

Trophic Chains As Transmission Routes Of Some Parasitic Worms Of Wild And Domestic Carnivores In The Northwest Caucasus

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Annotation. *This study analyzes trophic-epizootic chains involved in the circulation of helminths among wild, domestic and synanthropic animals in the North-West Caucasus. Various aspects of the problem are considered, including the species composition of helminths, the characters of their life cycles, the roles of intermediate and definitive hosts, and the influence of anthropogenic factors on the spread of helminthiases. Analysis of available data allows for an assessment of the scale of the problem and outlines directions for future research.*

Key words: *trophic chains, parasitic worms, trematodes, cestodes, nematodes.*

AIM OF THE STUDY: The aim of this study is to identify the species composition of trophic chains involving wild and domestic carnivores, and to determine the role of these animals in the detected chains of helminth circulation.

INTRODUCTION

The North-West Caucasus is characterized by high biodiversity, encompassing numerous species of wild, domestic and synanthropic animals. This diversity creates a complex system of trophic relationships, within which various helminths circulate. Understanding these trophic-epizootic chains is essential for developing effective measures to prevent helminthiases in both animals and humans.

This paper analyzes available data on the helminth fauna of the region, examines the role of different animal species in sustaining parasites circulation and discusses the influence of anthropogenic factors on these processes.

Wild animals play a crucial role in maintaining helminth circulation, acting as reservoir hosts for many parasite species. Wild boars serve as intermediate hosts for several helminths transmitted through the consumption of infested plants or invertebrates. The migration of wild animals and their contact with domestic animals facilitates the spread of these parasites.

Domestic animals, particularly those grazed on pastures, are often infected with helminths circulating among wildlife. Transmission occurs through contact with contaminated pastures, water, or through ingestion of infested feed. Infection of pets can lead to significant economic losses due to reduced productivity and increased treatment costs.

Synanthropic animals, such as rats and mice, also contribute to helminths circulation. They can serve as intermediate or reservoir hosts for several parasites transmissible to humans and domestic animals.

Anthropogenic factors including landscape modification, intensive livestock farming and urbanization significantly influence the spread of helminthiasis. Change in habitat structure can alter the abundance and distribution of wildlife, thereby affecting helminth circulation. Intensive livestock farming, in particular promotes conditions favorable for a high parasites and increased infection risk.

Although some researchers argue that the role of wild animals in the helminth's circulation is overstated, and that domestic animals and poor sanitary practices are primary sources of infection. This view overlooks the complexity of trophic-epizootic chains and the significance of reservoir hosts in maintaining parasites population. It is impossible to completely rule out the influence of wild animals on the spread of helminthiases.

LITERATURE STUDIES

Research on the helminth fauna of the Northwest Caucasus has been conducted repeatedly; however, data on the complete species composition and their trophic relationships remain fragmentary. The region is known for its high level of enzooticity for several helminthiases affecting both wild species-such as foxes, wolves, and wild boars-and domestic animals including cattle, small ruminants, dogs and cats). Among the most common helminths are members of the families Ancylostomatidae, Trichostrongylidae, Taeniidae, Toxocaridae, etc.

In the study covering 15 species of carnivores in the European part of the Russian Federation (across seven regions), five trematodes' species were identified, including two in raccoon dogs [6].

Similarly, twelve trematodes' species have been recorded in raccoon dogs in the Volga delta, all with life cycles linked aquatic environment [1, 2]. The similarity in trematode species composition between the floodplain zones of the North-West Caucasus and the Volga delta is likely due to comparable ecological and geographical conditions.

In the trophic-epizootic chains, amphibians, reptiles, birds, and rodents can serve as additional hosts for the cestode *Mesocestoides lineatus*. Carnivorous mammals acquire the imaginal stage of cestodes by consuming infected intermediate hosts harboring tetrateridia [8].

The intermediate hosts of the nematode *Crenosoma vulpis* include several species of terrestrial gastropods: *Agriolimax agreste*, *Arion intermedius*, *Succinea putris*, *Helix sp.* In the North Caucasus, certain species have also been recorded as reservoir hosts of *Crenosoma vulpis* [5, 6].

Both our data and the literature reports confirm that mouse-like rodents participate in the life cycles of various nematodes, including *Ancylostoma caninum*, *Uncinaria stenocephala*, *Ascaris columnaris*, *Toxocara canis*, and *Toxocara mystax* [6, 9].

MATERIALS AND METHODS

The material for this study consisted of helminthological collections from wild carnivores hunted in various zones of the North Caucasus. Helminth samples from domestic carnivores (dogs and cats) were obtained through necropsies performed on animal carcasses.

In total, four species of wild carnivores and two species of domestic carnivores were examined.

RESULTS

Examination of domestic dogs' stomachs, revealed frog fragments in 4.8% of rural dogs, 14.3% of urban stray dogs, and 33.3% of rural stray dogs.

Infection with the trematode *Alaria alata* was recorded in all five studied species of carnivorous mammal. The average prevalence rates in the region were: domestic dogs - 12.7%, jackals - 23.5%, badgers - 31.0%, foxes - 31.3%, raccoon dogs - 33.3%.

