HELMINTHIASIS IN CAPTIVE WILD CARNIVORES AND ITS CONTROL IN INDIA

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ABSTRACT

Helminthiasis in wild carnivores can cause high morbidity and mortality specially in young ones. This paper discusses in brief on the occurrence of helminthic infestation in wild carnivores as reported from India. They suffer from trematodes, cestodes, nematodes and acanthocephala infestation. Paragonimiasis, hydatidosis, dinofilariasis, hookworm infection and toxocariasis appear to be common among these animals. The various helminths recorded from Indian wild carnivores along with the host animal and location of the parasite have been listed. Infestation with trematodes, cestodes and nematodes have been frequently reported but there appears to be only one report of acanthocephala infestation from a Jungle Cat. The paper also discusses about the principles of control measures for helminthiasis in wild carnivores that can be adopted in Indian zoos.

KEYWORDS

Acanthocephala, captive wild carnivores, cestodes, control measures, Indian zoos, helminthiasis, nematodes, recommendations, review, trematodes

Many species of carnivores specially felids, canids, hyenas, bears, civets, mongooses, otters and red panda are usually exhibited in most of the Indian zoos. The major concern to managers and veterinarians of zoos is the health aspects of these wonderful creatures. There are scores of health problems arising out of various aetiological agents. However, parasitic infestations - especially those with helminthic origin affecting wild carnivores would be presently the subject of discussion. Since parasitism and its control in free-living wild carnivores is more complex and difficult to achieve due to obvious reasons, it would be prudent to limit the topic to captive wild carnivores of the Indian zoos. Therefore, it is necessary to know about the occurrence of different helminth parasites in captive wild carnivores before attempting any control measure.

Helminthic infestations have greater ramification and significant impact in these animals, when present in sufficient number and can cause high morbidity and mortality. These may be expressed as deaths in all age groups especially in young ones and weakness and unthriftness in survivors who may as a result have lowered body resistance and reproduction capabilities. Additionally poor exhibition value of animals in captivity and zoonotic risks to zoo employees could be the other facets of parasitic infestations.

Trematodes

Paragonimiasis: It is a parasitic infection of zoonotic importance of both free living and captive wild carnivores.

The disease is widely distributed throughout the country and has been reported in Tiger (*Panthera tigris*), Leopard (*Panthera pardus*), Clouded Leopard (*Neofelis nebulosa*), Rusty-spotted Cat (*Prionailurus rubiginosus*), Leopard Cat (*Prionailurus bengalensis*), Fishing Cat (*Prionailurus viverrinus*), Golden Cat (*Catopuma temmincki*), Jungle Cat (*Felis chaus*), Palm Civet (*Paradoxurus grayi*), Small Indian Civet (*Viverricula indica*), Large Indian Civet (*Viverra zibetha*), Himalayan Pine Marten (*Mustela martis*), Bear-cat (*Arctictis binturong*) and Common Mongoose (*Herpestes edwardsi*) (Mudaliar & Alwar, 1947; Hiregoudar & Pethkar, 1970; Singh & Somvanshi, 1978; Dutt & Gupta, 1978; Arora & Das, 1988; Parihar & Shrivastava, 1988; Rao & Acharjyo, 1991; Rao *et al.,* 1991; Pythal *et al.,* 1993; Arora, 1994; Arora *et al.,* 1998; Varadharajan & Pythal, 1999; Chowdhury, 2001; Nashiruddullah & Chakraborty, 2001).

The most common species encountered in Indian wild carnivores is *Paragonimus westermanii* though *P. compactus, P. edwardsi* and *P. kellicotti* have also been reported from few wild hosts.

The flukes remain inside the cysts chiefly in the lung parenchyma and rarely in brain, spinal cord and other organs without causing serious damage. Consequently, the death due to paragonimiasis is rather extremely rare. Most of the diagnosis of reported cases are based on post-mortem findings and in few instances through faecal sample examination.

The other important trematodes of wild carnivores reported from India by Patnaik and Acharjyo (1970), Amrithraj *et al.* (1999) and Chowdhury (2001) are listed in Table 1.

Cestodes

Echinococcosis/hydatidosis: *Echinococcus granulosus*, the causative parasite has wide geographical distribution and lives in the small intestine of carnivores (particularly the dog) and the metacestode (hydatid cyst) in various organs of a wide variety of ungulates and man (Soulsby, 1986). Because of its potentiality to affect man, the parasite is considered to be of zoonotic consequence.

There are reports on the occurrence of hydatid cysts in the liver of lions of old Madras Zoo (Ramanujachari & Alwar, 1954) and Maharajbagh Zoo, Nagpur (Ganorkar *et al.,* 1997).

