

GENERAL

AN INSIDE-OUT PERSPECTIVE OF THE TRUE SHRIKES – A REVIEW OF THE HELMINTHOFAUNA

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ABSTRACT

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Following a critical evaluation of literature sources, we present an annotated checklist of helminths reported from the True Shrikes. The list comprises of 27 species of flatworms, 15 species of tapeworms, 33 species of roundworms and 4 species of acanthocephalans; and includes the newest synonyms. The helminthofauna has been studied mainly in Red-backed Shrike (*Lanius collurio*), Lesser Grey Shrike (*Lanius minor*), Great Grey Shrike (*Lanius excubitor*), Brown Shrike (*Lanius cristatus*) and Long-tailed Shrike (*Lanius schach*). Aspects of helminth biology and distribution of parasites is listed and annotated literature is included.

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Why worms?

During the last decade an increase in the knowledge on true shrikes biology is evident, as well as growing interest of ornithologists, catalysed by organised shrike-specialized symposia (Yosef and Lohrer 1995, 1998) and improved research techniques and co-operation. However, these very productive years of shrike research yielded only one ornithologically focused work dealing with shrikes' parasites, namely that of the Red-backed Shrike nests and its associated arthropod fauna (Tryjanowski *et al.* – in press).

Parasites, giving at least 50% of expected number of species (Thompson 1996), are one of the crucial parameters in the environment of all organisms. Widsor (1995) expressed an urgent need to include also the parasitic species in future eco-

logical and environmental studies and considered it practically impossible to examine any organism in detail without at least acquiring basic knowledge on its parasitofauna.

Moreover, a review of the present knowledge and data on shrike helminths is desirable because most of the literature, including the elementary part of the basic compendia, was published in Russian and is not available in the SCI sources. Further, most of the papers are published in journals, which are not accessible to the majority of the shrike researchers. It is obvious that the critically prepared and specifically focused compilatory work is extremely helpful for all members of the shrike research community, enabling easy and direct access to the required information and references. Hence, here we have prepared an up to date review of the shrike helminthofauna at the turn of the present millennium.

How we prepared the checklist

The most comprehensive published source referring to the helminths in shrikes is a series of compendia, published in the 1950s and 1960s by Russian researchers. These publications include almost all previous publications. Another important feature of these publications is that they contain, in almost every cases, descriptions, figures and lists of synonyms. The present checklist evaluated the data from: 26 volumes of „Trematodes of animals and man” (Skryabin 1947-1971, we refer only to the volumes that mention shrike helminths), „Trematodes of birds of USSR” (Bykhovskaya-Pavlovskaya 1962), 11 volumes of „Principles of cestodology” (Spasskii 1963; Matevosyan 1963, 1969) and „Cestodes of birds of USSR” (Spasskaya 1966). Further, data on the occurrence of the roundworms and acanthocephalans in shrikes were found in the 29 volumes of „Principles of nematology” (Mozgovoy 1953; Skryabin and Sobolev 1963, 1964; Skryabin *et al.* 1965, 1967; Sonin 1968), as well as the two volumes on „Acanthocephalans of domestic and wild animals” (Petrotschenko 1956, 1958). Further, keys and reviews by Yamaguti (1958, 1959, 1961, 1963, 1971a, 1971b), Schmidt (1986) and Khalil *et al.* (1994) were utilized to help us complete this review.

In addition, we researched in detail the Helminthological Abstracts from 1954 to 1999 year. When possible, we mention all accessible publications (easily traceable at cases of parasites recorded only at shrikes); in more complicated cases (when the parasite is less specific), we report only the main literature sources, where the interested researcher can find the appropriate bibliography.

We use scientific names of hosts, as stated in the cited works. Similarly, we refer to the synonyms of the parasites, when we link to the newer names.

English transcriptions of authors' names from Cyrillic are written according to the newer reviews (Yamaguti 1961-1971, Khalil *et al.* 1994).

The history of the research of shrike worms

Records on worms parasitizing shrikes were published for the first time in the beginning of the 19th century. Probably, the first record of helminths in a shrike was

a description of a nematode *Hamularia cylindrica*, which was found under the skin (Zeder 1803). The next reference we found is that of Rudolphi who described two roundworms – *Filiaria collurionis* (1809) and *F. nodulosa* (1819). All of these species, after several shifts in synonymy, are today assumed as one species – *Hamtospiculum cylindricum* (Sonin 1968). Similarly, *Diplotriaena tridens* was described by Molin (1858) as *Filiaria tridens* from Red-backed Shrike in Europe.

We found that the most productive period on the subject was the first half of the 20th century and the 1960s. This research was predominated by the Russian School of Helminthology and supervised by well-known and prolific researchers such as Skryabin, Spasskii and Spasskaya.

Records of helminths in shrike species are listed in Table 1 and the comprehensive literature of helminths recorded exclusively in shrikes – in Table 2.

Table 1

The checklist of the helminths by the shrike species.

