INFESTATION OF NEMATODE PARASITE *FILOCHONA TELEOSTEI* IN RELATION TO SIZE, WEIGHT AND AGE OF SNOW TROUT *SCHIZOTHORAX RICHARDSONII* (GRAY)

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Abstract: Parasitological investigation was conducted to assess the effects of various biotic factors viz. length, weight and age of host on the infection patterns of *Filochona teleostei* (Singh & Malik, 1992) in snow trout *Schizothorax richardsonii* (HAM.) from hill streams of Garhwal Himalayas. The statistical analysis was carried out to calculate infection incidence, mean worm burden, regression values and their significance. About 20% fishes (18% male and 22% female) were found infected with nematode parasites. Infection patterns of *Filochona teleostei* revealed a negative correlation (r= - 0.347 to - 0.734) with length, (r= - 0.499 to - 0.671) with weight and (r= - 0.576) with age of host fish. The age immunity and stronger host resistance developed by the larger fishes are the possible reasons for the decrease in infection in larger and older fishes.

Keywords: Nematode parasite, *Filochona*, Snow trout, infection incidence, host size, host age

Introduction

Fishes are found abundantly in all natural waters. They provide a good protein rich source of diet for man especially in Garhwal Himalayan region of India, where a small amount of land is suitable for agriculture. The main fishery resources of Uttrakhand are rivers and their tributaries, high and low altitude natural lakes, man-made reservoirs and ponds. Trout and mahseer are local fishes of commercial value. The growth of these fishes depends upon various environmental factors including helminth parasites (Iwanowicz, 2011). The infection of helminth parasites in relation to host length, weight and sex have been studied earlier by Smyth (1962), Thomas (1964) for *Salmo trutta,* Arme and Owen (1967) for *Gastrosteus aculeatus*, Borowik (1968) for *Alburnus alburnus*, kennedy and walker (1969) for *Leuciscus leuciscus*, Lawrence (1970) for

Catostomus commersoni, Chauhan (1982) for *Barilius bola* and *Tor tor*, Scholz (1986) for *Perca fluviatilis*, Frandsen et al. (1989) for *Salvelinus alpinus*(L.), Robert et al. (1990) for *Anguilla spp*., Saad-Fares and Combes (1992) for *Diplodus vulgaris*. Recently Khanum and Parveen (1997) for *Macrognathus armatus*, Khanum et al. (2011) for *Macrognathus aculeatus*, Parveen and Sultana (2014) for *Nandus nandus* and Abiyu et al. (2020) for *Oreochromis niloticus* conducted similar studies. Little work has been done on the nematode parasites and fish host relationship especially in the context of Garhwal Himalayas (Singh and Malik, 1990). Present study provides the knowledge of infection incidence and intensity of nematode parasites in relation to length, weight and age of snow trout Schizothorax richardsoni.

Materials and methods

Present investigation was conducted on more than 450 specimens of *Schizothorax richardsonii* (Gray) collected from river Alaknanda (525 mASL) near Srinagar (Garhwal) during 2014-2016. The fishes were collected by netting method with the help of local fishermen. Each fish was identified, measured and weighed before autopsy. Male and female fishes identified according to Sharma and Mehta (2010). The age of fish was determined by scale method according to Lux (1971). After dissection, roundworms (*Filochona*) were collected from different parts of the alimentary canal and body cavity. Complete worms were killed in lukewarm water, fixed in hot 70% alcohol and glycerine (95: 5). Parasites were cleared and mounted in lacto-phenol, camera lucida drawings were prepared and identified (Singh and Malik ,1992). Fishes were separated   into six standard length groups (<16.0, 16.1-18.0, 18.1-20.0, 20.1-22.0, 22.1-24.0 and >24.1 cm) six body weight classes (<80.0, 80.1-110.0, 110.1-140.0, 140.1-170.0, 170.1-200.0 and >200.1 gm) five age classes (<1, 1-2, 2-3, 3-4 and >4 years). Following formulae were used for statistical analysis of various correlations and other calculations in the present investigation.

1. Coefficient of correlation (Snedecor and Cochran, 1968)

$$r = \frac{\sum dx.dy - \left(\frac{\sum dx \sum dy}{n}\right)}{\sqrt{\left(\sum dx^2 - \frac{(\sum dx)^2}{n}\right)\left(\sum dy^2 - \frac{(\sum dy)^2}{n}\right)}}$$

where, $\sum dx \sum dx$ = sum of deviations of the variations (x) from its assumed mean.
$\sum dy \sum dy$ = sum of deviations of the variations (y) from its assumed mean.
n = total number of items.

