

# TREMATODIASIS IN NORTH-EAST INDIA : A STUDY ON THE SPECTRUM OF DIGENETIC TREMATODES AMONG PIGS, BUFFALOES, CATTLE, GOATS AND SHEEP

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The prevalence pattern of trematode infection among pigs, cattle, goats and sheep in Assam, Meghalaya, Mizoram, Nagaland and Tripura, and buffaloes in Meghalaya was studied. The rate of infection by and large was considerably high in all the states, being the highest in Assam and lowest in Nagaland. The overall prevalence was more in cattle (88.15%) followed by buffaloes (85.94%), goats and sheep (39.61%) and pigs (14.43%) in receding order. Of a total of 31 different digeneans recovered, 26 species (*Paramphistomum epiclitum*, *P. ichikawai*, *P. gracile*, *Calicophoron calicophorum*, *C. papillosum*, *Cotylophoron cotylophorum*, *Explanatum explanatum*, *Orthocoelium orthocoelium*, *O. dicranocoelium*, *O. dawesi*, *O. scolicoelium*, *O. streptocoelium*, *O. parvipapillatum*, *O. dinniki*, *Leiperocotyle meghalayensis*, *Homalogaster paloniae*, *Olveria indica*, *O. bos*, *Gastrothylax crumenifer*, *Fischoederius elongatus*, *F. cobboldi*, *Velasquezotrema tripurensis*, *Fasciola gigantica*, *Eurytrema pancreaticum*, *Schistosoma indicum*, and *Opisthorchis neverca*) were recovered from cattle; 11 species (*P. epiclitum*, *C. calicophorum*, *C. cotylophorum*, *E. explanatum*, *H. paloniae*, *G. crumenifer*, *F. elongatus*, *F. cobboldi*, *F. gigantica*, *E. pancreaticum*, and *S. indicum*) belong to buffalo; 17 (*P. epiclitum*, *P. ichikawai*, *C. calicophorum*, *C. shillongensis*, *O. Orthocoelium*, *O. dicranocoelium*, *O. dawesi*, *O. scolicoelium*, *O. streptocoelium*, *O. parvipapillatum*, *O. dinniki*, *G. crumenifer*, *F. elongatus*, *F. cobboldi*, *Carmyerius spatiosus*, *F. gigantica* and *E. pancreaticum*) were recovered from goats and sheep and 5 (*Gastrodiscoides hominis*, *Fasciolopsis buski*, *F. gigantica*, *O. neverca* and *Artyfechinostomum malayanum*) were recovered from pigs. The species composition in the parasite spectrum was the richest in Assam (25 species), followed by Meghalaya (24 species), Tripura (23 species), Mizoram (12 species) and Nagaland (8 species).

Variations in the prevalence of various infections may be attributed to the physiographical

and climatic conditions of the region.

Among helminths, digenetic trematodes parasitizing the livestock gain a considerable importance from the veterinary as well as medical points of view. A perusal of relevant literature reveals that only a scanty information exists on aspects pertaining to trematodiasis in the north-eastern region of the country (Endrejat, 1964; Rajkhowa, 1980; Borkakoty *et al.*, 1984; Roy and Tandon, 1989, 1990 a,b,c) which represents a variety of climatic conditions ranging from tropical and humid to subtropical and superhumid.

The aim of the present study was to determine the prevalence of various trematode infections among the mammalian livestock in five states of north-east India.

## MATERIALS AND METHODS

### Study area and localities surveyed

The study area incorporated 13 localities coming under the jurisdiction of 5 states

( Fig. 1 ) which consist of both plains and hilly mountainous region of north-east India. The physiographical details of these places are provided in Table 1. From October, 1987 to April 1990, a total of 2445 cattle, 249 buffaloes, 2015 pigs and 1556 goats and sheep were explored to see the spectrum of digenetic trematodes fauna from all the localities covered under the study. The chosen sites of collection are the spots where the the majority of cattle and pigs are reared and/or slaughtered for meat consumption in the respective states. The cattle, goats and sheep slaughtered in Meghalaya comprise a mixed population of locally reared animals and those imported from the neighbouring Assam ; likewise the cattle, goats and sheep slaughtered in Mizoram and Nagaland also include animals brought from the bordering states of Assam and Tripura. However, the ruminants slaughtered in Assam and Tripura and pigs slaughtered in all the five states represent an indigenous stock. Buffaloes reared in Shillong comprise a mixed population of Assam and Tura. As these spots receive the host animals for slaughtering from their neighbouring area, the material collected at one place represents the collection from various altitudinal zones within that district.