TRE denotes *Trematoda*, CES – *Cestoda*, NEM – *Nematoda*, ACA – *Acanthocephala*; descr. – description of species, pict. – drawings of helminth

Species	Parasite	Helminth species	Main reference
<i>Lanius collurio</i>	TRE	<i>Brachylecithum asovi</i>	Bykhovskaya-Pavlovskaya 1962
		<i>Brachylecithum laniicola</i>	Bykhovskaya-Pavlovskaya 1962
		<i>Laterotrema vexans</i>	Bykhovskaya-Pavlovskaya 1962, pict.
		<i>Leucochloridium cyanocittae</i>	Yamaguti 1971a
		<i>Lyperosomum collurionis</i>	Panin 1984
		<i>Plagiorchis loossi</i>	Yamaguti 1971a
		<i>Plagiorchis maculosus</i>	Bykhovskaya-Pavlovskaya 1962 pict.
		<i>Prosthogonimus cuneatus</i>	Bykhovskaya-Pavlovskaya 1962
		<i>P. ovatus</i>	Bykhovskaya-Pavlovskaya 1962
		<i>Skrjabinus skrjabini</i>	Bykhovskaya-Pavlovskaya 1962
		<i>Strigea sphaerula</i>	Yamaguti 1971a
	CES	<i>Anomotaenia borealis</i>	Matevosyan 1963, descr., pict
		<i>Biuterina colluriones</i>	Petrova 1978, Matevosyan 1969, descr., pict.
		<i>Deltokeras granatensis</i>	Matevosyan 1969, descr., pict.
		<i>Dictyuterina cholodkowskii</i>	Georgiev <i>et al.</i> 1995, descr., pict.
		<i>Passerilepis crenata</i>	Petrova 1977
		<i>Passerilepis passeris</i>	Petrova 1978
		<i>Paruterina parallelepiped</i>	Matevosyan 1969, descr., pict.
		<i>Paruterina purpurata</i>	Zhelyazkova-Paspaleva 1962

Species	Parasite	Helminth species	Main reference
<i>Lanius collurio</i>	NEM	<i>Acuaria cordata</i>	Skryabin <i>et al.</i> 1965, descr., pict.
		<i>Diplotriaena tridens</i>	Sonin 1968, descr., pict.
		<i>Hadjelia truncata</i>	Skryabin and Sobolev 1963, descr., pict.
		<i>Oxyspirura petrowi</i>	Skryabin <i>et al.</i> 1967, descr., pict.
		<i>Parhamatospiculum cylindricum</i>	Skryabin <i>et al.</i> 1949, descr., pict.
		<i>Splendidofilaria pawlowskyi</i>	Petrova 1984
		<i>Splendidofilaria travassosi</i>	Petrova 1974
		<i>Syngamus trachea</i>	Zavadil 1966
		<i>Viguiera euryoptera</i>	Skryabin <i>et al.</i> 1965, descr., pict.
	ACA	<i>Polymorphus contortus</i>	Petrotschenko 1958, descr., pict.
<i>Lanius cristatus collurio</i>	TRE	<i>Brachylecithum asovi</i>	Panin 1984
		<i>Skrjabinus skrjabini</i>	Panin 1984
<i>Lanius cristatus</i>	TRE	<i>Brachylecithum laniicola</i>	Bykhovskaya-Pavlovskaya 1962
		<i>Brachylecithum amurensis</i>	Panin 1984
		<i>Lyperosomum amurensis</i>	Bykhovskaya-Pavlovskaya 1962
		<i>Lyperosomum longicauda</i>	Panin 1984
	CES	<i>Dictuterina cholodkowskii</i>	Georgiev 1995, descr.
		<i>Dilepis lanii</i>	Spasskii and Kononov 1972
		<i>Passerilepis passeris</i>	Spasskaya 1966, descr., pict.
	NEM	<i>Acuaria gendri</i>	Yamaguti 1961
		<i>Cramispirura longispiculata</i>	Larchenko 1973
		<i>Diplotriaena henryi</i>	Sonin 1968
		<i>Hamatospiculum cylindricum</i>	Sonin 1968, descr.
		<i>Hamatospiculum pertenuialatum</i>	Yamaguti 1961
		<i>Lemdana bengalensis</i>	Soota and Chaturvedi 1971
		<i>Microhadjelia multipapillata</i>	Jogis 1965
		<i>Oxyspirura petrowi</i>	Skryabin <i>et al.</i> 1967, descr., pict.
		<i>Splendidofilaria pawlowskyi</i>	Sonin 1966, descr., pict.
		<i>Viguiera euryoptera</i>	Skryabin <i>et al.</i> 1954
<i>Lanius schach</i>	TRE	<i>Brachylecithum attenuatum</i>	Panin 1984
		<i>Brachylecithum laniicola</i>	Panin 1984
		<i>Lyperosomum longicauda</i>	Panin 1984
		<i>Tanaisia cameroni</i>	Gupta and Saxena 1987, descr.
	CES	<i>Dictyuterina cholodkowskii</i>	Georgiev <i>et al.</i> 1995, descr.