2.
$$Dominance\ percentage = \frac{Total\ worm\ burden\ for\ the\ month \times 100}{Total\ worm\ burden\ for\ the\ year}$$
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3. Incidence (%) (Malhotra, Chauhan and Capoor, 1980)

$$Incidence\ (\%) = \frac{Number\ of\ infected\ fish}{Number\ of\ examined\ fish} \times 100$$

4. Incidence of infection (Snedecor and Cochran, 1968)

$$= \frac{Number\ of\ worms \times Number\ of\ infected\ fishes}{(Number\ of\ fishes\ examined)^2}$$

5. Linear Regression Equation (Snedecor and Cochran, 1968)

$$Y = \alpha yx + \beta yx.x$$

where, αyx = y – intercept
βyx = slope predicting y from x
(OR)
y = a + bx

where, a = y - bx

and b = $\frac{\sum xy - \frac{(\sum x)(\sum y)}{n}}{\sum x^2 - \frac{(\sum x)^2}{n}}$ $\frac{\sum xy - \frac{(\sum x)(\sum y)}{n}}{\sum x^2 - \frac{(\sum x)^2}{n}}$

y. x. are the mean variables of y and x respectively and

n = number of observations.

Results and discussion

Infection data for *Filochona teleostei* in *Schizothorax richardsonii* revealed a significant inverse relationship between incidence and fish length ($p>0.25$ to $p>0.025$). The higher infestations were observed in small size fishes in 2014-15 (Fig. 1) (male 16.1-18.0 cm, female <16.0 cm), then incidence decreased regularly in larger male fish and with fluctuations in female fish. In 2015-16 (Fig. 2) the middle-sized fishes (male 20.1-22.0 cm, female and total 18.1-20.0 cm) were found heavily infested than smaller and larger fishes. The mean worm burden did not show any definite correlation with fish length, as in 2014-15, it increased insignificantly ($p<0.10$) with an increase in fish length, while in 2015-16 the mean worm burden declined significantly ($p<0.001$) (Fig. 2). The highest mean worm burden in 2015-16 was observed in smaller fishes but in 2014-15 in relatively larger length classes. An analysis of regression, coefficient of correlation and level of significance have been summarized in Table 1.

Table 1: Regression Values illustrating the influence of length of *S. richardsonii* on the infection patters of *F. teleostei*.

|		Regression equation	Coefficient of correlation (r)	Level of significance (p)
		Incidence		
2014-15	Male	Y=37.911 - 0.762 X	-0.321	p >0.20
	Female	Y=34.642 - 0.517 X	-0.241	p >0.25
	Total	Y=37.373 - 0.664 X	-0.347	p >0.20
2015-16	Male	Y=36.259 - 0.717 X	-0.717	p <0.025
	Female	Y=60.390 - 1.916 X	-0.682	p <0.025
	Total	Y=45.825 - 1.405 X	-0.734	p <0.025
		Mean worm burden		
2014-15	Male	Y=1.782 + 0.007 X	0.038	p >0.45
	Female	Y=4.213 + 0.019 X	0.073	p >0.40
	Total	Y=2.172 + 0.062 X	0.494	p <0.10
2015-16	Male	Y=3.775 - 0.112 X	-0.262	p >0.25
	Female	Y=6.805 - 0.223 X	-0.836	p <0.001
	Total	Y=5.380 - 0.116 X	-0.936	p <0.001
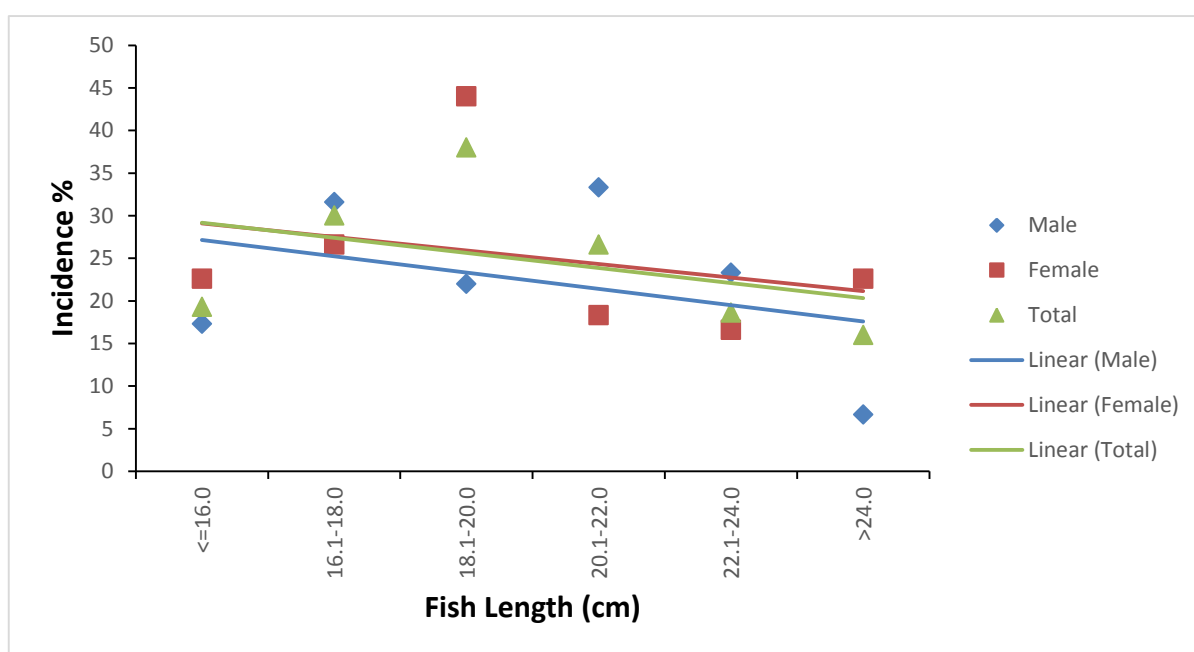
Fig 1(a): Correlation of infection incidence (a) of *F. teleostei* with length of *S. richardsonii* during 2014-15