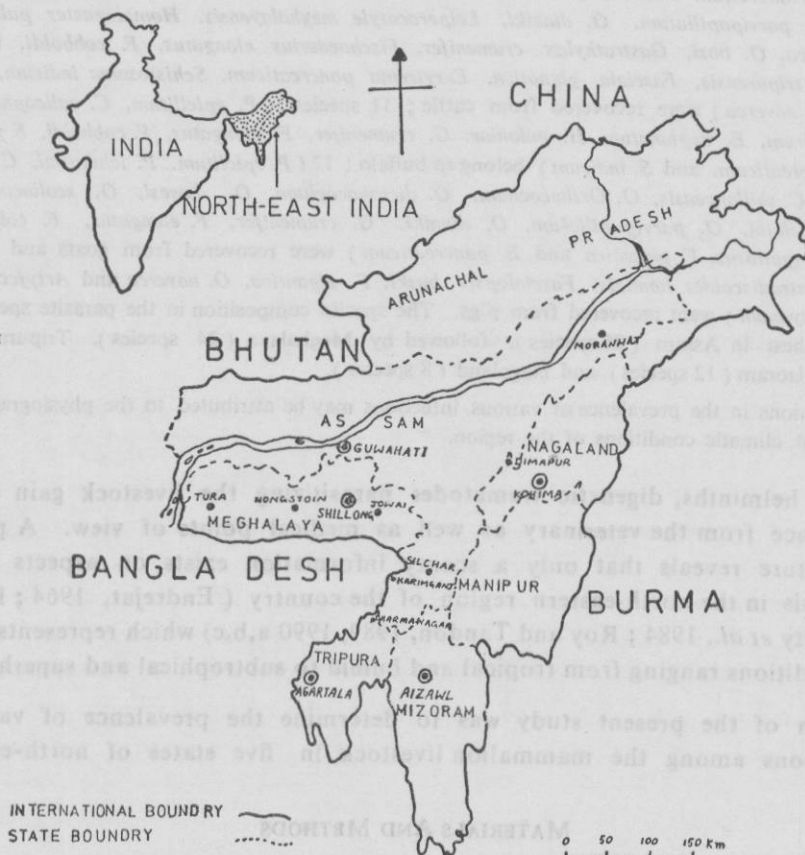


Fig. 1 : Map of North-East India, indicating the sites of collection

Table—1 Prevalence of trematode infections among livestock in different states of North-East India

State	Locality	Longitude	Latitude	Altitude mASL	Cattle			Goats & Sheep			Pigs		
					No. ex- amined	No. in- fec- ted	% in- fec- ted	No. ex- amined	No. in- fec- ted	% in- fec- ted	No. ex- amined	No. in- fec- ted	% in- fec- ted
Assam	Guwahati	91°45'45"	26°15'00"	55	11	11	100.00	47	26	55.31	24	8	33.33
	Silchar	93°15'00"	24°40'00"	24	107	104	97.19	72	53	73.61	41	15	36.58
	Karimganj	93°30'45"	24°30'00"	30	—	—	—	68	47	69.11	—	—	—
	Moranhath	94°45'45"	27°15'30"	100	—	—	—	22	17	77.27	—	—	—
	Total				118	115	97.45	209	143	68.42	65	23	35.38
Meghalaya	Shillong*	91°45'35"	25°30'45"	1524	1904	1681	88.28	913	398	43.59	1648	216	13.10
	Jowai	92°10'45"	25°25'45"	1390	106	94	88.67	62	29	46.77	32	4	12.50
	Nongstoin	91°15'45"	25°30'00"	1307	41	35	85.36	—	—	—	114	17	14.91
	Tura	90°13'20"	25°31'00"	396	17	17	100.00	—	—	—	18	4	22.22
	Total				2068	1827	88.34	975	427	49.94	1812	241	13.30
Mizoram	Aizawal	92°43'15"	23°43'30"	1132	79	64	81.01	36	12	33.33	42	2	4.76
Nagaland	Kohima	94°15'00"	24°30'00"	1444	82	64	78.04	6	1	16.66	64	2	3.12
	Dimapur	93°50'00"	24°35'00"	150	—	—	—	18	4	22.22	—	—	—
	Total				82	64	78.04	24	5	20.83	264	2	3.12
Tripura	Dharmanagar	92°10'00"	24°23'00"	52	62	58	93.54	216	124	57.40	10	2	20.00
	Agartala	91°18'00"	23°49'00"	12	36	36	100.00	96	40	41.66	22	3	13.63
	Total				98	94	95.91	312	164	52.56	32	5	15.62