Species	Parasite	Helminth species	Main reference
<i>Lanius schach</i>	NEM	<i>Hamatospiculum cylindricum</i>	Sonin 1968, descr., pict.
		<i>Hamulofilaria indica</i>	Soota and Chaturvedi 1971
<i>Lanius schach schach</i>	CES	<i>Deltokeras delachauxi</i>	Matevosyan 1969, descr., pict.
<i>Lanius schach formosae</i>	TRE	<i>Eumegacetes lanii</i>	Yamaguti 1971a, pict.
	NEM	<i>Capilaria (Tridentocapillaria) tridens</i>	Okulewicz 1993
<i>Lanius schach erythronotus</i>	TRE	<i>Lyperosomum longicauda</i>	Bykhovskaya-Pavlovskaya
<i>Lanius excubitor</i>	TRE	<i>Echinostoma coronale</i>	Yamaguti 1971a
		<i>Leucochloridium macrostomum</i>	Bykhovskaya-Pavlovskaya 1962
		<i>Prosthogonimus ovatus</i>	Bykhovskaya-Pavlovskaya 1962
	CES	<i>Anonchotaenia globata</i>	Matevosyan 1969, descr., pict.
		<i>Dictuterina cholodkowskii</i>	Georgiev <i>et al.</i> 1995, descr., pict.
		<i>Paruterina parallelepiped</i>	Matevosyan 1969, descr., pict.
		<i>Raillietina frontina</i>	Schmidt 1986
	NEM	<i>Acuaria excubitori</i>	Gupta and Kumar 1979
		<i>Diplotriaena artemisiana</i>	Yamaguti 1961
		<i>Diplotriaena henryi</i>	Sonin 1968, descr., pict.
		<i>Hamatospiculum cylindricum</i>	Sonin 1968, descr., pict.
		<i>Parhamatospiculum cylindrica</i>	Skryabin <i>et al.</i> 1949, pict.
		<i>Spirocerca lupi</i> larva	Skryabin <i>et al.</i> 1954
		<i>Viguiera euryoptera</i>	Skryabin <i>et al.</i> 1965, descr., pict.
	ACA	<i>Sphaeroirostris picae</i>	Dimitrova <i>et al.</i> 1997, descr., pict.
		<i>Sphaeroirostris teres</i>	Borgarenko and Khokhlova 1982
<i>Lanius excubitor lahtii</i>	TRE	<i>Eumegacetes hyderabadensis</i>	Jaiswal and Vadusev 1960, descr., pict.
<i>Lanius grimi</i>	NEM	<i>Parhamatospiculum cylindrica</i>	Skryabin <i>et al.</i> 1949, pict.

Species	Parasite	Helminth species	Main reference
<i>Lanius minor</i>	TRE	<i>Brachylaemus mesostomus</i>	Bykhovskaya-Pavlovskaya 1962, pict
		<i>Brachylecithum asovi</i>	Bykhovskaya-Pavlovskaya 1962
		<i>Laterotrema vexans</i>	Yamaguti 1971a
		<i>Lyperosomum alaudae</i>	Yamaguti 1971a
		<i>Plagiorchis multiglandularis</i>	Bykhovskaya-Pavlovskaya 1962
		<i>Prosthogonimus cuneatus</i>	Bykhovskaya-Pavlovskaya 1962
		<i>Prosthogonimus ovatus</i>	Bykhovskaya-Pavlovskaya 1962
	CES	<i>Anomotaenia borealis</i>	Matevosyan 1963, descr., pict.
		<i>Dictyuterina cholodkowskii</i>	Georgiev <i>et al.</i> 1995, descr., pict.
		<i>Orthoskrjabinia oschmarini</i>	Matevosyan 1969, descr., pict.
		<i>Paruterina parallelepiped</i>	Matevosyan 1969, descr., pict.
	NEM	<i>Acuaria cordata</i>	Skryabin <i>et al.</i> 1965, descr., pict.
		<i>Acuaria rotundata</i>	Skryabin <i>et al.</i> 1965, descr., pict.
		<i>Cheilospirura rotundata</i>	Skryabin <i>et al.</i> 1949
		<i>Diplotriaena artemisiana</i>	Yamaguti 1961
		<i>Diplotriaena henryi</i>	Sonin 1968, descr., pict.
		<i>Hadjelia truncata</i>	Skryabin and Sobolev 1963, descr., pict.
		<i>Hamatospiculum cylindricum</i>	Sonin 1968, descr., pict.
		<i>Hartertia zacharowi</i>	Skryabin 1954, descr., Skryabin and Sobolev 1963, descr., pict.
		<i>Oxyspirura petrowi</i>	Skryabin <i>et al.</i> 1967, descr., pict.
		<i>Oxyspirura popowi</i>	Yamaguti 1961
		<i>Parhamatospiculum cylindrica</i>	Skryabin <i>et al.</i> 1949 pict.
		<i>Physaloptera bilabiata</i>	Skryabin and Sobolev 1964, descr., pict.
		<i>Viguiera euryoptera</i>	Skryabin <i>et al.</i> 1965 descr., pict.
<i>Lanius rufus</i>	NEM	<i>Acuaria cordata</i>	Skryabin <i>et al.</i> 1965, descr., pict.
		<i>Hamatospiculum cylindricum</i>	Sonin 1968, descr., pict.
		<i>Viguiera euryoptera</i>	Skryabin <i>et al.</i> 1965, descr., pict.
<i>Lanius tigrinus</i>	TRE	<i>Brachylecithum minuta.</i>	Wang 1982, descr., pict.
	NEM	<i>Oxyspirura kaitingensis</i>	Skryabin <i>et al.</i> 1967 descr., pict.
<i>Lanius sphenocercus</i>	CES	<i>Biuterina passerina</i>	Matevosyan 1969, descr.,
		<i>Dictyuterina cholodkowskii</i>	Georgiev <i>et al.</i> 1995, descr., pict.
	NEM	<i>Hamatospiculum brasilianum</i>	Skryabin <i>et al.</i> 1949 pict.
		<i>Hamatospiculum cylindricum</i>	Sonin 1968, descr., pict.

