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Epidemiology of gastrointestinal nematode infections in yaks in Sikkim, India

PAPRI PAL[1], L R CHATLOD[2], H RAHMAN[3] and S BANDYOPADHYAY[4]

ICAR Research Complex for NEH Region, Sikkim Centre, Gangtok, Sikkim 737 102 India

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The incidence of many of the common diseases of cattle is also reported in yaks (Lensch 1996, Ranga Rao *et al*. 1994). However, the information in yaks with particular reference to health is very scarce. Infections with gastrointestinal nematodes can negatively affect health and overall productivity of infected animals, causing major of economic losses in small and large ruminant production (Idris *et al*. 2011). Some studies have reported on incidence of parasitic infections in domesticated yaks in Sikkim (Katiyar *et al*. 1981, Ansari *et al*. 1989, Rahman *et al*. 2010). Yadav *et al*. (2007) isolated *Parafilaria bovicola* from yak of Arunachal Pradesh, India, which is the causative agent of verminous haemorrhagic dermatitis. Studies on yak in Nepal found *Fasciola hepatica*, *Echinococcus* cysts and nematodes such as strongyles. Moreover, systemic studies have not been conducted regarding the epidemiology of gastrointestinal parasitic infections in yaks of Sikkim. The present study was undertaken to ascertain the epidemiology of gastrointestinal nematode infections in yaks in Sikkim as monitored by faecal egg counts.

Faecal samples of 6,453 yaks of both sexes and different ages in East and North districts of Sikkim were collected randomly from 12 villages of Sub-Alpine low humid zone (above 2,900 m amsl) and Alpine dry zone (4,300–7,000 m amsl) of Sikkim between April 2002 to March 2012 from organized and traditionally managed herds and subjected to qualitative and quantitative examinations of gastrointestinal parasites (Soulsby 1982) and the parasites were identified by examining the eggs and culturing for larvae (Soulsby 1982). The infective larvae were harvested and used for larval identification. The species were confirmed on the basis of morphometric characteristics of released larvae (L_3) after coproculture and percentage of bursate (strongyle) worms were calculated out of total strongyle reported in the host species.

The present study revealed that out of 6,453 animals tested from 2 agroclimatic zones of Sikkim, 21.15% were positive for various intestinal parasites either singly or in mixed infestation (Table 1). The occurrence of gastrointestinal nematodes was higher among animals reared at a lower altitude Sub-Alpine low humid zone (3,000 m amsl) than those reared at higher altitude Alpine dry humid zone (4,286 m amsl). Statistical analysis indicated a significant difference ($P<0.05$) in the prevalence of intestinal parasitism among

Table 1. Seasonal percent prevalence of nematodiasis in yaks in different agroclimatic zone

Agroclimatic zone	Spring (March – May)		Summer (June – August)		Autumn (Sep-Nov)		Winter (Dec- Feb)		Total	
	n	Positive (%)	n	Positive (%)	n	Positive(%)	n	Positive (%)	n	Positive (%)
Sub-alpine low humid zone (2,900–4,300m amsl)	289	72(24.91)	310	81 (26.13)	272	81(29.78)	376	67 (17.82)	1247	301 (24.14)
Alpine dry zone (4,300–6700m amsl)	1009	162 (16.06)	1438	312 (21.71)	1738	422(24.28)	1021	168 (16.45)	5206	1064 (20.44)
Overall	1298	234 (18.03)	1748	393 (22.48)	2010	503(25.02)	1397	235 (16.82)	6453	1365 (21.15)

Present address: [1]Research Associate, [2]Scientist (Chatlodlaxman @rediffmail.com). [3]Project Director, PD ADMAS, Bengaluru, Karnataka (hricar@gmail.com). [4]Senior Scientist, Veterinary Parasitology, IVRI Regional Station, Kolkata (subuicar @rediffmail.com).

