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A synoptic overview of golden jackal parasites reveals high diversity of species

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Abstract

The golden jackal (*Canis aureus*) is a species under significant and fast geographic expansion. Various parasites are known from golden jackals across their geographic range, and certain groups can be spread during their expansion, increasing the risk of cross-infection with other carnivores or even humans. The current list of the golden jackal parasites includes 194 species and was compiled on the basis of an extensive literature search published from historical times until April 2017, and is shown herein in synoptic tables followed by critical comments of the various findings. This large variety of parasites is related to the extensive geographic range, territorial mobility and a very unselective diet. The vast majority of these parasites are shared with domestic dogs or cats. The zoonotic potential is the most important aspect of species reported in the golden jackal, some of them, such as *Echinococcus* spp., hookworms, *Toxocara* spp., or *Trichinella* spp., having a great public health impact. Our review brings overwhelming evidence on the importance of *Canis aureus* as a wild reservoir of human and animal parasites.

Keywords: Golden jackal, *Canis aureus*, Parasites

Background

The golden jackal, *Canis aureus* (Carnivora: Canidae) is a medium-sized canid species [1] also known as the common or Asiatic jackal [2], Eurasian golden jackal [3] or the reed wolf [4]. Traditionally, *Canis aureus* has been regarded as a polytypic species (Table 1), with 14 subspecies distributed across a vast geographical territory in Europe, Asia and Africa [5, 6]. Recently, phylogenetic studies have demonstrated that at least two of the African subspecies need a formal recognition as distinct species. Koepfli et al. [3] suggested that *C. aureus anthus* forms a distinct monophyletic lineage to *C. aureus* and should be recognized as a separate species. Similarly, the phylogenetic comparison of the Egyptian jackal (*C. aureus lupaster*) with other wolf-like canids showed a close relationship with the gray wolf species complex rather than with other subspecies of golden jackals [7]. Nevertheless, because most of the studies dealing with parasites of golden jackals do not mention the subspecies, for the purpose of this review we have considered the entire group, without excluding the two former subspecies.

The distribution of golden jackals is limited to the Old World [8]. Molecular evidence supports an African origin for all wolf-like canids including the golden jackal [8]. It is considered that the colonization of Europe by the golden jackal took place during the late Holocene and early Neolithic, through the Balkan Peninsula [9]. During the last century, the species has recorded at least two geographic expansion events. A notable expansion started in the 1950s, with a second one following during the 1980s. This is particularly evident in Europe. Stable reproductive populations have been recorded in about 20 European countries, while in other nine, vagrant specimens were observed [10]. The factors that facilitate the territorial expansion of golden jackals are unclear, but land use [11], climate change [12, 13], and the lack of intra-genus competition have been suggested [12–14].

Golden jackals have an opportunistic nutritional behaviour with an extremely varied diet [15]. They prey or scavenge on small mammals, birds and their eggs, amphibians, reptiles, even invertebrates, and they take carrion when available. Occasionally, jackals also feed on vegetables or fruits. Additionally, their relatively broad home range, varying from 1.1 to 20.0 km^2 [16, 17], increases the chance of contact with various parasites but also with other hosts.

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Table 1 Subspecies and geographical distribution of the golden jackal, *Canis aureus*