Echinococcus granulosus worms associated with marked catarrhal enteritis were recovered from both small and large intestines of an Indian Wolf (*Canis lupus*) during necropsy at Nandankanan Zoo (Rao *et al.,* 1973).

The other cestodes / metacestodes reported from Indian wild carnivores (from small intestines) are given (Mudaliar & Alwar, 1947; Patnaik & Acharjyo, 1970; Arora, 1994; Chowdhury, 2001; Nashiruddullah & Chakraborty, 2001) in Table 2.

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Table 1. The important trematodes of wild carnivores reported from India

Name of the parasite	Name of the host	Location
Artyfechinostomum malayanum	Small Indian Civet	Intestine
Artyfechinostomum sufrartyfex	Honey Badger / Palm Civet	Small Intestine
Echinochasmus corvus	Jackal	Intestine
Echinochasmus perfoliatus	Rusty Spotted Cat	Small Intestine
Euparadistomum sundarami	Mongoose	Gall bladder
Euparyphium malayanum	Jungle Cat	Intestine
Haplorchis taichui	Fox	Small intestine
Pharyngostomum cordatum	Tiger / Jungle Cat	Small Intestine
Spelotrema narii	Jackal	Small Intestine

Nematodes

Dirofilariasis: Dirofilariasis or heartworm disease, caused by *Dirofilaria immitis* is a vector-borne disease having zoonotic importance.

Dirofilaria immitis is usually found in right ventricle of heart, pulmonary artery, vena cava and occasionally in lungs when the infestation is heavy. The disease has been reported from a wide range of wild felids and canids, namely, Lion (*Panthera leo*), Leopard and Black Panther (*Panthera pardus*), Tiger and White Tiger (*Panthera tigris*), Golden Cat (*Catopuma temmincki*), Jackal (*Canis aureus)*, Fox (*Vulpes bengalensis*), Wild Dog (*Cuon alpinus*) and Wolf (*Canis lupus)* at Nandankanan Zoo (Rao & Acharjyo, 1993); Asiatic Lion (*Panthera leo persica*) at Guwahati Zoo (Nashiruddullah & Chakraborty, 2001); and Lioness (*Panthera leo*) at Ranchi Zoo (Haque, 1998). Heartworms were detected in all these species only during necropsy.

Dirofilaria repens was found in the subcutaneous tissue of Indian Fox (*Vulpes bengalensis*) and Golden Cat (*Catopuma temmincki*) at Nandankanan Zoo (personal observation & A.T. Rao, pers. comm.).

Lungworm infection: Rao *et al.* (1971) recovered *Filaroides osleri* from nodules in the lungs of a Leopard Cat (*Prionailurus bengalensis*) suffering from pneunomia at Nandankanan Zoo.

Hookworm infection: Hookworms occur in a wide range of hosts and are cosmopolitan in distribution. The parasites cause haemorrhagic and necrotic enteritis resulting in loss of blood and anaemia. Most of the carnivores specially the felids and canids exhibited in Indian zoos harbour various species of hookworms. One of the species, *Galonchus perniciosus* causing nodular disease of the intestines has been frequently encountered in Lion, Tiger and Leopard at Nandankanan Zoo during post-mortem examination. Nashiruddin and Chakraborty (2001) recorded *G. perniciosus* in Indian Tiger from Assam State Zoo and studied the pathology in detail. Pythal *et al.* (1993) have also reported *G. perniciosus* infection in a Leopard.

Hookworm infection has also been recorded from different species of wild carnivores from India like Wild Dog, Wolf, Jackal, Fox, Jungle Cat, Leopard Cat, Clouded Leopard, Hyena, Lion, Tiger, Civet Cat, Honey Badger, Fishing Cat, Leopard, Sloth Bear, Mongoose and Red Panda. The list of hookworm species reported (Chowdhury, 2001) are given as under. These worms were recovered from small intestine only: *Ancylostoma caninum, A. braziliense, A. ceylanicum, A. duodenale, A. paraduodenale, Anthrocephalus gambiensis, A. herpestis, Uncinaria felidis, U. stenocephala* .

Table 2. The other cestodes / metacestodes reported from Indian wild carnivores from small intestines

Cestode/metacestode	Wild carnivore host
Dipylidium caninum	Indian Fox, Hyena, Jackal
Dipylidium otocyonis	Fox
Diphyllobothrium caninum	Hyena
Diphyllobothrium erinaceae	Tiger
Diphyllobothrium felis	Tiger
Diphyllobothrium latum	Leopard, Leopard Cat, Tiger, Wild Cat, Jackal
Mesocestoides lineatus	Leopard, Indian Fox, Jackal
Multiceps multiceps	Jackal
Spirometra erinaceae	Tiger, African Lion, Clouded Leopard, Fishing Cat, Jungle Cat, Small Indian Civet (sparganum in the sub-cutaneous tissue).
Taenia hydatigena	Jackal, Tiger
Taenia pisiformis	Tiger, Jackal, Jungle Cat
Taenia taeniaeformis	Clouded Leopard, Tiger

Rao and Acharjyo (1972) recovered several number of *Anthrocephalus longespiculum* from a fibromatous growth in the pancreas of a Hog Badger (*Arctonyx collaris*). Chakraborty and Chowdhary (1985) recorded *Acheilostoma collaris*, a new species from the pancreas of a Hog Badger.