Species	Parasite	Helminth species	Main reference
<i>Lanius senator</i>	CES	<i>Sphaeruterina purpurata</i>	Matevosyan 1969, descr., pict.
	NEM	<i>Hamatospiculum cylindricum</i>	Sonin 1968, descr., pict.
		<i>Microhadjelia multipapillata</i>	Quentin and Wertheim 1975
<i>Lanius superciliosus</i>	NEM	<i>Diplotriaena tridens</i>	Sonin 1968, descr., pict.
<i>Lanius vittatus</i>	NEM	<i>Diplotriaena tricuspis</i>	Yamaguti 1961
		<i>Vigueiera euryoptera</i>	Skryabin <i>et al.</i> 1965, descr., pict.
<i>Lanius bucephalus</i>	TRE	<i>Brachyacithulia asovi</i>	Panin 1984
		<i>Leucochloridium macrostomum</i>	Bykhovskaya-Pavlovskaya 1962
<i>Lanius auriculatus</i>	ACA	<i>Oligacanthorhynchus</i> sp.	Petrotschenko 1958
<i>Lanius elegans</i>	NEM	<i>Hamatospiculum cylindricum</i>	Sonin 1968, descr., pict.
<i>Lanius collaris</i>	NEM	<i>Hamatospiculum cylindricum</i>	Sonin 1968, descr., pict.
<i>Lanius ruficeps</i>	NEM	<i>Hamatospiculum cylindricum</i>	Sonin 1968, descr., pict.
<i>Lanius ludovicianus</i>	NEM	<i>Hamatospiculum cylindricum</i>	Sonin 1968, descr., pict.
<i>Lanius</i> sp. (<i>ludovicianus</i>)	NEM	<i>Porrocaecum semiteres</i>	Mozgovoy 1953, descr., pict.
<i>Lanius</i> sp.	TRE	<i>Philophtalvans grabii</i>	Yamaguti 1971
<i>Otomela phoenicuroides</i>	CES	<i>Deltokeras cholodkowskii</i>	Matevosyan 1969, descr., pict.
	NEM	<i>Oxyspirura petrowi</i>	Skryabin <i>et al.</i> 1967, descr., pict.
		<i>Oxyspirura popowi</i>	Yamaguti 1961
		<i>Parhamatospiculum cylindrica</i>	Skryabin <i>et al.</i> 1949, pict.
<i>Otomela romano-wi</i>	CES	<i>Dictyuterina cholodkowskii</i>	Georgiev <i>et al.</i> 1995

Helminth biology, life cycles and intermediate hosts

Reviewed literature sources were mostly focused taxonomically. Thus, information on ecology and biology is usually concise, mentions only hosts, distribution, locality and, when known, the life cycle and the intermediate hosts. No data on prevalence and intensity of infestation are available. All other useful, in our opinion, information, is included in Table 3.

Table 2
References of helminths recorded exclusively in *Laniidae*
TRE denotes *Trematoda*, CES – *Cestoda*, NEM – *Nematoda*, ACA – *Acanthocephala*

Parasite	Helminth	Reference
TRE	<i>Brachylecithum minuta</i>	Wang 1982
TRE	<i>Eumegacetes hyderabadensis</i>	Jaiswil and Vadusev 1960, Skryabin <i>et al.</i> 1970, Yamaguti 1971a
	<i>Lyperosomum amurensis</i>	Stsherbowitsch 1946, Yamaguti 1958, 1971 (<i>Brachylecithum</i>), Bykhovskaya-Pavlovskaya 1962, Panin 1984 (<i>Brachylecithum</i>)
	<i>Skrjabinus skrjabini</i>	Issaitchikoff 1920, Skryabin <i>et al.</i> 1952, Yamaguti 1958, 1971a, Bykhovskaya-Pavlovskaya 1962
	<i>Tanaisia cameroni</i>	Gupta and Saxena 1987
CES	<i>Biuterina colluriones</i>	Spasskii 1946, Matevosyan 1950
	<i>Deltokeras delachauxi</i>	Hs 1935, Olsen 1939, Mahon 1954, 1957, Yamaguti 1959,
	<i>Deltokeras granatensis</i>	Lopez-Neyra 1943
	<i>Dilepis lanii</i>	Spasskii and Konovalov 1972
	<i>Dictyuterina cholodkowski</i>	Skryabin 1914, Hs 1935, Wardle and McLeod 1952, Oshmarin 1963, Spasskaya 1964, Spasskaya and Spasskii 1971, Paspalev and Paspaleva 1972, Spasskii <i>et al.</i> 1976, Borgarenko 1981, Gal-kin 1981, Schmidt 1986, Korniyushin 1989, Khalil <i>et al.</i> 1994
	<i>Orthoskrjabinia oschmarini</i>	Spasskii 1946, Matevosyan 1948
	<i>Paruterina parallelepipedata</i>	Rudolphi 1810, Krabbe 1869, Fuhrmann 1908a, 1908b, 1908c, 1932, Joyeux and Baer 1935
NEM	<i>Acuaria excubitori</i>	Gupta and Kumar 1979
	<i>Acuaria rotundata</i>	Henry and Sisoff 1912, Railliet <i>et al.</i> 1912, Stiles and Hassall 1920, Cram 1927, Skryabin <i>et al.</i> 1949,
	<i>Cramispirura longispiculata</i>	Larchenko 1973
	<i>Hartertia zacharowi</i>	Skrjabin 1954 descr., Skryabin 1920, Skryabin <i>et al.</i> 1949, Cram 1927
	<i>Lemdana bengalensis</i>	Soota and Chaturvedi, 1971
	<i>Microhadjelia multipapillata</i>	Jogis 1965, Quentin and Wertheim 1975
	<i>Oxyspirura kaitingensis</i>	Hsü 1932, Cram 1937, Skryabin <i>et al.</i> 1949, Ali 1960, Baruš 1963, Rodriguez 1964, Rodriguez and Freitas 1964
	<i>Physaloptera bilabiata</i>	Dujardin 1845, Ortlepp 1922, Yorke and Maplestone 1926, Schulz 1927, Cram 1927, Creplin 1929, Skryabin <i>et al.</i> 1949,
ACA	<i>Oligacanthorhynchus sp.</i>	Petrotchenko 1959

