

PROTOZOAN DISEASES OF LIVESTOCK, WILD ANIMALS AND MAN IN HIMACHAL PRADESH - AN OVERVIEW

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INTRODUCTION

Location

The Himachal Pradesh is the North Western state of India situated south of Jammu and Kashmir, north-east of Punjab, north-west of Haryana and Uttaranchal and west of Tibet, between latitude 30° 22' 40" N and 33° 12' 40" N and longitude 75° 45' 55" E and 79° 04' 20" E with an altitude ranging from 350 m (low valleys) to 6,975 m (snow covered mountains) above mean sea level. It has a total geographical area of 56,673 km² including 9859 km² of permanent pastureland. The climate varies from sub-tropical to sub-arctic, while the rainfall varies from 350 to 3,800 mm per annum. The state is characterised by mild summer and moderate to severe winter with temperature varying from -25°C in January to 42°C in June. The region is well known for its biodiversity (Anonymous, 1985).

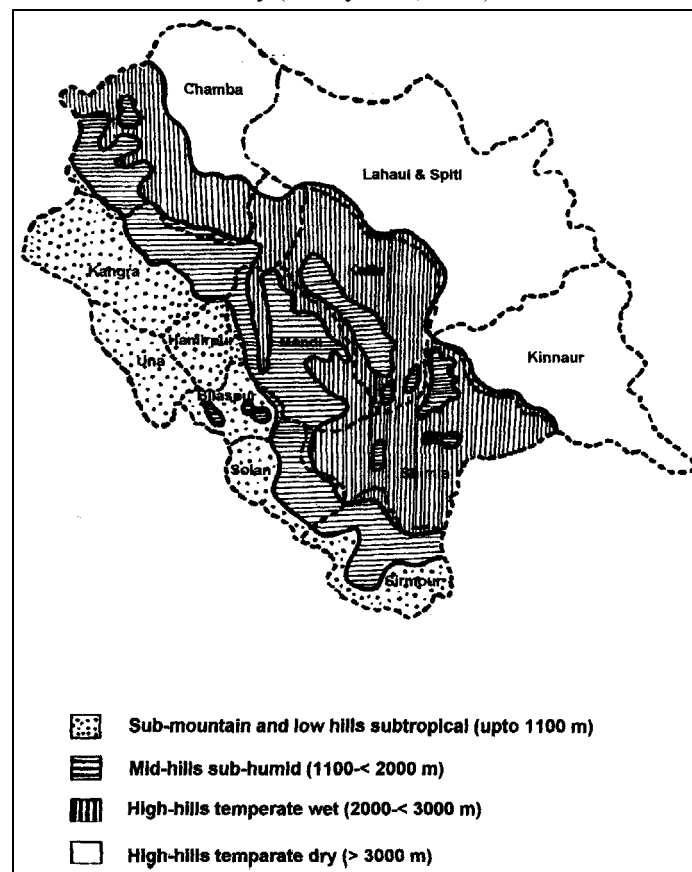


Figure 1. Agroclimatic zones of Himachal Pradesh

Agroclimatic zones

Agroclimatically the state is divided into 4 zones on the basis of topography, rainfall and altitude (Fig. 1).

Zone I	Submountainous low hills-subtropical (up to 1,100 m)
Zone II	Mid hills-subhumid (1,100- < 2,000 m)
Zone III	High hills temperate wet (2,000- < 3,000 m)
Zone IV	High hills temperate dry (> 3,000 m)

Climate

Himachal Pradesh lies in the lap of Himalayas. Its climate is largely conditioned by that single factor. The state is veiled from plains by the Shivalik range of mountains with its slopes covered with forests and meadows. The climatic conditions vary from hot and sub-humid tropical in southern low tracts, (450-900 m), warm and temperate (900-1800 m), cool and temperate (1900-2400 m) and cold alpine and glacial (2400-4800 m) in the northern and eastern high mountain ranges. The climate in Lahaul-Spiti and Kinnaur is of semi-arid high land type. Due to wide range of altitudes and climatic conditions, Himachal has rich flora and fauna contributing to rich biodiversity of western Himalayas.