Statistical analysis revealed a significant (p>0.35 to <0.05) inverse correlation between incidence of *F. teleostei* and weight of *S. richardsonii*. Incidence showed fluctuations and there was no stability between successive weight classes.
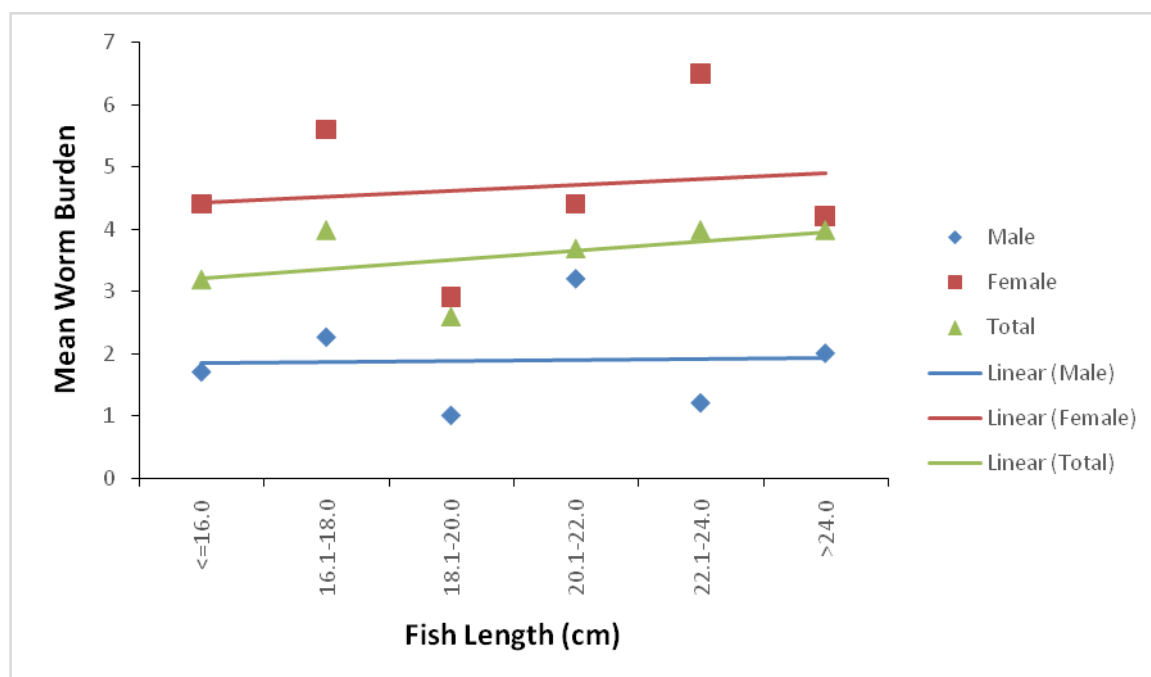
Fig 1 (b): Correlation of mean worm burden (b) of *F. teleostei* with length of *S. richardsonii* during 2014-15

Table 2: Regression Values illustrating the influence of weight of *S. richardsonii* on the infection patters of *F. teleostei*.