The trematodes *Pharyngostomum cordatum* was detected in foxes (EI 20.0%), raccoon dogs (EI 20.8%), jackal (EI 17.6%), badgers (EI 11.9%). Infection occurred in floodplain, plain and foothill zones.

The trematode *Euparyphium melis* was recorded in jackals (EI 29.4%), raccoon dog (EI 20.8%), fox (EI 20.0%), badger (EI 18.4%).

The trematode *Metorchis albidus* was found in raccoon dog (EI 25.0%), jackal (EI 17.6%), badger (EI 14.3%), fox (EI 13.3%), raccoon dog (EI 8.3%), as well as in domestic carnivores, including urban stray dogs (EI 9.5%), rural stray dogs (EI 14.3%), urban stray cats (EI 13.3%), rural stray cats (EI 26.7%). Infections of trematodes with invasive larval forms in the geographical zones of the North-West Caucasus are given in Table 1.

Table 1 – Infection of trematode hosts with invasive larval forms in the landscape-geographical zones of the North-West Caucasus

View helminths	View Master	Category Master	EI %
<i>Alaria alata</i>	lake frog (adults)	Insert (intercalary)	8,0
			4,0
	lake frog (tadpoles)	Insert (intercalary)	4,0
	Grass snake	Tank	10,0
	Ordinary vole	Tank	5,0
Bush vole	Tank	2,5	
<i>Pharyngostomum cordatum</i>	lake frog (adults)	additional	2,0
	lake frog (tadpoles)	additional	0
	Grass snake	Tank	2,5
<i>Euparyphium melis</i>	lake frog (adults)	additional	1,0
<i>Metorchis albidus</i>	bream	additional	2,0
	Crucian carp	additional	2,0

The life cycles of all trematodes identified in the examined carnivorous are linked to aquatic environment. Their circulation involves intermediate hosts (freshwater gastropods) and additional hosts such as insects, fish and amphibians.

In the helminth communities of the studied carnivores, the cestodes *Taenia crassiceps*, *Taenia pisiformis*, *Taenia hydatigena*, were identified. Their life cycle follows trophic-epizootic chains with two obligatory links - carnivorous mammals (definitive hosts) and mouse-like rodents (intermediate hosts).

Taenia crassiceps were detected in all six studied carnivores' species. It occurred in all zones of the region, with relatively high prevalence: raccoon dogs by the cestode *Taenia crassiceps* is 33.3%, badger - 32.1%, fox - 25.0%, jackal - 21.5%, domestic cat - 18.3%, domestic dog - 15.5%

Taenia pisiformis was found in foxes in four zones, with prevalence ranging from 6.7% to 20.0% depending on the zone and in jackals 5.9%. it was also recorded in rural yard dogs (EI 4.8%), urban stray dogs (EI 9.5%) and rural stray dogs (EI 9.5%).

Larvocysts of *Cysticercus pisiformis* were detected in the common vole (EI 2.5%), and lesser forest mouse (EI 2.5%).

Taenia hydatigena was recorded in the examined foxes (6.7), and jackals (11.8%), as well as in rural stray cats (EI 6.7%). Larvocysts were found in shrub voles (EI 2.5%) [7].

The source of echinococcal infection for jackals and dogs may include slaughterhouse waste, internal organs of wild ungulates left in the forest by hunters, or carrion from wild and domestic ungulates.

The life cycles of *Dipylidium caninum* and *Mesocestoides lineatus* involve arthropods – fleas and oribatid mites as intermediate hosts [3].

Mesocestoides lineatus was found in all studied carnivorous species across all zones. Average prevalence was 45.0% in foxes, 44.6% in badgers, 39.6% in raccoon dogs, 37.2% in jackals, 21.6% in domestic cats, and 19.0% in domestic dogs [3].

Larvocysts *Tetrathyridium rugosum* were recorded in mouse-like rodents (additional hosts); in the common vole (EI 5.0%), in the shrub vole (EI 2.5%) [3].

The high prevalence and wide distribution of *Mesocestoides lineatus* are associated with high population densities and the availability of intermediate and additional hosts in the diet.

Mature *Echinococcus granulosis* was found in jackals. According to both our observation and veterinary reports, larval echinococcosis occurs in some wild and domestic ungulates in the region, including wild boar, red deer, roe deer, cattle and small ruminants. Infection occurs when carnivores consume organs and tissues from ungulates affected by echinococcal cysts.

Infection of cestode hosts with invasive larval forms in the landscape-geographical zones of the North-West Caucasus is revealed in Table 2.