Helminthofauna in shrikes comprise of both monoxenous and heteroxenous species. Recorded monoxenous worms with direct ontogeny without intermediate hosts are ascaridate roundworms, namely *Porrocaecum semiteres*. The rest reported helminth taxons are heteroxenous organisms, using different groups of organisms as intermediate hosts during part of ontogeny and for vection to definite hosts. Considering the food strategies of *Laniidae*, the most obvious vectors of larval stadia are the invertebrates, generally the main component of their diet. In several cases, also small vertebrates were reported as intermediate hosts (Table 3). Ontogeny of larvae of flatworm *Strigea* is restricted to amphibians and reptiles. Members of tapeworm genus *Paruterina* was found in mammals and small rodents as intermediate hosts. However, another species of the same order *Paruterinoidea*, counting also genera *Sphaeriuterina*, *Biuterina*, *Orthouterina*, *Anonchotaenia*, namely *Metroliasthes lucida*, helminth of galliform birds, was recorded in *Orthoptera* and *Coleoptera* (Jones 1936). Larvae and juveniles of acanthocephalan *Sphaerostris* was found in *Insectivora* and *Reptilia*. Most of the data on intermediate host were obtained by experimental infection of invertebrates.

Table 3
Main features of the biology of shrike helminths

Parasite species	Hosts	Distribution	Infected organs	Intermediate hosts
¹ <i>Brachylaemus mesostomus</i>	<i>Passeriformes</i> 10 spp., <i>Columbiformes</i> 2 spp.	Eu	intestine tenue	Snails as first and second intermediate hosts (Yamaguti 1971a)
<i>Brachylaima mesostoma</i> , syn ¹	<i>Passeriformes</i> 10 spp., <i>Columbiformes</i> 2 spp.	Eu	intestine tenue	
² <i>Brachylecithum amurensis</i>	<i>L. cristatus</i> , <i>L. cristatus collurio</i>	As	liver	Terrestrial snails at <i>Brachylecithum americanum</i> . Second intermediate host probably insects (Skryabin 1952)
<i>B. asovi</i>	<i>Passeriformes</i> 4 spp., <i>Coraciiformes</i> 1 sp.	Eu, As	liver, biliary ducts,	
<i>B. attenuatum</i>	<i>Passeriformes</i> 12 spp.	Eu, As	gall-bladder	
<i>B. laniicola</i>	<i>Passeriformes</i> 7 spp., <i>Cuculiformes</i> 2 spp., <i>Coraciiformes</i> 1 sp.	Eu, As	biliary ducts	
<i>B. minuta</i>	<i>L. tigrinus</i>	As	intestine	
<i>Echinostoma coronale</i>	<i>Passeriformes</i> 2 spp.	As	intestine	Many echinostomatids at water, snail as first and second intermediate hosts, also reptilia known as second (Skryabin <i>et al.</i> 1956)

Parasite species	Hosts	Distribution	Infected organs	Intermediate hosts
³ <i>Eumegacetes hyderabadensis</i>	<i>L. excubitor lahtora</i>	As	intestine	Only known intermediate host are larvae of <i>Eumegacetes medioximus</i> from water Arthropoda (Stafford 1931)
<i>E. lanii</i>	<i>L. schach formosae</i> , <i>Troglopteron canorum</i>	As	cloaca	
<i>Eumegacetes triangularis</i> , syn ³	<i>Passeriformes</i> 3 spp., <i>Coraciiformes</i> 4 spp., <i>Charadriiformes</i> 1 sp., <i>Caprimulgiformes</i> 1 sp.	Eu, As	cloaca	
<i>Laterotrema vexans</i>	<i>Passeriformes</i> 10 spp., <i>Piciformes</i> 1 sp.	Eu	intestine, bursa Fabricii	not checked
<i>Leucochloridium cyanocittae</i>	<i>Passeriformes</i> 6 spp., <i>Charadriiformes</i> 6 spp.	Eu, NA	cloaca	<i>Gastropoda</i> (Bykhovskaya-Pavlovskaya 1962)
<i>L. macrostomum</i>	<i>Passeriformes</i> 30 spp., <i>Cuculiformes</i> 2 spp., <i>Galliformes</i> 4 spp., <i>Piciformes</i> 3 spp.	Eu, As	intestine, cloaca	<i>Succinea</i> (Bykhovskaya-Pavlovskaya 1962)
<i>Lyperosomum alaudae</i>	<i>Passeriformes</i> 5 spp.,	Eu, As	gall-bladder	unknown
<i>L. amurensis</i> , syn ²	<i>L. cristatus</i> , <i>L. cristatus collurio</i>	As	liver	unknown
<i>L. collurionis</i>	<i>Passeriformes</i> 3 spp., <i>Caprimulgiformes</i> 1 sp.	Eu, As	biliary ducts	unknown
<i>L. longicauda</i>	<i>Passeriformes</i> 11 spp., <i>Falconiformes</i> 1 sp., <i>Galliformes</i> 1 sp.	Eu, As	biliary ducts, liver	unknown
<i>Philophthalmus gralli</i>	<i>Passeriformes</i> 4 spp., <i>Anseriformes</i> 1 sp., <i>Galliformes</i> 4 spp.	As	eye conjunctive sac??	<i>Terebia granifera</i> and <i>Melanoides newcombi</i> (Yamaguti 1971a)
<i>Plagiorchis loosi</i>	<i>Passeriformes</i> 1 sp., <i>Falconiformes</i> 1 sp.	Eu	intestine	unknown
<i>P. maculosus</i>	<i>Passeriformes</i> 29 spp., <i>Anseriformes</i> 4 spp., <i>Rodentia</i> , <i>Carnivora</i>	Eu, As	intestine	First intermediate hosts snails, second <i>Diptera</i> (Skryabin 1958)
<i>P. multiglandularis</i>	<i>Passeriformes</i> 10 spp., <i>Falconiformes</i> 1 sp., <i>Galliformes</i> 3 spp., <i>Charadriiformes</i> 3 spp., <i>Piciformes</i> 4 spp., <i>Rodentia</i>	Eu, As	?	<i>Heptagenia</i> (Ephemeroptera) (Stein 1957)
<i>Prosthogonimus cuneatus</i>	<i>Passeriformes</i> 14 spp., <i>Anseriformes</i> 15 spp., <i>Galliformes</i> 9 spp.	Eu, As, Afr, NA, SA	oviducts	First intermediaries snails, second dragonflies (Skryabin 1961)