		Regression equation	Coefficient of correlation (r)	Level of significance (p)
		Incidence		
2014-15	Male	Y=25.911 - 0.015 X	-0.135	p >0.35
	Female	Y=43.132 - 0.106 X	-0.607	p <0.10
	Total	Y=35.162 - 0.069 X	-0.671	p <0.05
2015-16	Male	Y=26.911 - 0.015 X	-0.661	p <0.05
	Female	Y=29.432 - 0.044 X	-0.257	p >0.25
	Total	Y=26.346 - 0.045 X	-0.499	p >0.15
		Mean Worm Burden		
2014-15	Male	Y=2.548 - 0.002 X	-0.174	p >0.35
	Female	Y=3.688 + 0.003 X	0.241	p >0.30
	Total	Y=3.230 + 0.006 X	0.050	p >0.45
2015-16	Male	Y=2.664 - 0.009 X	-0.747	p <0.05
	Female	Y=4.079 - 0.013 X	-0.564	p <0.05
	Total	Y=3.566 - 0.009 X	-0.733	p <0.025

In 2014-15, (Fig. 3) the maximum incidence occurred in moderately heavier fishes (male 140.1-170.0gm, female and total 110.1-140.0gm); while during 2015-16, maximum incidence was noted from lighter fishes (<80.0 gm) in both sexes (Fig. 4). The heavier males >200.1 gm were free of infection. In females, the incidence decreased up to the lowest level in fishes of 140.1-170.0 gm, then increased in heavier fishes. However, in total (male and female) fishes, the incidence was almost stable in all fishes of >140.1 gm body weight.

Mean worm burden exhibited different patterns in both sexes in 2015-16 (Fig. 3).
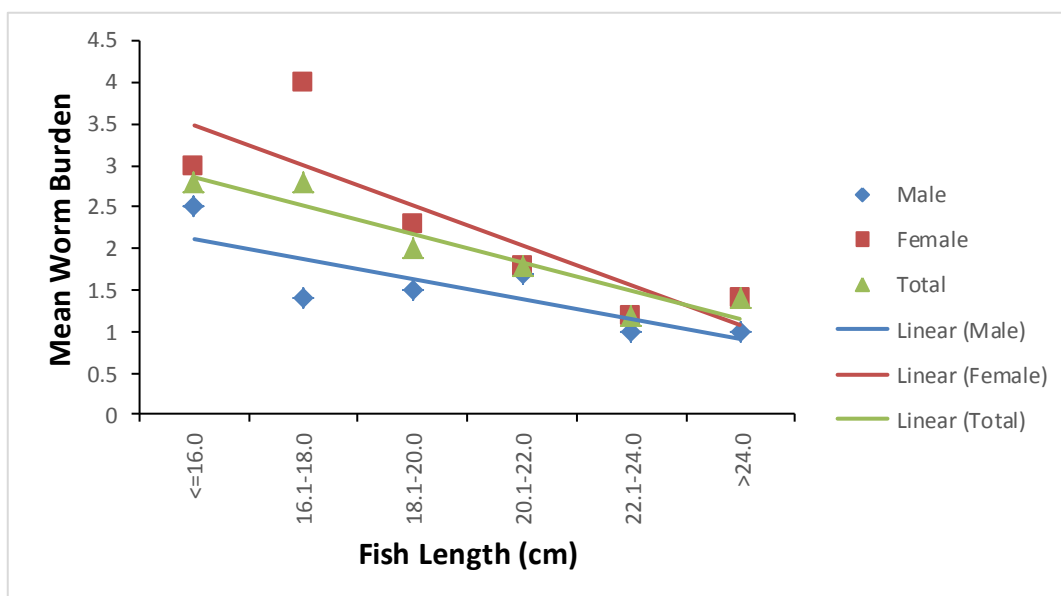
Fig 2 (b): Correlation of mean worm burden of *F. teleostei* with length of *S. richardsonii* during 2015-16
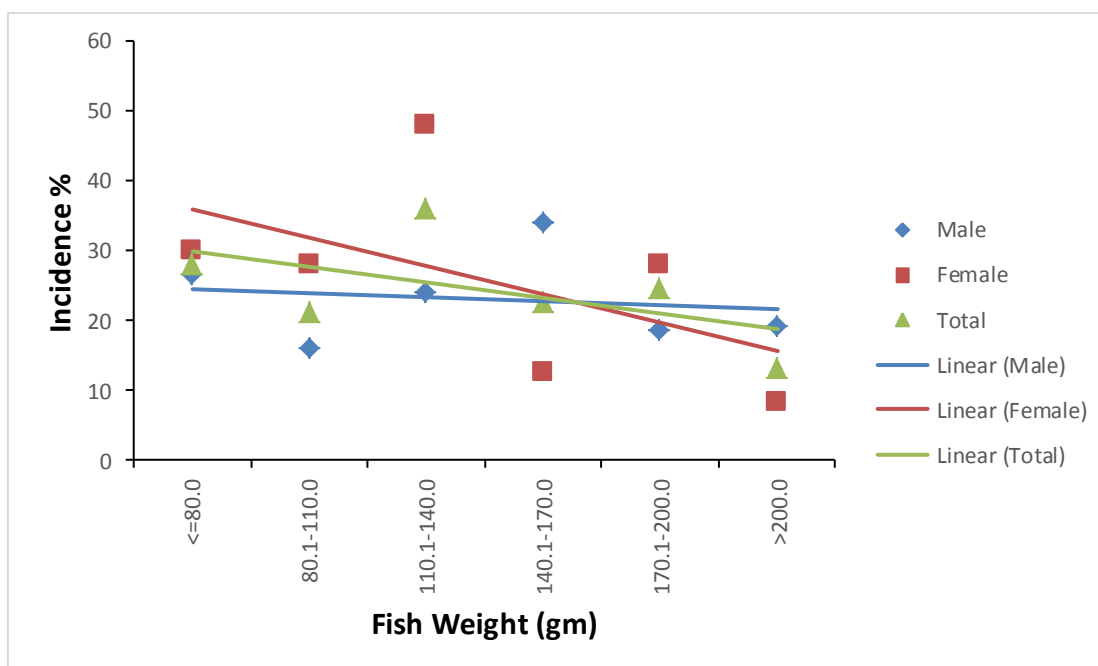