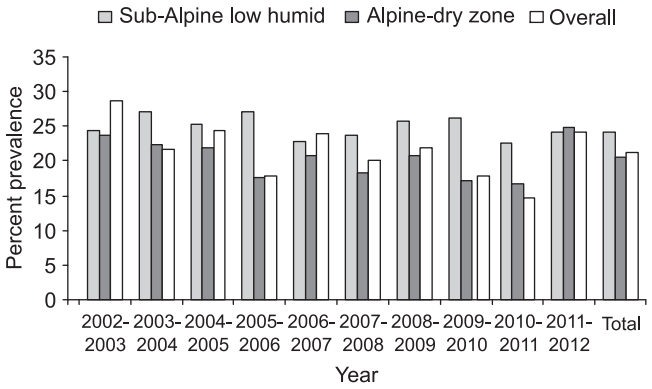

Fig. 1. Annual variations in prevalence of gastrointestinal nematodiasis in yaks in Sikkim.

animals reared at different agroclimatic zones (Table 1). An overall low rate infection with GI parasites in yaks recorded in the alpine dry area might be due to uncondusive agroclimatic conditions prevailing in these selected areas of study, which does not favour propagation of parasitic ova thus leading to unavailability of infective larvae on grazing ground (Rahman *et al*. 2010). Other studies reported prevalence's of GIP in yaks to be greater than 20% (Hogg 2004). Similar findings were obtained in the present study. The prevalence of gastrointestinal nematodes did not show a marked seasonal pattern in this study (Table 1). However, the occurrence of parasites was minimum during winter (December-February) and much higher levels were recorded during autumn (Septembr-November) followed by summer (June-August) and spring (March-May). The annual variations in the prevalence of nematodiasis in different agroclimatic zones of Sikkim in yaks are presented in Fig. 1.

Table 2. Overall prevalence of gastrointestinal parasites recorded in yaks in Sikkim

Parasite	No. (%) infected*		
	2002-2007 (n = 2996)	2007-2012 (n = 3457)	Overall (n = 6453)
Flukes			
Amphistome spp.	77 (2.57)	139 (4.02)	210 (3.25)
Dicrocoelium spp	64 (2.34)	130 (3.76)	194 (3.01)
Cestodes			
Moniezia spp.	243 (8.11)	292 (8.45)	535 (8.29)
Nematodes			
Strongyle spp.	595 (10.86)	747 (21.61)	1342 (20.81)
Strongyloides spp.	148 (4.94)	122 (3.53)	270 (4.18)
Toxocara spp.	211 (7.04)	238 (6.88)	449 (6.96)
Trichuris spp.	69 (2.31)	76 (2.24)	145 (2.25)
Nematodirus spp.	201 (6.71)	236 (6.83)	437 (6.77)
Protozoa			
Eimeria spp.	257 (8.58)	286 (8.27)	543 (8.42)
Total	610 (20.36)	755 (21.84)	1365 (21.15)

*Total numbers and total percentage of animals exceed expected values owing to multiple gastrointestinal parasitism.

A significant drop in the overall prevalence of gastrointestinal nematodiasis occurred between 2002–2003 and 2010–2011. Yaks in sub-alpine low humid zone had a significantly higher prevalence of nematodiasis during the study period as compared to alpine dry zone of Sikkim. The overall occurrence of different parasites recorded is presented in Table 2. Of the 2,996 yaks examined, 20.36% were positive for various parasites**,** either singly or in mixed infections, during the first 5-year phase period (2002–2007), while the equivalent figures were 21.84% during 2007–2012, out of 3,457 yaks. The overall most commonly occurring parasites in the region were strongyle followed by *Eimeria* spp, *Moniezia*, *Toxocara* spp., *Nematodirus* spp., *Strongyloides* spp., *Amphistome* spp., *Dicrocoelium* spp and *Trichuris* spp., Among Strongyles, *Haemonchus* spp., was most prevalent parasite than other nemaodes viz, *Trichuris* spp. The higher rate of infection could be possibly due to conducive agroclimatic conditions, constant exposure of infections and availability of infective stage larvae on the grazing ground by animals. The present findings are in agreement with those of Katiyar *et al*. (1981), Ansari *et al*. (1989) and Ranga *Rao et al*. (1994), who found 3 species of trematode and cestode respectively and 10 species of nematodes and reported infection in 75% yaks with predominant infection of