Toxocariasis: Toxocariasis is very common in carnivores specially felids causing ill health in all the age groups and mortality in young ones. Chakraborty and Maity (1995) reported the death of five 1½ month old Himalayan Wolf pups at Darjeeling Zoo due to the above malady caused by *Toxocara canis*. Successful treatment of clinical cases of toxocariasis in Snow Leopards caused by *Toxocara cati* has been reported from Darjeeling Zoo (Maity *et al.,* 1994). An Asiatic Lion of Bikaner Zoo which suffered from parasitic gastritis caused by *Toxocara leonina* was successfully treated (Tanwar *et al.,* 1984). A survey of faecal samples of wild mammals of Kanpur Zoo revealed the presence of *Toxocara leonina* in both African and Indian lions, Tiger and Fishing Cat. *Ascaris felis* was noticed in Indian Lion in Nandankanan Zoo. The recovery of *T. leonina* from Asiatic Lion and Tiger; *T. cati* from Leopard and Jungle Cat and *T. canis* from Tiger and Jackal at Assam State Zoo have been recorded (Nashiruddullah & Chakraborty, 2001). *Toxocara mystax* from Tiger, Leopard, Jungle Cat and Leopard Cat and *T. transfuga* from Himalayan Black Bear, Sloth Bear and Red Panda have also been reported (Chowdhury, 2001). Besides, few other species of nematodes reported in Indian wild carnivores Chowdhury (2001) and Nashiruddullah and Chakraborty (2001) have been listed in Table 3.

Acanthocephala: There appears to be only one report on the occurrence of *Oncicola* sp. from Jungle Cat in Nandankanan Zoo (Patnaik & Acharjyo, 1970)

Table 3. Other nematodes reported by Chowdhury (2001) and Nashiruddullah and Chakraborty (2001) in Indian wild carnivores

Parasite	Host	Location
Belascaris marginata	Jackal, wolf, fox	Intestine
Bronchostrongylus subcrenatus	Tiger	Bronchi and trachea
Capillaria aerophila	Tiger	Bronchi and trachea
Capillaria cameroni	Jungle cat	Urinary bladder
Capillaria sp.	Leopard-cat	Kidney
Capillaria sp.	Mongoose	Intestine
Cyclospirura subequalis	Tiger, jungle cat	Cysts in stomach wall
Dracunculus medinensis	Leopard, Jackal	Sub-cutaneous tissue
Gnathostoma spinigerum	Leopard, tiger, jackal, civet cat, golden cat	Stomach, liver, body cavity, mesentery, diaphragm etc.
Herpestrongylus herpesti	Mongoose	Body cavity, lungs, gall bladder
Metathelazia cameroni	Jungle Cat	Lung
Metathelazia chabaudi	Mongoose	Bronchioles
Ollulanus tricuspis	Lion, Tiger	Stomach
Parascaris felis	Lion	Intestine
Physaloptera brevispiculum	Jungle Cat, Honey badger	Stomach
Physaloptera masoodi	Jungle Cat	Stomach
Physaloptera preputualis	Clouded Leopard, Leopard, Fishing Cat, Jungle Cat, Leopard Cat	Stomach
Physaloptera vulpineus	Fox	Stomach
Physaloptera sp.	Tiger, Fox, Mongoose	Stomach
Viverra nisakimolensis	Civet Cat, Jungle Cat	Intestine
Spirocerca lupi	Jungle Cat, Bear Cat, Lion, Jackal	Mainly oesophogus and stomach
Spirura herpestis	Mongoose	Stomach
Spirura ritypleurites	Mongoose	Stomach
Strongyloides akbari	Honey badger	Intestine
Strongyloides tumefaciens	Jungle Cat	Large Intestine
Subulura vulpes	Fox	Intestine
Vogdeloides herpesti	Mongoose	Bronchioles
Toxocara canis	Jackal, Lion, Leopard, Tiger	Small intestine
Toxocara cati	Lion, Tiger, Leopard, Clouded Leopard, Fishing Cat, Leopard Cat, Jungle Cat, Golden Cat, Civet	Intestine
Toxocara leonina	Lion, Tiger, Leopard, Snow Leopard, Fox, Fishing Cat, Leopard Cat	Small Intestine
Rictularia mjobergi	Bear Cat	Intestine
Rictularia cahirensis	Civet Cat, Honey Badger	Intestine
Rictularia affinis	Jackal	Intestine
Rictularia sp.	Small Indian Civet	Stomach
Trichinella spiralis	Civet Cat	Diaphragm, skeletal muscles
Trichuris sp.	Tiger, Mongoose	Caecum, Large Intestine

Principles of control measures

Though helminth parasites are known to occur in free-living wild carnivores, there appears to be no specific information on the pattern of morbidity and mortality.