Livestock and wild animals

About 92% population in Himachal Pradesh is rural and depends directly on agriculture, horticulture and animal husbandry (Anonymous, 1994). The state has a total livestock population of 50.93 lakh constituting 21.9 lakh cattle, 6.2 lakh buffaloes, 10.7 lakh sheep and 11.0 lakh goats and roughly about 1.0 lakh other animals (equines, mithun, yak, camel, pig, rabbit, etc.) excluding poultry against total human population of 51.11 lakh living in 16,807 inhabited villages (Table. 1). The livestock population has been almost static during 1982 to 1992. It increased by a meager 2.1% as compared to human population, which showed a growth of 19 % during this period (Chauhan, 1995).

Table 1. District wise livestock population in Himachal Pradesh (1992 census)

District	Cattle	Buffalo	Sheep	Goat	Dog	Others	Total	Poultry
Bilaspur	60,461	86,858	24,615	63,472	8,770	1,309	2,45,485	58,844
Chamba	2,38,988	34,832	2,58,490	1,75,268	14,730	2,800	7,25,108	67,871
Hamirpur	60,671	94,089	49,498	30,719	8,500	1,783	2,45,260	28,810
Kangra	3,98,558	1,47,386	1,55,432	2,05,024	32,448	10,544	9,49,392	2,42,681
Kinnaur	20,937	3	57,720	28,622	2,182	4,358	1,13,822	5,795
Kullu	1,57,448	670	1,09,835	56,382	9,062	1,379	3,34,778	21,315
Lahul & Spiti	8,910	-	42,766	11,445	205	3,405	66,731	4,923
Mandi	4,30,331	1,07,676	1,96,041	2,03,270	14,184	5,155	9,56,657	81,363
Shimla	3,29,055	23,258	1,26,531	95,831	16,469	5,866	5,97,010	45,082
Sirmaur	2,35,557	40,108	27,616	1,15,915	14,850	4,586	4,38,632	39,475
Solan	1,43,491	74,349	19,713	82,541	10,304	3,042	3,33,440	46,167
Una	67,209	91,694	6,088	47,100	13,731	826	2,26,648	21,776
H.P. (Total)	67,51,616	7,00,923	10,74,345	11,15,591	1,45,435	45,053	52,32,963	6,64,039

Source – Directorate of Economics and Statistics, Shimla (Himachal Pradesh), 1994.

Owing to differing climate in the state, it has a variety of wild life. The carnivorous animals include leopard or panther, hyena, ibex, jackal, wild dog, yellow jungle cat, fox, wolf, and marmot. Other animals are sambar, cheetal, barking deer, chausingha, ghural and hog deer. Kastura (musk deer) is found at high altitudes and hares, jungle fowl, peafowl, partridges and quails are plentiful in the lower hills. Kali pheasant is found in the low slopes and monal (snow pheasant), the state bird at high snowy altitudes.

Status of parasitic diseases

In Himachal Pradesh, animals are kept in a wide variety of husbandry systems and in different numbers - from a single cow kept for the family to large herds and flocks maintained in a range of systems. The traditional sheep and goat rearers called *Gaddis* are nomadic and their flocks are migratory in nature through well defined routes in Himalayan pasture (Bhasin and Singh, 1995). These animals remain confined to the low plains in zone I and II and border areas of Punjab during the winter season, but migrate to the alpine pasture land (3,000- 4,500 m above m.s.l.) in zone III and zone IV during spring and summer seasons. The constant movement of flocks of sheep and goats over a large area ranging different states may greatly facilitate the spread of infection among livestock. A recent estimate in Kangra district revealed that parasitic diseases are responsible for 24.5 % mortality and 40.0 % morbidity in various dairy farms (Chauhan *et al.*, 1994).

The information discussed in this chapter is restricted to the studies on protozoan parasites of particular concern to the livestock industry and does not necessarily reflect the overall pattern of animal

disease in the state due to lack of research and reporting from far-flung remote areas of the state. Considerable information has been amassed on parasitic infections of livestock in Kangra district and to a lesser extent in other low hill and mid hill area, but hardly on any high hills zones of Lahaul and Spiti, Kinnaur, etc.

Specific protozoan diseases of general importance

Table 2 and 3 present a checklist of most important protozoan diseases observed in common livestock (cattle, buffalo, sheep, goat, etc.) and human beings based on the studies conducted in Himachal Pradesh. Coccidiosis and haemoprotista of livestock are the two major disease entity in Himachal Pradesh and dealt here in detail.