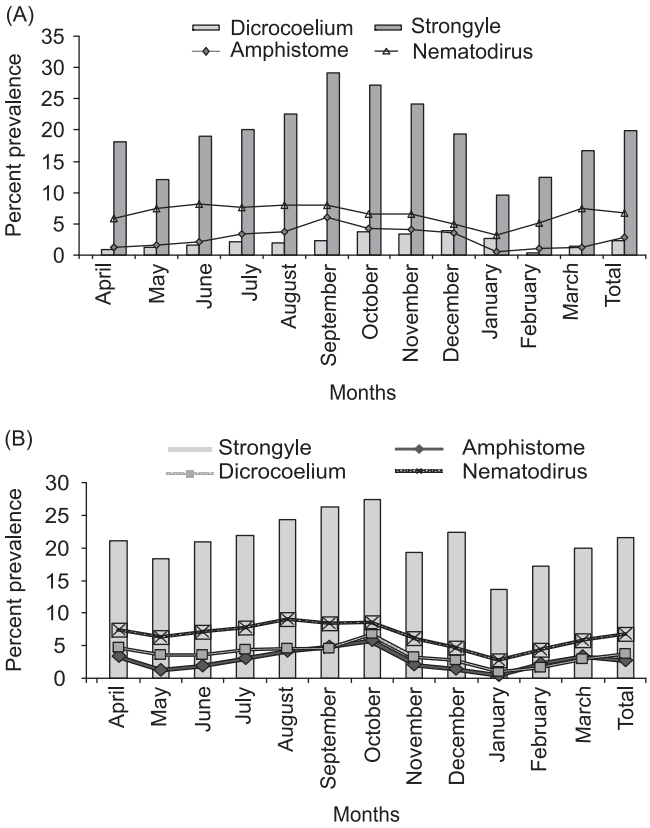

Fig. 2. Monthly prevalence of fluke and gastrointestinal strongyle infections in yaks during (a) 2002–2007 and (b) 2007–2012 (averaged over five years).

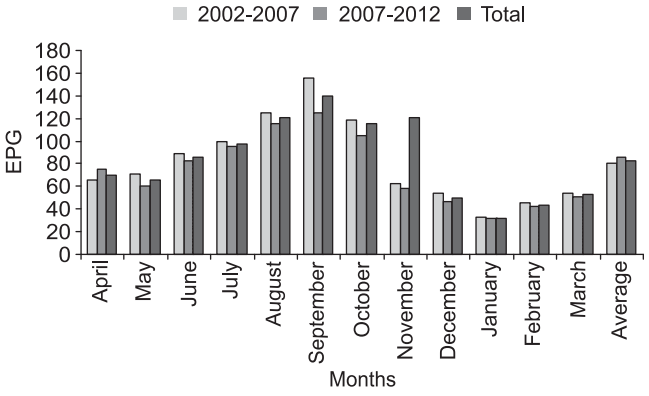

Fig. 3. Nematode egg counts (EPG) in yaks (averaged over five years, 2002–2007 and 2007– 2012)

Table 3. Influence of age on the prevalence of gastrointestinal parasites in yaks

Animal group (age wise)	Animals examined	Animal Infected (%)
Group A (1–5 months)	1004	316 (31.47)
Group B (6 months –2 years)	2158	492 (22.81)
Group C (above 2 years)	3291	557 (16.92)
Total	6453	1365 (21.15)

