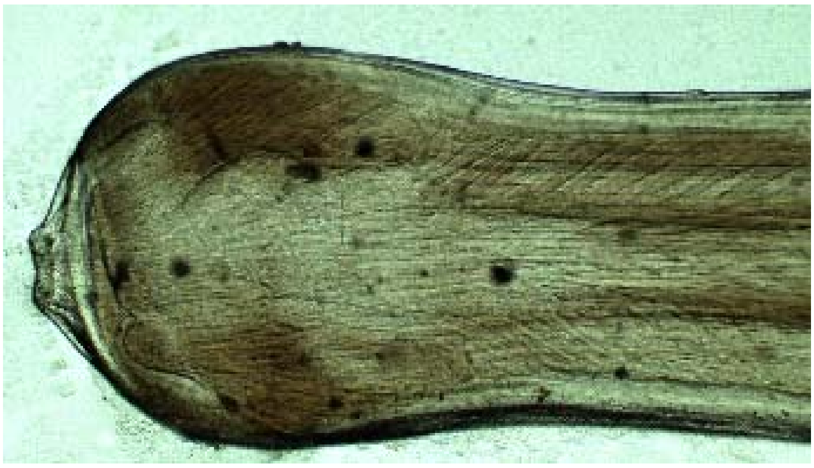

Fig. 6 View of the posterior end of the *Eustrongylides* sp. larvae under a compound microscope (40X)

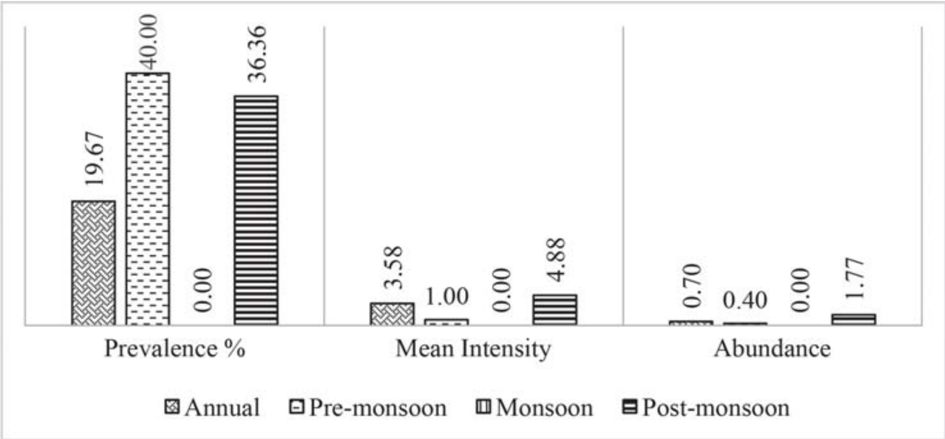

Fig. 7 Prevalence, intensity, and abundance of *Eustrongylides* sp. in different seasons

G. giuris was observed in the pre-monsoon season (40 %); however, the mean intensity and the abundance were highest in post-monsoon (4.88 and 1.77, respectively). The fish samples collected during the monsoon season were devoid of the parasitic larvae. The seasonal variations in the percentage of prevalence, intensity, and abundance of nematode infestation in *G. giuris* are depicted in Fig. 7.

The highest temperature in Nagawara lake was recorded in the pre-monsoon season (27°C). The pH was recorded to be lowest in the monsoon season (7.58) while it was 7.93 and 7.83 in the pre-and post-monsoon seasons. The water quality parameters of the lake during the study period are shown in Table 1.

The temperature has shown a non-significant negative correlation with the prevalence (0.021), mean intensity (0.816), and abundance (0.804) of the parasite in *G. giuris* *w*hile pH has shown a non-significant positive correlation with prevalence (0.980), mean intensity (0.424) and abundance (0.444).

Discussion

In the present study, the occurrence of the *Eustrongylides* larvae was detected only in *G. giuris* but not in any other fish species showing a high degree of susceptibility of this species to the parasite.

Seasonal variation in the occurrence of the parasite was observed during the present study and Kaur *et al*. (2013) also reported similar results. They also observed a decrease in gonado-somatic index and fecundity of infested *G. giuris*. The highest mean intensity and abundance of the larvae in Nagawara lake were found in the post-monsoon season coinciding with low temperature and high pH. No fish was found infested during the monsoon season, which may be attributed to the low pH in the season. The correlation of prevalence, mean intensity, and abundance had shown a non- significant positive correlation with pH while it was negative with temperature. Dana *et al*. (2018) also reported that higher parasite richness is associated with increased pH but not significantly with water temperature and turbidity.

Chen (1973) reported the occurrence of *Eustrongylides* sp. larvae in fishes of family Cyprinidae but no larvae were recorded in cyprinids from Nagawara lake. The occurrence of *Eustrongylides* sp. larvae in the fish species of families Bagridae, Channidae, Engraulidae, Percichthyidae, and Siluridae were also reported by Chen (1973) and Wang *et al*. (1997).

Parasites are considered as indicators of environmental health and stability. *Eustrongylides* sp. are typically found in eutrophic waters, where high concentrations of nutrients and minerals provide ideal conditions for the parasite to exist. In the present scenario, eutrophication has become very common due to excessive agricultural runoff and urban development. Also, the occurrence of the parasite in fish and its intensity might vary according to the species and the individual resistance to infestation. This infestation may affect the reproductive capacity of the fishes. Kaur *et al*. (2013) has studied the effects of *Eustrongylides* sp. larvae infection on the ovaries of *G. giuris*. The displeasing appearance of infested fishes may affect consumer acceptability leading to economic loss too.