Table 2. Protozoan parasites frequently reported from domestic animals in Himachal Pradesh

Species	Host	References
<i>Eimeria</i> spp.	Cattle, buffalo, sheep, goat equine, rabbit, poultry	IVRI Annual reports, 1996-99
<i>Babesia bigemina</i>	Cattle, buffalo	Jithendran (1997, 2000)
<i>Babesia equi</i>	Horse	Sharma <i>et al.</i> (1998)
<i>Theileria annulata</i>	Cattle, buffalo	Jithendran (1997, 2000)
<i>Trypanosoma evansi</i>	Cattle, buffalo	Jithendran (2000)
<i>Encephalitozoon cuniculi</i>	Rabbit (kidney)	Sharma <i>et al.</i> (1995)

Table 3. Protozoan parasites diagnosed in human beings in Palampur area of Himachal Pradesh

Organism	Location	References
<i>Giardia lamblia</i>	Intestine	Personal observation
<i>Entamoeba histolytica</i>	Intestine	Personal observation
<i>Plasmodium</i> spp.	Blood	Personal observation

a. Protozoan parasites of intestinal tract

Coccidiosis

The term coccidiosis commonly used to refer to infection by members of the family Eimeriidae, which include the genera *Eimeria* and *Isospora*. Protozoan of *Eimeria* spp causes this disease of great economic importance. It is the genus *Eimeria* that is of concern in cattle, buffaloes, sheep, goat and other domestic animals.

Ruminants: Coccidiosis is a serious managemental disease in small ruminants and large ruminants below 6 month of age and morbidity in higher age groups. Coccidia damage the host's intestinal epithelial cells, making them more susceptible to bacterial invasion and allowing increased flow of tissue fluid into the intestinal lumen. Watery diarrhoea, which may be bloody in cattle is the major sign of infection and usually occurs about 2 weeks after ingestion of oocysts. It causes severe enteritis and diarrhoea. Clinical coccidiosis in cattle and buffalo is normally seen in animals over 4 weeks of age. Dehydration, weight loss, tenemus, rectal prolapse, anaemia or even death may occur in some cases depending upon the species involved. The disease in sheep and goat is chiefly confined to young animals up to 6 months of age and the infection is of mixed type. In sheep and goats young animals of < 6 months age are the main victims of coccidiosis. *E. arloengi*, *E. intricata*, *E. parva* and *E. ninakoyakimovae* were reported to occur in goats in H.P. out of the 11 species of coccidia known to harbour Indian goats (Gupta *et al.*, 1992; Mitra *et al.*, 1998). However, good stock management and avoidance of stress can considerably reduce the risk of clinical disease due to coccidiosis. Adequate nutrition, good hygiene practices, reasonable sock density and prevention of other diseases are important. Coccidiostats may be used prophylactically during the anticipated period of risk or to treat clinical cases. Recently *Isospora* sp. has been observed in horse (HPKV Annual reports, 1998).

Poultry: Intestinal coccidiosis, caused by *Eimeria* and *Isospora* species, is very common in India and affect all categories of animals including poultry where it is still a problem, particularly under deep litter system. Medication first by sulphonamides and later by other drugs, have effectively controlled the

malady making poultry keeping a commercial proposition. However, occasional outbreaks are still not uncommon in commercial poultry keeping. Various *Eimeria* spp., which parasitize specific portions of the intestinal tract of chickens. Infections with coccidian are found in the intestinal tract often causing enteritis and diarrhoea. Coccidiosis is a major cause of mortality and sub optimal growth and conversion efficiency in immature flocks. The sporulated oocyst is the infective stage of the life cycle.