Fig 3 (a): Correlation of infection incidence of *F. teleostei* with weight of *S. richardsonii* during 2014-15
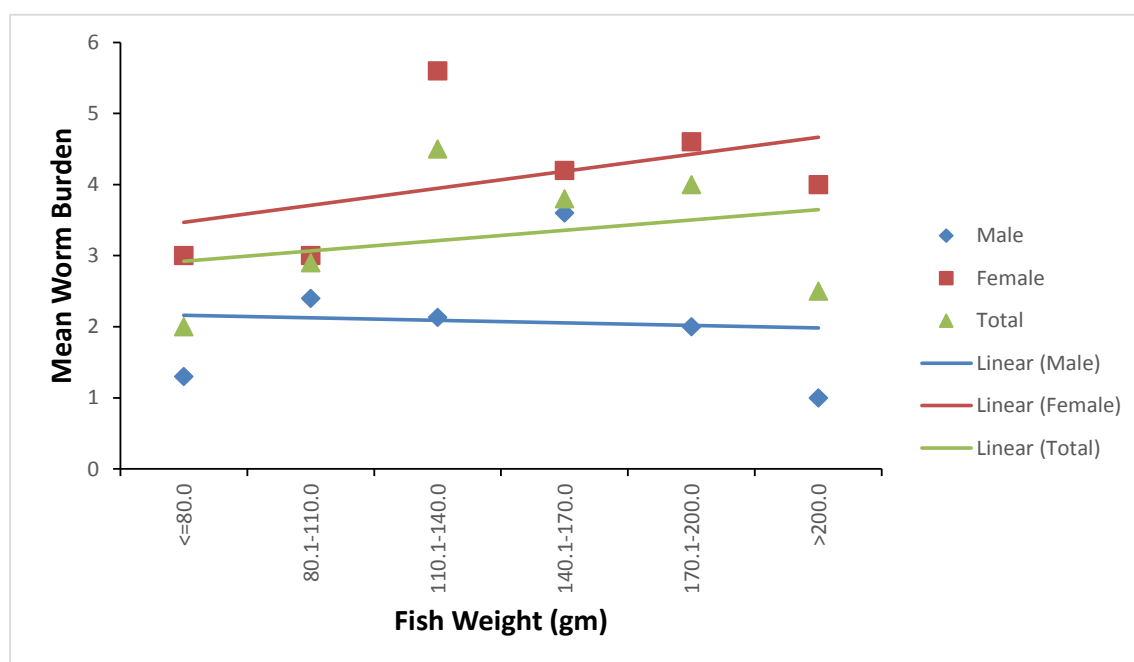
Fig 3 (b): Correlation of mean worm burden of *F. teleostei* with weight of *S. richardsonii* during 2014-15

In male fish the analysis of regression showed that the mean worm burden decreased slowly with the increase in fish weight but in female fish it increased. However, in fishes of both sexes, the incidence was found maximum in middle weight classes (male 140.1-170.0 gm; female and total 110.1-140.0gm) and minimum in lighter or heavier fishes. During 2015-16 (Fig. 4), the correlation was negative in both sexes. Lighter fish (<80.0 gm) showed maximum mean worm burden while heavy fish (>200.1 gm) were free of infection. An analysis of linear regression,

coefficient of correlation and level of significance for both years is given in Table 2.