Haemonchus contortus and other strongyles and amphistomes from Sikkim. Hogg (2004) and Yunfeil *et al*. (2004) also reported presence of different parasites in the yak of Ladakh (India), Bhutan, Nepal and China. The comparatively less prevalence of *Amphistome* and *Dicrocoelium s*pp. ova in the present study is probably due to less availability of intermediate host or constant deworming against soft bodied trematodes in the alpine region, seasonal climatic fluctuations, feeding quality (Coop and Holmes 1996), husbandry systems and genetic backgrounds of animals. *Haemonchus* species emerged as the most prevalent species in the region, with *Bunostomum, Oesophagostomum* and *Nematodirus* also being common in yaks. Hogg (2004) reported prevalences of GIN in yaks to be greater than 20%. The present study indicated the same trend, but the months differed owing to different climatic conditions and timing of the onset of monsoon in the region.

The monthly prevalence of flukes (amphistomes and *Dicrocoelium*), strongyles and *Nematodirus* in yaks during the study is shown in Fig. 2. In general, second phase of the study revealed significant ($P < 0.05$) rise in prevalence of *Dicrocoelium* (than amphistomes) and strongyle infections in yaks as compared to first phase of the study. *Nematodirus* spp. also showed the same trend. Monthly evaluation of data further revealed that strongyle was the most prevalent parasite in yaks throughout the year, in both phases, whereas all the other parasites, viz. *Dicrocoelium* and amphistomes. experienced 2 peaks, the first in March – May and second in August to October. In *Nematodirus* spp. the first peak was in February – April and second in July - September. Among other gastrointestinal parasites, *Toxocara* spp. and *Eimeria* spp. were important in young calves. Out of 1,365 positive samples subjected to faecal egg counts for gastrointestinal nematodiasis, the count ranged from 100–2,900 epg with the maximum value for prevalence (27.73%) and the over all mean epg (140.125) were recorded during post rainy season (Fig. 3). The occurrence of helminths especially strongyles were high through out the period of study with a high peak during August to November. With the onset of winter from December onwards, the mean total egg count fell to a low level, steadily falling to a minimum of 32.673 EPG in January after that it raised slowly with the increase in temperatures and rainfall. The difference in overall monthly mean nematode egg counts between two 5 years study was not significant ($P>0.05$). The higher prevalence and degree of EPG in summer and autumn seasons as compared to other seasons may be due to the differences in grazing patterns of the animals in the areas under study. The rise in strongyle EPG could be attributed to a more favourable temperature and humidity for development and survival of preparasitic stages leading to increased availability of infective larvae on pasture during subsequent months. The study also indicated that, under normal conditions, animals harboured a worm burden without any clinical signs, but worm burden

Table 4. Management-wise percent prevalence of gastrointestinal nematode infection in yaks in Sikkim, India

Locality	Number of faecal sample examined	Number of animals infected	% infection	EPG range	Parasitic		Trematode	Nematodes	Mixed infection
					Single parasitic infection	Multiple Parasitic infection			
Organized government Farm	320	53	16.56	100–1800	11(3.44)	42(13.13)	7 (2.18)	27(8.44)	19(5.94)
Traditionally managed farm	6133	1312	21.39	100–2900	342(5.58)	970(15.82)	203(3.31)	814(13.27)	295(4.81)
Total population	6453	1365	21.15	100–2900	353(5.47)	1012(15.68)	210(3.25)	841(13.03)	314(4.87)