\* Out of 249 Buffaloes examined, 214 (85.94%) were infected with different trematode species

### Collection and processing of samples

The fluke species reported in the present study were collected from the rumen, intestine, bile duct and circulatory system of freshly slaughtered host animals. The live specimens were collected in 0.9% physiological saline and then fixed in Bouins or formalin after due flattening. Identification of species was accomplished after Yamaguti (1971) and Eduardo (1982-1985).

### RESULTS

The prevalence of trematode infections in the livestock of the five states of north-east India as recorded during the survey is presented Table 1. The highest rate of infection was revealed among the animals from Assam, followed by those in Tripura Meghalaya and Mizoram (receding order), and the lowest in Nagaland. Further, the rate of infection was found to be low in order of increasing altitude. Thus the host animals from Agartala, Silchar, Karimganj, Dharmanagar, Guwahati, Moranhat, Dimapur and Tura (12 to 396 mASL) which represent a low to medium range of altitude had a high rate, whereas those of Aizwal, Nongstoin, Jowai, Kohima and Shillong, which represent a high altitudinal zone (1132 to 1524 mASL of the region, showed comparatively low rate of infection in almost all the animal types examined. The data on the species-wise prevalence of infections in the various host animals in respect of each state are presented below.

#### Assam

Of the total 118 cattle, 209 goats and sheep and 65 pigs examined, 97.45%, 68.45%, and 35.38% were found infected with one or more species of trematodes, respectively (Table 1). Of the total 25 species of flukes recovered, 21, 12 and 4 species were represented in cattle, goats and sheep and pigs, respectively (Table 2). The most predominantly occurring species was revealed to be *F. gignatica*, followed by *G. crumenifer* and *P. epiclitum* in cattle; *G. cruminefer*, followed by *C. calicophorum* and *P. epiclitum* in goats and sheep; and *G. hominis* followed by *F. buski* and *A. malayanum* in pigs. *O. bosi* was encountered as a rare infection in cattle and so were *F. gigantica* in goats and sheep, and *O. noverca* in pigs.

#### Meghalaya

A total of 2068 cattle, 249 buffaloes, 975 goats and sheep and 1812 pigs examined at necropsy, revealed the presence of 20, 11, 9 and 4 species of flukes, respectively (Table 3). The more commonly occurring species were *G. crumenifer*, followed by *F. gigantica* and *P. epiclitum* in cattle; *F. gigantica*, *G. crumenifer* and *P. epiclitum* in buffaloes; *P. epiclitum*, *O. dawesi* and *F. elongatus* in goats and sheep; and *A. malyanum* in pigs. However, *O. bosi* in cattle, *S. indicum* in buffaloes, *C. shillongensis* and *F. pancreaticum* in goats and sheep and *G. hominis* in pigs showed the lowest prevalence. Of the paramphistomid species recovered, two namely, *Leiperocotyle meghalayensis* from cattle and *Calicophoron shillongensis* from goats are new species, described elsewhere (Roy and Tandon, 1990b, 1990c).

Table—2. Prevalence of different species of trematodes on animals of food value in Assam