The infection incidence for *F. teleostei* showed a significant negative correlation with age of host (Fig. 5, Table 3). The minimum incidence of infection was observed in the age group of 3-4 years, then increased due to the fact that very few large specimens were collected and most of them were found infected. On the other hand, mean worm burden did not show significant negative correlation with age of fish. In general, it showed oscillations in different age groups.

Table 3: Regression Values illustrating the influence of age of *S. richardsonii* on the infection patters of *F. teleostei* during 2014-16

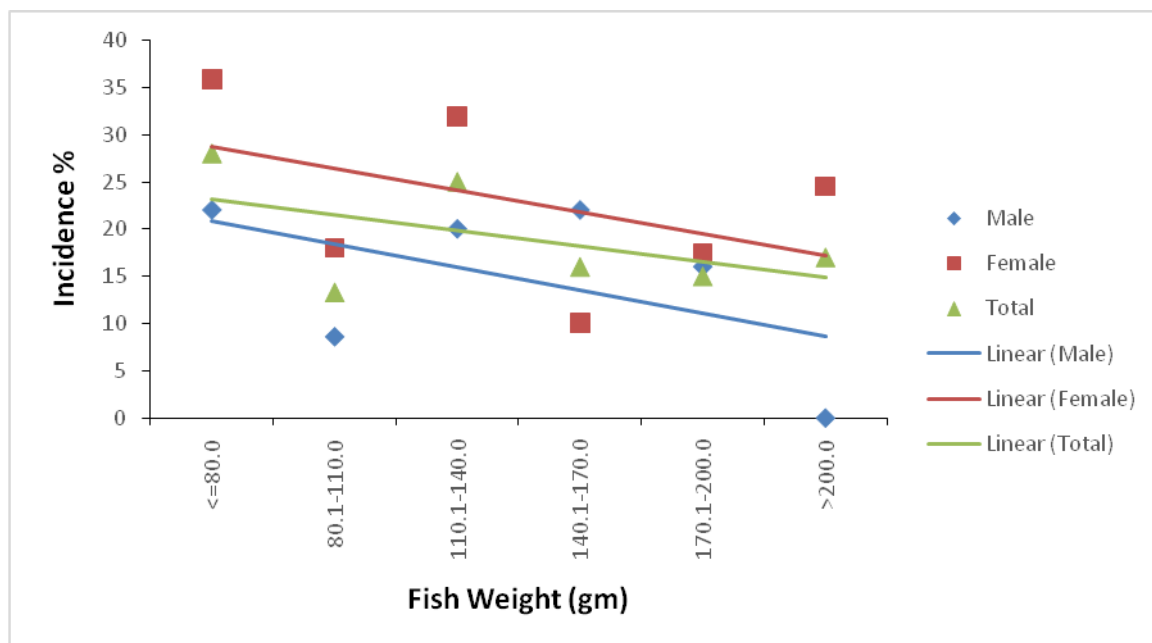|	Regression equation	Coefficient of correlation (r)	Level of significance (p)
Incidence			
Male	Y=23.011 - 2.739 X	-0.657	$p < 0.10$
Female	Y=29.787 - 3.323 X	-0.753	$p < 0.05$
Total	Y=26.765 - 3.019 X	-0.576	$p < 0.05$
Mean Worm Burden			
Male	Y=1.902 - 0.182 X	- 0.182	$p > 0.35$
Female	Y=3.782 + 0.269 X	-0.532	$p < 0.10$
Total	Y=3.049 + 0.166 X	- 0.654	$p < 0.10$