Rabbit

Coccidiosis caused *Eimeria* spp. is a major cause of morbidity and mortality in all age groups. The disease occurs in hepatic and intestinal forms, the latter being more common (Jithendran, 1997). Hepatic coccidiosis is caused by *E. stiedai*. The disease usually affects weaning rabbits of 5-8 weeks of age and is characterised by anorexia, ill thrift, weight loss and an enlarged abdomen. Grossly liver reveals number of white to yellowish spots and microscopically hyperplasia is encountered in bile duct. Death of young naive rabbits is observed before oocysts are being passed in faeces. Intestinal coccidiosis is also seen mainly in weaners, although 96 % rabbits shed oocysts, irrespective of age. Several *Eimeria* species have been documented which vary in pathogenicity and occupy the small or large intestine, or both (Fig. 2). The disease is characterised by weight loss, soft and watery faeces and severe dehydration before death. Mortality varies with the species of *Eimeria* involved, immune status of the host and amount of inoculum. Of the 25 species, which are reported to cause coccidiosis in rabbits, 8 have been reported from Himachal Pradesh. Mixed infections were common and 82 % of the infected animals harboured 2-4 *Eimeria* species. In order of preponderance, *E. magna* was the most common (39.4 %) followed by *E. perforans* (16.7 %), *E. media* (16.7 %), *E. irrisidua* (13.3 %), *E. stiedai* (6.1 %), *E. intestinalis* (3.3 %), *E. piriformis* (3.3 %) and *E. coecicola* (1.2 %). Jithendran and Bhat (1996) reported that the level of infection based on the oocysts per gram of faeces (OPG) revealed higher OPG in private farms ($0.05-80 \times 10^3$) as compared to Government farms ($0.3-16.5 \times 10^3$). The clinical coccidiosis observed in organised farms in various age groups is shown in Fig. 3. An outbreak of intestinal coccidiosis due to *E. perforans* in Angora rabbit was reported from Kangra valley (Krishna and Vaid, 1987) and recently a number of reports from this area have indicated that *E. magna* and *E. perforans* are prevalent in this region of which *E. magna* has been moderately pathogenic (Bhat and Jithendran, 1995). In commercially reared rabbits coccidiosis occurs in sub clinical form leading to growth retardation and altered feed conversion. The control of rabbit coccidiosis relies on improved management practices and chemical coccidiostats. The commonly used coccidiostats in this region are nitrofurans, sulpha drugs, clopidol, amprolium and monensin (Jithendran and Bhat, 1998).

b. Blood protista of animals

Himachal Pradesh is relatively free from blood-borne parasites when compared to other states in our country. This freedom is due to the fact that the state is also free from many tick species and biting insect vectors associated with transmission of such parasites except in warmer plain regions. Routine surveillance of blood smear from all species of animals carried out at our laboratory revealed species of protozoa, rickettsia and microfilaria (nematodes). Information on the epidemiology of these diseases in H.P. is scanty and merits further investigation.

Haemoprotzoan diseases caused by vector-borne blood protista constitute a disease entity of considerable economic importance in the state. Theileriosis, babesiosis and anaplasmosis are important and are on the increase over the last decade in low and mid hill regions. *Trypanosoma evansi* transmitted by biting flies were recorded in cattle, buffaloes and equines in warmer plains of Una district only.

Theileriosis

Theileriosis caused by *Theileria annulata* and transmitted through the bites of *Hyalomma* and *Rhipicephalus* has been considered as the most important blood protista in the region with higher incidence in exotic breeds and the crossbred stocks of all age groups consistent with the general epidemiology of the diseases in tropical areas (Jithendran, 1997). The disease in small ruminants has not been recorded. Cases of theileriosis are generally observed during summer or rainy season when the ticks have higher activity although sporadic outbreaks have been recorded year round. Clinically a rise of body temperature up to 107 °F and enlarged superficial lymph nodes accompanied by dullness, anorexia,

salivation, lacrymation and discharge from nostrils. The demonstration of Koch's blue bodies in the lymphocytes and monocytes of the lymph node smear or peripheral blood film is pathognomonic of the disease. Tetracycline has been used with great success in treating *Theileria* infected animals besides the commercially available schizont vaccine for prophylactic use. However, excluding the organised farms use of vaccine is not popular due to higher cost and non-availability. Transmission involves the tick vector and hence elimination of the vector population becomes essential for the control of theileriosis.

Babesiosis

Babesia bigemina is a common ailment in cattle transmitted by *Boophilus microplus* is manifested by pyrexia (40-42 °C) and haemoglobinuria. A case of equine piroplasmiasis caused by *Babesia equi* infection in mare has been observed (Sharma *et al.*, 1998) with a clinically subnormal temperature (100.2 °F) accompanied with haemoglobinuria and erythrocytes with 95 % parasitaemia. The disease in small ruminants has not been reported in the state. An outbreak of *Babesia* sp. has been reported among yak in the state. Further studies are required. The demonstration of characteristic piroplasmic stages in the erythrocytes from peripheral blood film is used for diagnosis. Berinil is drug of choice used in the region with great success in treating infected animals in addition to supportive therapy. Transmission involves the tick vector and hence elimination of the vector population becomes essential for the control of babesiosis.