Trematodes recovered	Cattle	Goats and Sheep	Pigs	
	No. (%) infected	No. (%) infected	No. (%) infected	
<i>Paramphistomum epiclitum</i>	34 (28.81)	38 (18.81)	—	—
<i>P. ichikawai</i>	9 (7.62)	—	—	—
<i>Calicophoron calicophorum</i>	24 (20.33)	43 (20.57)	—	—
<i>Cotylophoron cotylophorum</i>	25 (21.18)	—	—	—
<i>Explanatum explanatum</i>	31 (26.27)	—	—	—
<i>Orthocoelium orthocoelium</i>	15 (12.71)	6 (2.87)	—	—
<i>O. dicranocoelium</i>	22 (18.64)	26 (12.44)	—	—
<i>O. dawesi</i>	23 (19.49)	32 (15.31)	—	—
<i>O. scoliocoelium</i>	2 (1.69)	5 (2.39)	—	—
<i>O. streptocoelium</i>	6 (5.08)	9 (4.30)	—	—
<i>O. parvipapillatum</i>	5 (4.23)	19 (9.09)	—	—
<i>O. dinniki</i>	12 (10.16)	—	—	—
<i>Olveria indica</i>	4 (3.38)	—	—	—
<i>O. bosii</i>	1 (0.84)	—	—	—
<i>Homalogaster paloniae</i>	16 (13.55)	—	—	—
<i>Gastrodiscoides hominis</i>	—	—	12	(18.46)
<i>Gastrothylax crumenifer</i>	38 (32.20)	45 (21.53)	—	—
<i>Fischoederius elongatus</i>	31 (26.27)	36 (17.22)	—	—
<i>F. cobboldi</i>	15 (12.71)	21 (10.04)	—	—
<i>Fasciola gigantica</i>	48 (40.67)	4 (1.91)	—	—
<i>Fasciolopsis buski</i>	—	—	10	(15.38)
<i>Eurytrema pancreaticum</i>	19 (16.10)	—	—	—
<i>Opisthorchis noverca</i>	—	—	2	(3.07)
<i>Artyfechinostomum malayanum</i>	—	—	8	(12.30)
<i>Schistosoma indicum</i>	8 (6.77)	—	—	—

### Mizoram

The sample size ( 79 cattle, 36 goats and sheep and 42 pigs ) of animals screened for parasitic infections from this state was relatively small. Also, the species range was found to be narrower as compared to that in similar hosts in the other states investigated.

Of total 12 trematode species encountered from the livestock, only 7 were represented in cattle, 4 in goats and sheep and only 2 in pigs ( Table 4 ). *G. crumenifer* was the most prevalent species in cattle. However, in goats and sheep, another paramphistomid, *F. elongatus* was of frequent occurrence, with a prevalence rate of 19.44%.

Table 3. Prevalence of different species of trematodes in animals of food value in Meghalaya

Trematodes recovered	Cattle	Buffaloes	Goats / Sheep	Pigs
	No. (%) infected	No. (%) infected	No. (%) infected	No. (%) infected
<i>Paraphistomum epiclitum</i>	726 (35.11)	69 (27.71)	285 (29.23)	—
<i>Calicophoron calicophorum</i>	509 (24.61)	48 (19.27)	—	—
<i>C. shillongensis</i> n. sp.	—	—	2 (0.20)	—
<i>Cotyloporon cotyloporum</i>	352 (17.02)	32 (12.85)	—	—
<i>Explanatum explanatum</i>	388 (18.76)	51 (20.48)	—	—
<i>Orthocoelium orthocoelium</i>	238 (11.51)	—	51 (5.23)	—
<i>O. dicranocoelium</i>	377 (18.23)	—	—	—
<i>O. dawesi</i>	292 (14.12)	—	162 (16.61)	—
<i>O. streptocoelium</i>	331 (16.00)	—	22 (2.25)	—
<i>O. dinniki</i>	122 (5.89)	—	—	—
<i>Lelperocotyle meghalayensis</i> n. sp.	22 (1.63)	—	—	—
<i>Oleria indica</i>	56 (2.71)	—	—	—
<i>O. bosi</i>	3 (0.15)	—	—	—
<i>Homalogaster paloniae</i>	145 (7.01)	22 (8.83)	—	—
<i>Gastrodiscoides hominis</i>	—	—	—	35 (1.93)
<i>Gastrothylax crumenifer</i>	1066 (51.54)	81 (32.53)	186 (19.07)	—
<i>Fischoederius elongatus</i>	428 (20.89)	61 (24.49)	158 (16.21)	—
<i>F. cobboldi</i>	252 (12.18)	34 (13.65)	—	—
<i>Fasciola gigantica</i>	996 (48.16)	128 (51.4)	3 (0.31)	—
<i>Fasciolopsis buski</i>	—	—	—	38 (2.09)
<i>Eurytrema pancreaticum</i>	308 (14.89)	33 (13.25)	2 (0.21)	—
<i>Opisthorchis neverca</i>	1 (0.04)	—	—	67 (3.69)
<i>Artyfechinostomum malayanum</i>	—	—	—	142 (7.84)
<i>Schistosoma indicum</i>	110 (5.31)	5 (2.0)	—	—

Table 4. Prevalence of different species of trematodes in animals of food value in Mizoram