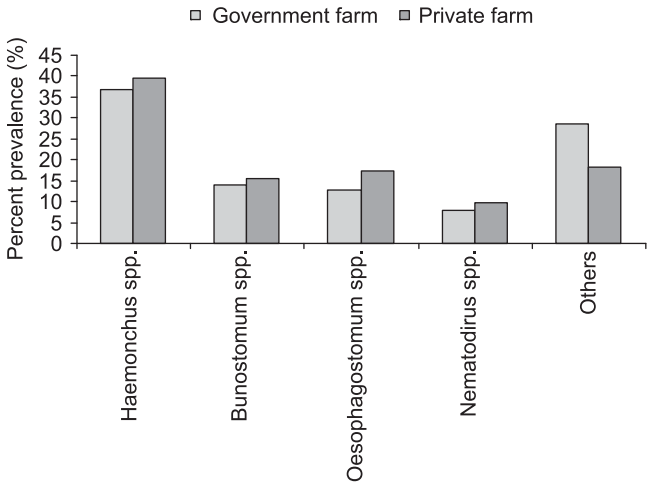

Fig. 4. Prevalence of various genera of gastrointestinal nematode in yaks depending on the results of larval cultures by farms.

reached a threshold pathogenic level during the monsoon and postmonsoon seasons (Rahman *et al*. 2010). The egg count data revealed that the highest risk of GI parasites and pasture contaminations was from August to October.

The highest infection was in yaks at 1–5 months of age followed by animals of 6 months to 2 years of age and lowest in those of above 2 years of age (Table 3). The prevalence of nematode infections is less (Table 4) in the organized Government farm animals than it is in animals that are traditionally managed. In traditionally managed farms reared by nomadic tribes, the animals are allowed to graze in communal pasture at an altitude of less than 5,000 feet during winter (December to March). So the chances of getting infection are more in these animals when compared with organized government farms where the animals are allowed to graze within the farm managed grazing lands.

Depending on the results of larval cultures, *Haemonchus* was the predominant nematode species (Fig 4), followed by *Bunostomum* spp., *Oesophagostomum* and *Nematodirus* species (Fig. 4). *Haemonchus* species was predominant in both the farms. The present findings are in agreement with those of Ansari *et al*. (1989).

These findings suggested that variations in agroclimatic conditions in different places of Sikkim and in grazing practices adopted by livestock owners have direct effects on epidemiological pattern of gastrointestinal nematode infection in yaks. The data generated in this study indicated that under prevailing agroclimatic conditions of Sikkim, India, prevalence of GI nematodes slightly high among yaks. However, the EPG estimated in this study indicated level of sub clinical infections in the host species and may initially be of help in planning chemotherapeutic and prophylactic strategies for yaks from an area studied and also of the regions with similar climatic conditions. Further, investigation on epizootiology of gastrointestinal parasites in yaks in high alpine region, larval bionomics and pasture burden are required for better understanding of GI parasitism in the region. Based on the present findings it may be suggested that broad spectrum anthelmintic treatment of yaks may be given atleast twice in a year, once during March-April and then in August-September that could reduce the gastrointestinal parasitic infection and increase the productivity of animals in this state.

SUMMARY

Yaks (6,453) of indigenous breed were individually sampled during the grazing period to determine the prevalence and variation of natural gastrointestinal (GI) parasitic infections in yaks. The overall prevalence of different parasites recorded after coprological studies was *Strongyles* (20.81%), *Coccidia* spp.(8.42%), *Moniezia* spp. (8.29%), *Toxocara* spp. (6.96%), *Nematodirus* spp. (6.77%), *Strongyloides* spp. (4.18%), amphistome spp (3.25%) and *Trichuris* spp.(2.25%). The rate of infection was more in Sub-Alpine low humid area as compared to Alpine dry zone. The faecal egg counts (eggs per gram, epg) of nematodes ranged from 100 to 2,900, with high loads during rainy and post–rainy seasons. The rate of infestation was higher in calf and the parasites mostly recorded in them were *Haemonchu*s spp., *Toxocara* spp. and *Eimeria* spp. The seasonal distribution of parasitism indicated a higher infection in autumn and summer as compared with spring and winter. The *Haemonchus* spp. was the predominant. A significantly higher FEC was observed in traditionally managed farm yaks when compared with organized Government managed farm animals. Our results may help to devise an effective control strategy against GI nematodes in Sikkim, a North-East Himalayan region of India.

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