Fig 4 (a): Correlation of infection incidence of *F. teleostei* with weight of *S. richardsonii* during 2015-16
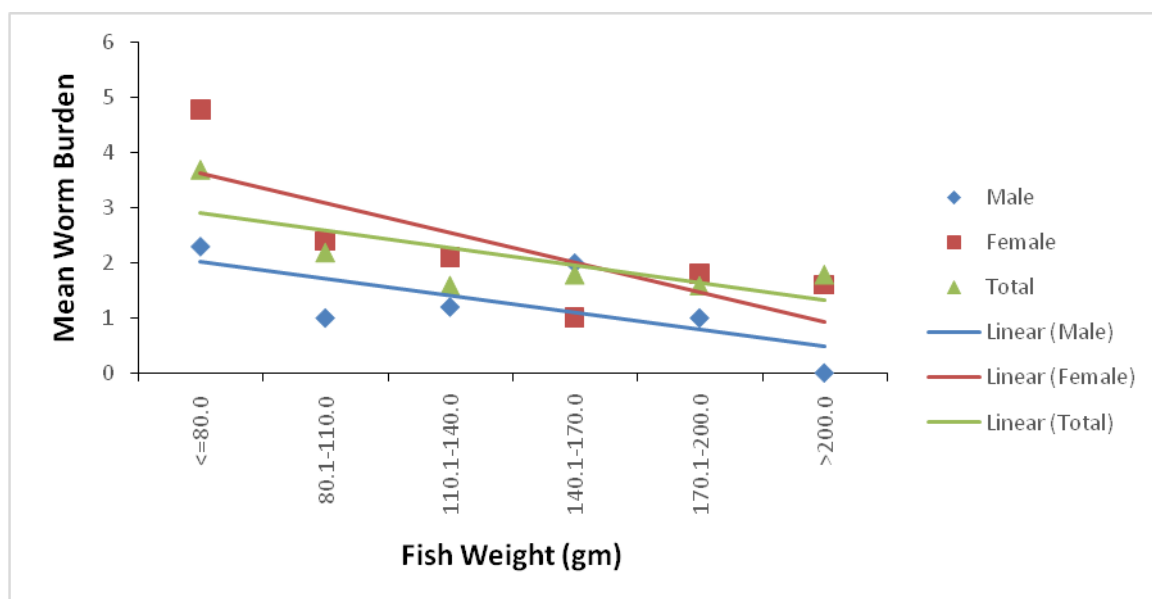

Fig 4 (b): Correlation of mean worm burden of *F. teleostei* with weight of *S. richardsonii* during 2015-16
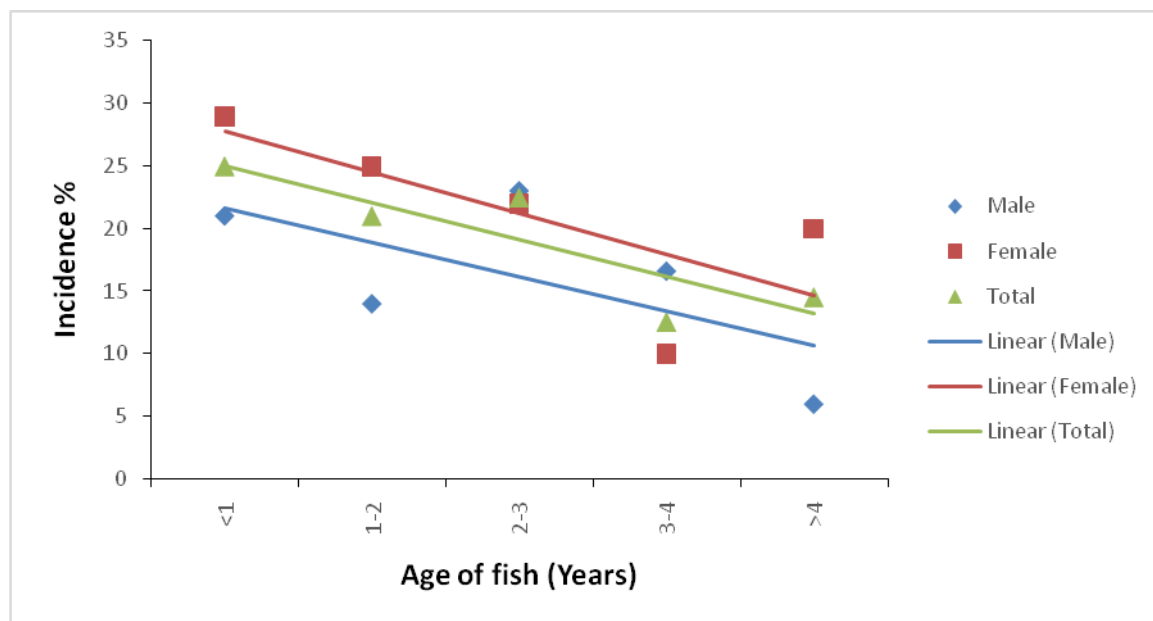
Fig 5 (a): Correlation of infection incidence of *F. teleostei* with age of *S. richardsonii* during 2014-16
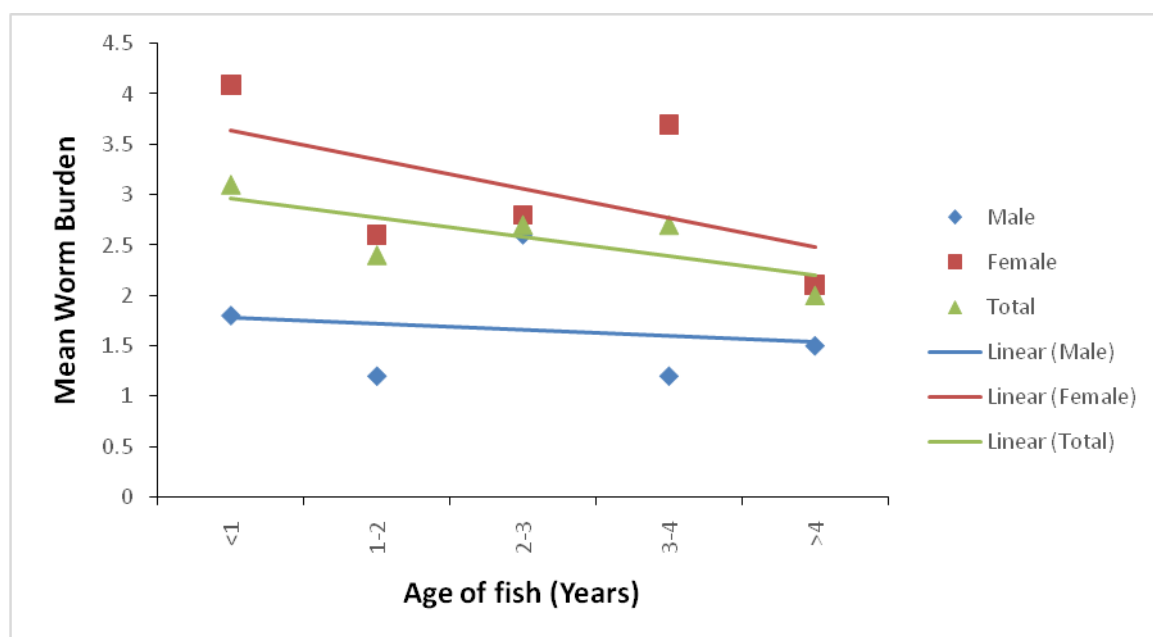