Trematodes recovered	Cattle	Goats / Sheep	Pigs
	No. (%) infected	No. (%) infected	No. (%) infected
<i>Paramphistomum epiclitum</i>	38 (48.10)	—	—
<i>Calicophoron calicophorum</i>	—	3 (8.33)	—
<i>Explanatum explanatum</i>	9 (11.39)	—	—
<i>Orthocoelium orthocoelium</i>	24 (30.37)	—	—
<i>O. dicranocoelium</i>	—	6 (16.66)	—
<i>O. dawesi</i>	—	5 (13.88)	—
<i>Gastrodiscoides hominis</i>	—	—	1 (2.38)
<i>Gastrothylax crumenifer</i>	44 (55.69)	—	—
<i>Fischoederius elongatus</i>	34 (43.03)	7 (19.44)	—
<i>Fasciola gigantica</i>	26 (32.91)	—	—
<i>Opisthorchis neverca</i>	—	—	1 (2.38)
<i>Schistosoma indicum</i>	2 (2.53)	—	—

## Nagaland

The sample size of animals herein was also small, comprising of 82 cattle, 24 goats and sheep and 64 pigs. The spectrum of fluke infections comprised a total of 8 trematode species (Table 5), of which cattle harboured only 5. While the infection in goats and sheep was represented by only two *Orthocoelium* species, pigs of the region harboured only *O. noverca*. No overlapping of hosts was exhibited by any of these species. Cattle revealed a fairly high prevalence of *F. gigantica*, followed by *P. epiclitum* and *O. orthocoelium* exhibiting the lowest prevalence.

Table 5. Prevalence of different species of trematodes in animals of food value in Nagaland

Trematodes recovered	Cattle		Goats / Sheep		Pigs	
	No.	(%)	No.	(%)	No.	(%)
	infected		infected		infected	
<i>Paramphistomum epiclitum</i>	23	(28.4)	—	—	—	—
<i>Calicophoron calicophorum</i>	11	(13.41)	—	—	—	—
<i>Orthocoelium orthocoelium</i>	2	(2.43)	—	—	—	—
<i>O. dawesi</i>	—	—	2	(8.83)	—	—
<i>O. streptocoelium</i>	—	—	3	(12.5)	—	—
<i>Fischoederius elongatus</i>	19	(23.17)	—	—	—	—
<i>Fasciola gigantica</i>	34	(41.46)	—	—	—	—
<i>Opisthorchis noverca</i>	—	—	—	—	2	(3.12)

## Tripura

Of 98 cattle, 312 goats and sheep and 32 pigs examined, 95.91%, 52.56% and 15.62%, respectively, were found to be infected with trematodes. Of a total of 23 species of flukes encountered (Table 6), 15 were represented in cattle and 11 in goats and sheep, of which 5 were common to both categories of hosts. Pigs harboured only 2 species, none of which occurred in the other animals. *G. crumenifer* was the species of commonest occurrence in cattle and so was *Carmynerius spatiosus* for goats and sheep. The latter species was found to be exclusive to Tripura. Likewise, the Tripura cattle, which definitely represent an indigenous stock, also harboured a paramphistomid fluke, described as a new species with the name *Velasquezoirema tripurensts* n. sp., elsewhere (Roy and Tandon, 1990a). *E. pancreaticum* and *F. gigantica* emerged as the least

Table 6. Prevalence of different species of trematodes in animals of food value in Tripura

Trematodes recovered	Cattle		Goats / Sheep		Pigs	
	No.	(%) infected	No.	(%) infected	No.	(%) infected
<i>Paramphistomum epiclitum</i>	—	—	61	(21.79)	—	—
<i>P. ichikawai</i>	20	(20.40)	37	(11.85)	—	—
<i>P. gracile</i>	23	(23.46)	—	—	—	—
<i>Calicophoron calicophorum</i>	—	—	61	(19.55)	—	—
<i>C. papillosum</i>	28	(28.57)	—	—	—	—
<i>Cotylophoron cotylophorum</i>	30	(30.62)	—	—	—	—
<i>Explanatum explanatum</i>	5	(5.1)	—	—	—	—
<i>Orthocoelium dicranocoelium</i>	—	—	38	(12.17)	—	—
<i>O. scolioocoelium</i>	—	—	7	(2.24)	—	—
<i>O. dawesi</i>	—	—	19	(6.08)	—	—
<i>O. parvipapillatum</i>	19	(19.38)	36	(11.53)	—	—
<i>O. dinniki</i>	14	(14.28)	27	(8.65)	—	—
<i>Olveria bosi</i>	4	(4.08)	—	—	—	—
<i>Gastrodiscoides hominis</i>	—	—	—	—	1	(3.12)
<i>Gastrothylax crumenifer</i>	55	(56.12)	—	—	—	—
<i>Fischoederius elongatus</i>	24	(24.48)	8	(2.56)	—	—
<i>F. cobboldi</i>	10	(10.20)	—	—	—	—
<i>Carmyerius spatiosus</i>	—	—	76	(24.35)	—	—
<i>Velasquezotrema tripurensis</i> n. sp.	2	(2.04)	—	—	—	—
<i>Fasciola gigantica</i>	7	(7.14)	5	(1.60)	—	—
<i>Eurytrema pancreaticum</i>	1	(1.02)	—	—	—	—
<i>Artyfechinostomum malayanum</i>	—	—	—	—	4	(12.5)
<i>Schistosoma indicum</i>	7	(7.14)	—	—	—	—