The diverse geoclimatic conditions of India presents a panorama of helminthic infestations among wild carnivores peculiar to each region. The control measures, undoubtedly, would depend upon several factors like life cycle, preponderance of intermediate hosts, survivability of the non-infective stage of parasites in nature, availability of susceptible hosts, status of nutrition, season and environment. For example, the eggs of some of the helminths like ascarids remain viable for several months and the life cycle of several helminths involve intermediate hosts (e.g. snail and crab or crayfish (*Paragonimus* sp.), mosquitoes (*Dirofilaria immitis*), rodents as paratonic hosts (*Toxocara* sp.) etc.). The degree of parasitaemia may also be influenced by housing, zoo sanitary measures, periodic deworming etc. Therefore, it is desirable to have a proper understanding of the design and dimension of animal enclosure, micro- and macro-climate of the enclosure environment, species, population size, sex and age group of carnivores maintained, feeding and management practices, life cycle and epidemiology of helminths involved, susceptibility and concurrent disease etc. Further, the rationale behind the control of helminths in wild carnivores of Indian zoos is presumptive in as much as each carnivore is infected and that the contamination of the zoo environment is a continuous process because of space confinement, over crowding, movement of keepers from one enclosure to the other, presence of stray dogs, cats, rodents, mosquitoes etc.

All the above relevant issues will have a definite bearing on control measures designed to be adopted for a particular species in a zoo. Some of the measures which may be adopted in Indian zoos are described below.

1. Newly arrived carnivores should be kept in quarantine at least for a period of 30 days as they can be a potential source of helminthic infection to the resident healthy zoo carnivores. During quarantine, frequent screening for helminths followed by treatment of positive cases with appropriate anthelmintic should be carried out.

2. It is generally believed that nutritional deficiency increases the susceptibility of animals to helminthic infection. Therefore, adequate supply of good quality, hygienic and nutritious diet as per the need of the species and clean water from protected source must be ensured.

3. The feeding/retreating housing facilities must have impervious and crack-free surfaces both on the floor and walls to facilitate proper cleaning and disinfection. Houses must be well illuminated and ventilated.

4. Good drainage system to prevent water logging, dampness and unhygienic condition must be ensured. The enclosure environment should be kept clean and dry.

5. Periodical drive to eliminate/ prevent the spread of mosquitoes, flies, snails, rodents, stray dogs, cats etc. inside the zoo premises should be carried out as they serve as vectors/ transmitters of helminthic infection.

6. The excreta and food refuses of carnivores and all sorts of garbage, solid and liquid wastes generated inside the zoo premises can act as reservoir and breeding ground for disease-causing helminths and their vectors. Therefore, proper cleaning and disposal of wastes daily and disinfection with desired disinfectants of the enclosure and surrounding areas is a must.

7. General zoo sanitary measures of animal enclosures and surrounding areas including the veterinary complex and all places frequented by visitors must be ensured. Hospital wastes should

be properly disinfected and disposed off.

8. It is most unlikely to keep wild carnivores absolutely free from helminthic infestation. Hence a monitoring-and-control-of-helminths programme should be implemented with an aim to reduce the parasitic burden. This can be achieved by periodical faecal sample examination for three consecutive days and treatment of positive cases with appropriate broad spectrum anthelmintic on a regular basis. The deworming schedule usually adopted for wild carnivores in most of the Indian zoos should be strictly followed.

9. Change of anthelmintics should be instituted from time to time to avoid drug resistance.

10. There is seasonal variation in helminthic infection among all animals including wild carnivores. Special emphasis has to be given during rainy season followed by winter and summer seasons.

11. Young animals are more vulnerable to helminthic infection. As such they warrant special attention and care at birth and thereafter.

12. Since stress of all kinds increases the susceptibility to parasitic infection, attempts should be made to avoid stress as far as possible in the daily routines.

13. When helminthiasis is persistent, the host animal-environment relation has to be considered. Heavy build up of infective parasitic fauna may be present in the top soil of the enclosure creating an environment for repeated infection. In such cases periodic changing of the infected top soil of the ground may help in the control of helminths to a great extent.

14. Overcrowding of enclosures must be avoided as otherwise frequent reinfection may occur.

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