Parasite species	Hosts	Distribution	Infected organs	Intermediate hosts
<i>Prosthogonimus ovatus</i>	<i>Passeriformes</i> 26 spp., <i>Podicipediformes</i> 1 sp., <i>Pelecaniformes</i> 1 sp., <i>Anseriformes</i> 6 spp., <i>Galliformes</i> 9 spp.	Eu, As, Afr, SA	oviducts	First: snails <i>Bithynia leachi</i> , <i>Gyraulus albus</i> , <i>G. gredleri</i> Second: dragonflies <i>Libellula quadrimaculata</i> , <i>Anax parthenope</i> , <i>Sympetrum</i> (Panin 1957)
<i>Tanaisia cameroni</i>	<i>L. schach</i>	As	urinary tract	unknown
<i>Skrjabinus skrjabini</i>	<i>L. collurio</i>	As	gall-bladder	unknown
<i>Strigea sphaerula</i>	<i>Passeriformes</i> 8 spp.	Eu, As	intestine	<i>Rana</i> , <i>Triturus</i> , <i>Natrix</i> , <i>Vipera</i> (Skryabin <i>et al.</i> 1959)
<i>Anomotaenia borealis</i>	<i>Passeriformes</i> 20 spp.	Eu, As	intestine	unknown
<i>Anonchotaenia globata</i>	<i>Passeriformes</i> 41 species	Eu, As, Af, NA	intestine	unknown
<i>Biuterina colluriones</i>	<i>L. collurio</i>	Eu	intestine	unknown
<i>B. passerina</i>	<i>Passeriformes</i> 8 species	Eu, As	intestine	unknown
⁴ <i>Deltokeras delauchauxi</i>	<i>L. schach schach</i>	As	intestine	unknown
<i>D. granatensis</i>	<i>L. collurio</i>	Eu	intestine	unknown
<i>Dictyuterina cholodkowsky</i> , syn. ⁴	<i>L. collurio</i> , <i>Otomela romanowi</i> , <i>L. cristatus</i> , <i>L. schach</i> , <i>L. minor</i> , <i>L. excubitor</i> , <i>L. sphenocercus</i>	Eu, As	intestine	unknown
<i>Dilepis lanii</i>	<i>L. cristatus</i>	As	intestine	Ground oligochaetes were found out as intermediate hosts of <i>Dilepis undula</i> , parasite of passerine birds (Matevosyan 1963)
<i>Orthoskrjabinia oschmarini</i>	<i>L. minor</i>	Eu	intestinum tenue	unknown
<i>Paruterina paralepipeda</i>	<i>Passeriformes</i> 5 spp.,	Eu	intestine	Freeman (1957) and Rausch (1949) identified <i>Rodentia</i> as intermediate hosts of <i>Paruterina candelabraria</i> and <i>P. rauschi</i> , parasites of owls
⁵ <i>P. purpurata</i>	<i>Passeriformes</i> 6 spp.	Eu	intestine	