Of the 31 species of digenetic flukes recovered from cattle, buffaloes, goats and sheep pigs in north-east India, *Calicophoron shillongensis*, *Leiperocotyle meghalayensis* and *Velasquezotrema tripurensis* represent the species, not reported from other regions of the country (Roy and Tandon, 1990 a-c). *Paramphistomum gracile*, *Orthocoelium parvipapillatum* and *O. dinniki*, recorded in the present investigation, represent new records from India (Roy and Tandon, 1989). *P. gracile*, *O. dinniki*, *O. scoleocoelium*, *O. parvipapillatum*, and *Opisthorchis neverca* constitute new locality records (from north-east India) in the country. However, *P. cervi* from cattle, and *Opisthorchis tenuicollis* and *Gastrodiscus aegyptiacus* of pigs, which have been earlier reported from Assam (Sharma and Gogoi, 1986) were not encountered in the present study; so were also the species, namely, *P. gotoi* and *Orthocoelium narayani* of cattle and *O. sinensis*, *Haplorchis taichuii* and *Artyfechinostomum indicum* of pigs, which have been reported from other parts of the country

(Srivastava, 1982). The presence of *F. gigantica* in pigs is reported herein for the first time.

The present findings regarding the prevalence of *F. gigantica*, *E. pancreaticum* and *E. explanatum* in ruminant hosts in the north-eastern states differ from those of Sharma and Lal (1983) in Meerut, Kulkarni (1984) in Great Nicobar Island, and Busetti *et al.* (1983) in Brazil, in showing either higher or lower rates of infections by these species. These differences can be attributed to the different agroclimatic conditions of the region under study.

In respect of bovine hosts the present observations are in agreement with those of Rahman and Mondal (1983) who found *C. colyphorum* to be the predominant paramphistomid infection in Bangladesh cattle, as it is in Assam cattle. However, compared to the results of these authors, a higher prevalence of *G. crumenifer* and a low rate of infection due to *S. indicum* were recorded in all the five states under the present study. Besides, the *G. crumenifer* infection in buffaloes was also found to be much less than reported from elsewhere in the country (Sharma and Lal, 1983).

The overall rate of infection in respect of goats and sheep as recorded herein is similar to that found in Andhra Pradesh by Hafeez and Rao (1978); however a species-wise comparison reveals lower figures for *P. eptelitum*, *G. crumenifer*, *F. cobboldi* and *C. calicophorum* in the region under the present study.

With regard to swine hosts, the prevalence of fluke infections was found to be much lower than that reported by Sharma and Gogoi (1986) in pigs of Assam. However, all the four species, viz. *F. buski*, *A. malyanum*, *G. hominis* and *O. noverca* which have zoonotic importance (Chandra, 1984) were reported from one or the other state under study. The prevalence of these species bears an epidemiological significance too, since except *O. noverca*, all of them have been reported from human hosts in Assam. Although, at present there is no data available for human fascioliasis and eurytremiasis in the region, the zoonotic potential of *F. gigantica* and *E. pancreaticum* cannot be ignored.

A lower rate of occurrence of the various fluke species in higher altitude zones, as observed in the present study indicates towards the fact that a hilly terrain with fast flowing water may not provide suitable habitats for the snail, intermediate hosts (Service, 1984). An inverse correlation of prevalence with altitude has been observed in the case of fascioliasis in cattle (Bundy *et al.*, 1983). Further, differences in the prevalence as observed in different localities in the present study may be attributed to the different ambient climatic conditions. The latter would influence the biology of the larval stages of the parasite and also of the invertebrate intermediate host(s) and determine their survival.

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