Fig 5 (b): Correlation of mean worm burden of *F. teleostei* with age of *S. richardsonii* during 2014-16

These results are supported by the study of *Bothriocephalus claviceps* infections in Perch in which Scholz (1986) reported maximum infection in middle size fishes, while very small or large fishes showed lesser susceptibility to bothriocephalid infections. This infection pattern may be the result of composition of food and age immunity. Davis and Huffman (1978) also reported more infestations in middle sized *Gambusia affinis* by 26 helminth species. Similar

observations are also reported by Davey and Peachey (1968) for *Bothriocephalus scorpii* (Muller) in Turbot (*Psetta maxima*, L.). DeGroot (1971), Frandsen et al. (1989) suggested that an increase in the number of *Philonema oncorhynchi* in *Salvelinus alpinus* may be due to more frequent host parasite contact. Hoglund and Thulin (1989) also observed an increase in both prevalence and relative density of *Paradiplozoon homoin* infection in relation to host size in Sweden. Similar

observations are reported by Marcogliase (1989), Robert et al. (1990), Saad-Fares and Combes (1992), Nie and Kennedy (1991) and Farhaduzzaman (2010). Levsen et al. (2017) reported significant positive relationship of parasite prevalence and abundance with host size/length in marine cultured fishes. He concluded that effect of body size on infection rate is related to change in the feeding habit of host.The occurrence of negative correlation i.e. an increase in the host's size with a reduction in the level of parasitism has been reported (Zdzitowiecki,1988, Oliva et al. 1990 and Iyaji et al. 2009). According to these authors the negative correlation may be due to changing in the feeding habit or development of immunity reaction that occurs in older fish (Adams, 1985). Age has often been found to be positively associated with prevalence and intensity of parasite infection (Madhavi and Rukmini,1991, Chandler et al. 1995). Poulin (2000) stated that in the fish population parasitic infection tends to increase with increasing host age and size. He argued that older fish have longer time to accumulate parasites than younger ones. Results of our study are in accordance with that of Pennycuick (1971), Anderson and Gordon (1982) and Gordon and Rau (1982). They argued that the lower prevalence in larger individuals may be due to the development of immunity with age. In the authors view there may be two possibilities for decrease in infection in larger host; age immunity and stronger host resistance developed by larger fishes and change in feeding habit in larger fishes.

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