Humans get infected from the consumption of raw or undercooked infested and/or contaminated fish or fish products. Guerin *et al*. (1982) were the first to report natural *Eustrongylides* sp. infection in humans. So, this report on the occurrence of the *Eustrongylides* sp. parasite in Nagawara lake warrants people to be cautious and to avoid consuming undercooked fish caught from the lake. Further studies are needed for a better understanding of the life cycle of the *Eustrongylides* sp. and how it affects predator-prey interactions.

Acknowledgments

The authors are grateful to the Indian Council of Agricultural Research, New Delhi for the funding and the Director, ICAR-CIFRI, Barrackpore for the guidance and facilities provided for conducting the research. The support rendered by the fishermen of Nagawara Lake is also duly acknowledged.

References

Anderson, R. C. 2000. Nematode parasites of vertebrates. Their development and transmission (2nd ed). *CAB International Publishing, Wallingford*.

APHA 1998. Standard Methods for the Examination of Water and Wastewater. 20th edn. Washington DC: American Public Health Association.

Baitha, R., Manna, S. K., uresh, V. R., Paniprasad, K. and Naskar, M. 2018. Topographic distribution pattern of *Posthodiplostomum* sp. metacercariae on body surface of cyprinid fishes of river Ganga. *Journal of the Inland Fisheries Society of India*, 50(2): 73-78.

Cribb, T. H. and Bray, R. A. 2010. Gut wash, body soak, blender, and heat-fixation: approaches to the effective collection, fixation and preservation of trematodes of fishes. *Systematic Parasitology,* 76: 1-7.

Chen, C. 1973. An illustrated guide to the fish diseases and causative pathogenic fauna and flora in the Hubei province. Science Press, Beijing, 456 p.

Dana, M. C., Travis, M. and Pieter, T. J. J. 2018. Parasites of invasive freshwater fishes and the factors affecting their richness. *Freshwater Science*, 37. DOI: 10.1086/696566.

Dzika, E., Kusztala M., Kolzlowski, J. 2008. Metazoan parasite fauna of fish species in lake Kortowskie. *Archives of Polish Fisheries*, 16: 75-86.

Friend, M. and Franson, J. C. 1999. Field manual of wildlife diseases. *Madison: US Geological Survey*.

Guerin, P. F., Marapendi, S. and Mc Grail 1982. Intestinal perforation caused by larval Eustrongylides. *Morbidity and Mortality Weekly Report*, 31: 383-389.

Justine, J., Briand, M. and Bray R. A. 2012. A quick and simple method, usable in the field, for collecting parasites in suitable condition for both morphological and molecular studies. *Parasitology Research*, 111: 341-351.

Karmanova, E. M. 1968. Dioctophymatidae of animals and manand diseases caused by them. *Fundamental Nematology*, 20: 123-206.

Kaur, P., Shrivastav, R. and Qureshi, T. A. 2013. Pathological effects of *Eustrongylides* sp. Larvae (Dioctophymatidae) infection in freshwater fish, *Glossogobius giuris* (Ham.) with special reference to ovaries. *Journal of Parasitic Diseases*, 37: 245-250.

Margolis, L., Esch, G. W., Holmes, J. C., Kuris, A. M. and Shad, G. A. 1982. The use of ecological terms in parasitology - Report of an Ad Hoc Committee of American Society of Parasitology. *Journal of Parasitology*, 68: 131-133.

Melo, F. T. V., Melo, C. S. B., Nascimento, L. C. S., Giese, E. G., Furtado, A. P. and Santos, J. N. 2016. Morphological characterization of *Eustrongylides* sp. larvae (Nematoda, Dioctophymatoidea) parasite of *Rhinella marina* (Amphibia: Bufonidae) from Eastern Amazonia. *Brazilian Journal of Veterinary Parasitology,* 25(2): 235-239.

Menconi, V., Riina, M. V., Pastorin, P., Mugetti, D., Canola, S., Pizzul, E., Bona, M. C., Dondo, A., Acutis, P. L. and Prearo, M. 2020. Pathological effects of *Eustrongylides* sp. larvae (Dioctophymatidae) infection in freshwater fish, *Glossogobius giuris* (Ham.) with special reference to ovaries. *Journal of Parasitic Diseases*, 37(2): 245-250.

Moravec, F. 1994. Parasitic nematodes of freshwater fishes of Europe. Kluwer Academic Publishers, Berlin, Germany.

Schmidt, G. D. 1986. CRC Handbook of tapeworm identification. Vol. Platyhelminthes Cestoda Systématique. *CRC Press,* Boca Raton, Florida.

Shukerova, S. 2005. Helminth fauna of the Prussian carp, *Carrasius gibelio* (Blosh, 1782), from the Srebarna biosphere reserve. *Trakia Journal of Sciences*, 3: 36-40.

Splading, M. G. and Forrester, D. J. 1993. Pathogenesis of *Eustrongylides ignotus* (Nematoda: Dioctophymatoidea) in Ciconiiformes. *Journal of Wildlife Diseases*, 29: 250-260.

Urdes, L. D., Marin, M. P., Diaconescu, C., Nicolae, C. G. and Hangan, M. 2015. First case report of Eustrongylidosis in eel (*Anguilla anguilla*) populations inhabiting Danube Delta lakes. *Agriculture and Agricultural Science Procedia*, 6: 277-280.

Wang, W., Li, L., Yu, Y., Feng, W., Xiao, C., Wang, G., Liu, J., Yao, W. and Feng, S. 1997. Parasite fauna of fishes in Wuling Mountains area. *In:* Song, D. (ed), *Invertebrates of Wuling mountains area*. Science Press, pp 73-146.