Table 2 - Infection of cestode hosts with invasive larval forms in the landscape-geographical zones of the North-West Caucasus

Type of helminth (larval form)	View Master	Category Master	EI %
<i>Taenia crassiceps</i> (<i>Cysticercus longicollis</i>)	Common vole	intermediate	5,0
	Shrub vole	intermediate	5,0
<i>Taenia pisiformis</i> (<i>Cysticercus pisiformis</i>)	Common vole	intermediate	2,5
	Small Forest Mouse	intermediate	2,5
<i>Taenia hydatigena</i> (<i>Cysticercus tenuicollis</i>)	Shrub vole	intermediate	2,5
<i>Mesocestoides lineatus</i> (<i>Tetrathyridium rugosum</i>)	Common vole	additional	5,0
	Shrub vole	additional	2,5

In the studied wild and domestic carnivores, 16 nematodes species were identified- eight biohelminths, and eight soil-transmitted helminths.

In wild carnivores: *Capilaria plica*, *Capilaria putorii*, and *Thominx aerophilus* were recorded.

Prevalence of *Capilaria plica* and *Thominx aerophilus* was: foxes – 20.0% and 18.3%; raccoon dog – 12.5% and 8.3%; jackal – 5.9% and 11.8%; badger – 14.2% and 21.4%, respectively. *Capilaria putorii* was 6.7% in foxes and 8.9% in badgers.

The detection of *Capillariidae* nematodes in all studied wild carnivores' species indicates that earthworms of the genus *Lumbricus* participate in trophic-epizootic chains in the region as intermediate or reservoir hosts.

Trichinella infection was found in four species of wild carnivores. Due to the technical limitations, species level identification by PCR was not possible.

Foxes, raccoon dogs, jackals, badgers, as well as wild boars and some mouse-like rodents contribute to the maintenance of natural foci of trichinosis in the region. Infection occurs through predation or scavenging of infected animals [3].

Crenosoma vulpis, was recorded in foxes 10.0%, raccoon dog 16.7%, badger – 14.3%, and jackals– 8.8%, in the foothill mountain zones.

These species of mollusks are common in biotopes where wild carnivorous mammals infested with the nematode *Crenosoma vulpis* were obtained.

The structure of the trophic-epizootic chains for *Crenosoma vulpis* includes foxes, raccoon dogs, jackals, and badgers (definitive hosts); terrestrial gastropods – *Agriolimax agreste*, *Arion intermedius*, *Succinea putris*, *Helix sp.* as intermediate hosts; and common voles and lesser forest mice as reservoir hosts.

Uncinaria stenocephala was recorded in six carnivore's species. prevalence ranged: jackals 23.3% to 35.3%; badgers 21.4% to 35.7%; in domestic dogs from 19.0% to 42.8%; in raccoon dogs from 16.7% to 33.3%; domestic cats 13.3% to 26.7%; foxes 6.7% to 26.7%. Larvae were found in 2.5% of the examined of common voles, 2.5% of lesser forest mice.

Toxocara mystax was found in foxes 6.7% and domestic cats 13.3% to 26.7%, depending on the conditions of keeping.

Toxocara canis was detected in jackals 17.6% to 25.5%; in foxes 6.7% to 13.3%, domestic dogs was 9.5% in apartment dogs, rural yard dogs – 19.0%, stray dogs – 33.3%, and stray cats (EI 6.7% in urban areas, and in rural areas EI 13.3%).

DISCUSSION

Analysis of the results obtained shows that the life forms of 30 out of 33 registered helminths species either circulate or capable of circulating along trophic chains, that include carnivorous mammals (definitive hosts), as well as various invertebrate and vertebrate species serving as intermediate, additional or reservoir hosts. Thus, trophic chains also function as epizootic chains, forming a unified system – trophic-epizootic chains. These species composition of these chains is one of the key mechanisms shaping the helminth communities of carnivorous mammals.

Stomach content analysis demonstrated that amphibians form part of the diet of the examined wild carnivores and certain categories of domestic dogs. This is facilitated by favorable natural and climatic conditions, the high population density of amphibians and their availability for most of the year.

Rodents-particularly mouse-like species-were found to be among the main food of the studied wild and some categories of domestic carnivores in the region. the background rodent species consumed include the common vole, shrub vole, small forest mouse [4].

Depending on the landscape zone, the occurrence of the common vole remains in carnivores' stomachs was as follows: fox 20.0% to 40.0%; raccoon dog 8.3% to 50.0%; jackals 23.5% to 64.7%; badgers 14.3% to 64.2%.

The occurrence of shrub vole in the stomachs of the examined were ranging: foxes 40.0% to 46.7%; raccoon dog 33.3% to 41.7%; jackals 35.3% to 41.2%; badgers 35.7% to 42.8%.

The occurrence of lesser forest mouse in the stomachs of the examined ranging: foxes 26.7% to 40.0%; raccoon dog 33.3% to 50.0%; jackals 35.3% to 41.2%; badgers 57.1% to 64.2%.

CONCLUSION

Analysis of existing data demonstrates that trophic-epizootic chains play a significant role in the circulation of helminths in the North-West Caucasus. For a more comprehensive understanding of this phenomenon, further research is required to clarify the species composition of helminths in the region, determine the specific role of various animal species in parasite circulation, and assess the impact of anthropogenic factors. The findings of this study can be applied in developing effective measures for the prevention of helminthiasis, aimed at protecting the health of both animals and humans.

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