Parasite species	Hosts	Distribution	Infected organs	Intermediate hosts
<i>Passerilepis cre-nata</i>	<i>Passeriformes</i> 37 species, <i>Piciformes</i> 4 sp., <i>Coraciiformes</i> 2 sp., <i>Galliformes</i> 3 sp., <i>Charadriiformes</i> 2 sp., <i>Falconiformes</i> 1 sp., also probably <i>Apodemus sylvaticus</i>	Eu, Am, Af, NA	intestine	<i>Geotrupes silvaticus</i> (Skryabin and Mathevosjan 1945) <i>Orthoptera</i> (Dutt and Mehra 1962)
<i>P. passeris</i>	<i>Passeriformes</i> 29 spp., <i>Piciformes</i> 1 sp., <i>Falconiformes</i> 1 sp., <i>Rodentia</i> (Spasskaya 1966)	Eu, As, Af	intestine	unknown
<i>Raillietina frontina</i>	<i>Passeriformes</i> 2 spp., <i>Piciformes</i> 9 spp.	Eu, As, SA	intestine	<i>Mollusca</i> , <i>Oligochaeta</i> , <i>Insecta</i> , <i>Diptera</i> , <i>Hymenoptera</i> , <i>Coleoptera</i> , <i>Carabidae</i> (Artyukh 1966)
<i>Sphaeruterina purpurata</i> , syn. ⁵	<i>Passeriformes</i> 6 species	Eu	duodenum, intestinum tenue	Freeman (1957) and Rausch (1949) identified <i>Rodentia</i> as intermediate hosts of <i>Paruterina candelabraria</i> and <i>P. rauschi</i> , parasites of owls
<i>Acuaria cordata</i>	<i>Passeriformes</i> 17 spp.	Eu, As, Afr SA	under cuticle of glandular stomach	Docenko (1952) recorded <i>Orthoptera</i> and <i>Coleoptera</i> as intermediate hosts for <i>Acuaria hamulosa</i>
<i>A. excubitori</i>	<i>L. excubitor</i>	As		
<i>A. gendri</i>	<i>L. collurio</i> , <i>Passeriformes</i> 1 sp.	Eu, As	stomach	
⁶ <i>A. rotundata</i>	<i>L. minor</i>	As	mandibula (not clear record)	
<i>Capillaria (Tridentocapillaria) tridens</i>	<i>Passeriformes</i>	Eu, NA	intestine	Skryabin <i>et al.</i> (1957) reported oligochaetes for related species
<i>Cheilospirura rotundata</i> , syn. ⁶	<i>L. minor</i>	As	mandible (not clear)	See <i>Acuaria</i>
<i>Cramispirura longispiculata</i>	<i>L. cristatus</i>	As		unknown
⁷ <i>C. popowi</i>	<i>Passeriformes</i> 2 spp.		frontal eye, orbita	unknown

Parasite species	Hosts	Distribution	Infected organs	Intermediate hosts
⁸ <i>Diplotriaena artemisiana</i>	<i>Passeriformes</i> 10 spp.	Eu, As	air bags	Anderson (1962) artificially infected <i>Orthoptera</i> by <i>Diplotriaena isabellina</i> , helminth of passerines
<i>D. henryi</i> , syn. ⁸	<i>Passeriformes</i> 18 spp., <i>Coraciiformes</i> 1 sp., <i>Strigiformes</i> 1 spp.	Eu, As	air bags, body cavity	
<i>D. tricuspis</i>	<i>Passeriformes</i> 28 spp. (Sonin 1968)	Eu, Af, As, NA, SA, Au	air bags, body cavity	
<i>D. tridens</i>	<i>Passeriformes</i> 19 spp., <i>Coraciiformes</i> 1 spp.	Eu, Af, As, SA, Au	air bags, body cavity	
<i>Hadjelia truncata</i>	<i>Passeriformes</i> 3 spp., <i>Caprimulgiformes</i> 1 sp., <i>Cuculiformes</i> 1 sp., <i>Coraciiformes</i> 3 spp.	Eu, As	muscular stomach	<i>Tenebrionidae</i> (Skryabin and Sobolev 1963)
⁹ <i>Hamatospiculum brasilianum</i>	<i>L. sphaenocercus</i> , <i>Picus</i> sp.		base of the bill	unknown
¹⁰ <i>H. cylindricum</i>	<i>Passeriformes</i> 22 spp., <i>Piciformes</i> 2 spp.	Eu, Af, As, NA, SA	under skin	unknown
<i>H. insigne</i> , syn. ⁹	<i>Piciformes</i> 4 spp.	SA	under skin at head and neck	unknown
<i>H. pertenuialatum</i> , syn. ¹⁰	<i>L. cristatus</i>	NA	under skin at neck	unknown
<i>Hamulofilaria indica</i>	<i>L. schach</i> , <i>Passeriformes</i> 1 sp.	As	in <i>L. schach</i> in eyes found females, from <i>Cissa chinensis</i> known males in mesentery	unknown
<i>Hartertia zacharowi</i>	<i>L. minor</i> , another sp. of genus <i>Hartertia</i> at <i>Carnivora</i>	Eu	intestine	Termites are intermediate hosts of <i>Hartertia gallinarum</i> (Theiler 1919)
<i>Lemdana bengalensis</i>	<i>L. cristatus</i>	As	subcutaneous tissue	unknown
<i>Microhadjelia multipapillata</i>	<i>L. cristatus</i> , <i>L. senator</i>	Eu, As	not checked	<i>Tenebrionidae</i> (Skryabin and Sobolev 1963)
<i>Oligacanthorhynchus</i> sp.	<i>L. auriculatus</i>		intestine	Genus <i>Oligacanthorhynchus</i> lives in larvae of ground beetles (Petrotschenko 1958)