Anaplasmosis

Though a rickettsial organism, belonging to the genus, *Anaplasma* occur in two forms, *A. marginale* and *A. centrale*. Although both the species have been recorded sporadically in cattle, the former has been well documented (Jithendran, 1997). Its importance needs a mention since it is usually found either alone or in association with *Theileria* and/or *Babesia* infection mostly in exotic and cross bred animals. A high body temperature (103-104 °F) is associated with pyrexia with increased lacrymation and salivation. In the animals suffering. The demonstration of characteristic organisms in erythrocytes is used for diagnosis. Control strategies applicable to other haemoprotozoan parasite are also effective against anaplasmosis as well.

Trypanosomosis

Trypanosomosis caused by *Trypanosoma evansi* is again a vector borne extracellular flagellate transmitted by biting flies. The disease outbreaks have been reported from warmer plains of Una district but without any incidence in hilly regions of the state so far. The demonstration of flagellates in the thin or thick blood films or by biological test by inoculation in laboratory animals is used for diagnosis. Quinapyramine sulfate and chloride salts are used in the region with great success. No vaccine is available. Elimination of the vector population (*Tabanus* fly) becomes essential for the control of trypanosomes.

c. Protozoan diseases of other organs

Encephalitozoonosis

Infection caused by microsporidian, *Encephalitozoon cuniculi* (*Nosema cuniculi*) is usually asymptomatic. Spores liberated from ruptured intestinal cells infect renal tubular epithelium and endothelium of capillaries in the central nervous system and occasionally characterised by neurological signs and polyuria. Histological examination shows granulomatous lesions in brain and kidney. This organism may be a threat to immunosuppressed human beings. An incidence of 2.8 % has been reported from Angora rabbits of Kullu and Kangra districts of Himachal Pradesh (Sharma *et al.*, 1995).

Toxoplasmosis

Toxoplasmosis caused by a coccidian parasite *Toxoplasma gondii* is a world wide zoonotic disease. The definitive host is cat and other feline animals. The infections occur in many warm-blooded animals including sheep, goats, pig, dog, poultry and mice etc. by consuming food contaminated by *Toxoplasma* oocysts. Abortion due to toxoplasmosis has also been diagnosed besides a significant high level of antibody titre in migratory sheep (31 %) and goats (60 %) (Jithendran and Vaid, 1996). *T. gondii* has been recognised as one of the cause of abortion and neonatal mortality in migratory sheep and goats

in Himachal Pradesh. Serological surveys revealed 36 % seroprevalence with a titre ranging from 1:25 to 1:5000 by modified agglutination test (Dubey *et al.*, 1995; Jithendran and Vaid, 1996).

Sarcocystosis

Sarcocystis infection is encountered normally at the time of histopathological examination of herbivorous animals. In most animals this parasite does not cause clinical diseases. Life cycle in definitive hosts (dogs) is initiated by eating infected slaughterhouse wastes (offal) although no transmission studies were carried out in the state.

d. Protozoan Parasites recorded in other host species

Ruminants

Other less important parasitic infections are *Balantidium coli*, *Cryptosporidium sp.*, etc. in cattle. An outbreak of *Babesia sp.* has been reported among yak in the state.

Equine

Isospora spp. has been recorded in equines in Himachal Pradesh.

Pig

The protozoan, *Balantidium coli* is very commonly found in the colon of some pigs at pig farms maintained by army.

Dog and Cats

Only few cases of unidentified coccidian parasites and *Entamoeba spp.* were recorded.

Poultry

Besides coccidiosis rarely some flagellate parasites were also recorded in poultry mainly of *Trichomonas* species.

e. Parasitic zoonoses

There is a close contact of man and animals in the tribal areas of Himachal Pradesh, where domestic animals are kept in basement of the house with human occupants in the first floor of same house. In addition, *Gaddis* also remain in close contact with sheep, goat and dogs throughout the year, exposing them to many animal born diseases of occupational risk. Their migratory life style is likely to have no access to permanent educational, medical and veterinary health services. They may also not have safe and sanitary water supplies leading to many zoonotic diseases.

Giardiasis caused by *Giardia spp.* and amoebiasis caused by *Entamoeba spp.* seems to be the most common protozoan zoonotic diseases in human in the region. Another disease of clinical significance is toxoplasmosis. *Toxoplasma* usually causes a febrile illness. But in pregnant women it poses a danger to the foetus. Test for toxoplasmosis is usually done only by infertility clinics, as it is one of the causes of abortions. In some of the areas of upper Himachal, however, which is home to big cats rather than to the little domestic ones, the source of infection in humans seems to be quite different. Studies suggest that the ingestion of poorly cooked mutton, which harbours the developing phase of *Toxoplasma*, could be the mode of transmission.

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