Parasite species	Hosts	Distribution	Infected organs	Intermediate hosts
<i>Oxyspirura kaitingensis</i>	<i>L. tigrinus</i>	As	under eyelid	Insects (<i>Pycnoscelus surinamensis</i>) recorded as intermediate host at <i>Oxyspirura mansonii</i> (Schwabe 1951)
<i>O. petrowi</i>	<i>Passeriformes</i> 13 spp., <i>Falconiformes</i> spp., <i>Galliformes</i> 4 spp., <i>Coraciiformes</i> 1 sp.	As, Na	under eyelid	
<i>O. popowi</i> , syn. ⁷	<i>Passeriformes</i> 8 spp., <i>Galliformes</i> 4 spp.	As, NA, SA	frontal eye cavity, orbita	
<i>Parhamatospiculum cylindrica</i> , syn. ¹⁰	<i>L. collurio</i> , <i>L. excubitor</i> , <i>L. grimi</i> , <i>Otomela phoenicuroides</i>		under skin, heart	unknown
<i>Physaloptera bilabiata</i>	<i>L. minor</i> , another sp. of genus <i>Physaloptera</i> at lizards, <i>Carnivora</i>	Eu	intestine	unknown
<i>Polymorphus contortus</i>	<i>L. collurio</i> , <i>Anseriformes</i> 4 spp.	Eu	intestine	Water crustaceans and fishes recorded for <i>Polymorphus</i> (Petrotschenko 1958)
<i>Porrocaecum semiteres</i>	<i>Passeriformes</i> 4 spp., <i>Charadriiformes</i> 3 spp.	Eu, As	intestine	Geohelminth, direct onthogeny without intermediate host
¹¹ <i>Sphaerostris picae</i>	<i>Passeriformes</i> 7 spp., <i>Insectivora</i> 1 sp. ,	Eu, As, Afr	intestine	Juvenile form in <i>Lacerta muralis</i> (golvan 1956). Larvae in <i>Crocodyra leucodon</i> and <i>Coluber jugularis</i> (Dimitrova <i>et al.</i> 1997)
<i>S. teres</i> , syn. ¹¹	<i>Passeriformes</i> 5 spp., <i>Anseriformes</i> 1 sp.	Eu, Afr	intestine	
<i>Spirocera lupi</i> (larva)	<i>L. excubitor</i> , definitive hosts: <i>Carnivora</i>	Eu, As, Afr, NA, SA		<i>Scarabeidae</i> , <i>Tenebrionidae</i> , (Skryabin <i>et al.</i> 1967)
<i>Splendidofilaria pawlowskyi</i>	<i>Passeriformes</i> 6 spp.	Eu, As	heart cavity	unknown
<i>S. travassosi</i>	<i>L. collurio</i> , <i>Coraciiformes</i> 1 sp.	Eu, As	heart cavity	unknown
<i>Syngamus trachea</i>	<i>Passeriformes</i> 12 spp., <i>Galliformes</i> 11 spp., <i>Piciformes</i> 2 spp., <i>Falconiformes</i> 1 sp.	Eu, As, Afr, NA, SA, Aus	trachea	<i>Eisenia foetida</i> (Clapham 1934, 1935), <i>Scolopendra</i> , <i>Tipula</i> , <i>Sminturus</i> (Clapham 1939a), <i>Musca</i> , <i>Luscinia</i> (Clapham 1939b)
<i>Viguiera euryoptera</i>	<i>Passeriformes</i> 5 spp.	Eu, As, Afr	glandular stomach	unknown

What are future perspectives?

Three European shrikes species – Red-backed Shrike, Lesser Grey Shrike (*L. minor*) and Great Grey Shrike (*L. excubitor*), and two Asian species – Brown Shrike (*L. cristatus*) and Long-tailed Shrike (*L. schach*) have been studied most in-

tensively so far from the parasitological view. All other shrikes' species were referred to sporadically. Despite the diverse shrike assemblage in the African continent there is only one record for an African shrike species – Common Fiscal Shrike (*L. collaris*). Considering the current data, it is hard to reach conclusions on specificity of parasites, because a very large proportion of the literature is still based on sporadic records from most of the shrikes' species.

However, increase of our knowledge of ecto- and endo-parasites, including worms, is imperative and has emergent importance. Information on mutual relations among parasites and bird behaviour, condition, morphometry and other parameters should be the focus of future shrike researchers. In addition, sole faunistic records of parasites for specific bird species give us better understanding of the ecological relations and biological diversity of the different geographical regions. Nevertheless, times of serial shooting of bird are (we hope) over, so the question arises as to how one can obtain worm specimens.

Many museums continue to acquire material by collecting „naturally” dead birds and by using a network of collaborators. Most ringing centres, throughout their work, also find birds that die of exhaustion, and most of us find dead birds from time to time, as well. However, the majority of this material is rarely used and is lost for science. It is true that the birds found dead are not always fresh, what is optimal for helminthological studies, but we recommend to use all specimens that are available. The rapidity of preservation of the worms is crucial for subsequent successful taxonomic determination. One should remember that the death of the host initiates the processes wherein the helminths are very quickly destroyed. It is assumed that the quickest to be lost are the structures connected to the worms' surface, such as rostellar hooks and other sclerotised structures.

Protocol for collection and preservation of helminths

After finding a dead shrike it is necessary to immediately dissect it. From Table 2 it is possible to see which body parts are most exposed to infection. The obtained worms have to be saved in a solution of 75% ethyl alcohol or 4% formaldehyde. It is also possible save the complete gastrointestinal tract, but it is important to make a cut along it before putting it into conservant (ethyl alcohol). A very simple way to preserve the worm, without deforming it, is to put the living animal into warm (close to boiling) 4% formaldehyde.

The authors will be very grateful for your help in the collection of every possible worm. In case of need, questions or further clarifications please contact VD at the address given above.

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