Subspecies	Common name	Range	Synonyms
Canis a. aureus Linnaeus, 1758	Common jackal	Middle Asia; Afghanistan; Iran; Iraq; Arabian Peninsula; Baluchistan; northwestern India	*C. balcanicus*; *C. caucasica*; *C. dalmatinus*; *C. hadramauticus*; *C. hungaricus*; *C. kola*; *C. lanka*; *C. maroccanus*; *C. typicus*; *C. vulgaris*
Canis a. algirensis Wagner, 1841	Algerian wolf	Algeria; Morocco; Tunisia	*C. barbarus*; *C. grayi*; *C. tripolitanus*;
Canis a. anthus Cuvier, 1820	Senegalese wolf; grey jackal; slender jackal	Senegal	*C. senegalensis*
Canis a. bea Heller, 1914	Serengeti wolf; Serengeti jackal	Kenya; northern Tanzania	
Canis a. cruesemanni Matschie, 1900	Siamese jackal; South East Asian jackal	Thailand; Myanmar; East India	
Canis a. ecsedensis Kretzoi, 1947	Pannonian jackal	Pannonian Basin	*C. minor*; *C. balcanicus*; *C. hungaricus*
Canis a. indicus Hodgson, 1833	Indian jackal; Himalayan jackal	Pakistan; India; Nepal; Bhutan; Burma	
Canis a. lupaster Hemprich & Ehrenberg, 1833	African wolf; Egyptian wolf; Egyptian jackal	Egypt; Algeria; Mali; Ethiopian Highlands; Senegal	*C. lupaster*; *C. lupus lupaster*; *C. sacer*
Canis a. moreoticus Geoffroy Saint-Hilaire, 1835	European jackal; Caucasian jackal; Reed wolf	Southeastern Europe; Asia Minor; Caucasus	*C. graecus*
Canis a. naria Wroughton, 1916	Sri Lankan jackal	Southern India; Sri Lanka	*C. lanka*
Canis a. palaestina Khalaf, 2008		Palestine; Israel	
Canis a. riparius Hemprich & Ehrenberg, 1832	Somali wolf	Somalia; Ethiopia; Eritrea	*C. hagenbecki*; *C. mengesi*; *C. somalicus*
Canis a. soudanicus Thomas, 1903	Variegated wolf; Nubian wolf	Sudan; Somalia	*C. doederleini*; *C. nubianus*; *C. thooides*; *C. variegatus*
Canis a. syriacus Hemprich & Ehrenberg, 1833	Syrian jackal	Israel; Lebanon; Jordan	

All these biological and behavioural features create premises for their infection with a broad range of pathogens, including parasites. Golden jackals are known to host a large spectrum of viral, bacterial and parasitic pathogens [18–20]. The literature survey indicates that the studies published on golden jackal parasites are usually limited to a country or, more commonly to a region, and there is no synoptic overview on this potentially important topic. The aim of the present work was to review all the published data on the parasite fauna of golden jackals in a comprehensive and updated list. The goal is consistent with the demographic and territorial expansion tendency of this species and increased contact with domestic animals and humans.

Literature survey methodology

The list of the golden jackal parasites was compiled on the basis of an extensive literature search published from historical times until April 2017. Abstracts in conference proceedings and theses were also considered. The search queries were performed in the several databases: Pub Med [21], Science Direct [22], Web of Science [23], Helminthological Abstracts [24], Biological Abstracts [25], BioOne [26], Host-Parasite Database of the Natural History Museum (London) [27] and the web search engine Google Scholar [28]. Additionally, two Russian databases, namely the Russian Scientific Electronic Library [29] and the Scientific Library Earth Papers [30] were also used as sources of information.

The parasites are listed in tables, organized according to their taxonomic rank, and species within families are alphabetically listed. Taxonomy follows Adl et al. [31] for protists; Gibson et al. [32], Jones et al. [33], and Bray et al. [34] for trematodes; Kahlil et al. [35] and Nakao et al. [36] for cestodes; De Ley & Blaxter [37] for nematodes; Amin [38] for acanthocephalans; and the database "Catalogue of Life: 2016 Annual Checklist" by Roskov et al. [39] for arthropods. The names of the species were updated according to the current taxonomy, but synonyms used by different authors are also indicated. Each species is indexed together with the country of the report, the method of examination and reference. The records within a species are listed according to the alphabetical order of the country name. If two or more reports for the same country are registered, the ranking was made chronologically, according to the year publication. The prevalence, frequency and intensity of infection are also given, when available. The prevalence was provided or calculated only when the sample size was at least 10. In the case of experimental infection studies, the country has not been specified. Articles that report infections in captive jackals and doubtful records are mentioned and/or discussed accordingly.

Protists

Eight families with 21 species were reported in golden jackals in 23 countries. Additionally, several protists were identified only to the generic level or were doubtfully considered as parasites of golden jackals (Table 2) [40–85].

Leishmania

The sand fly-borne kinetoplastids of the genus *Leishmania* were reported in golden jackals from 13 countries (Table 2), showing a large geographical distribution in Asia, Africa and Europe. At least three species of *Leishmania* have been identified by molecular methods in naturally infected golden jackals (*L. donovani*, *L. infantum* and *L. tropica*). Additionally, golden jackals were experimentally shown to be receptive for the infection with *L. major* [85], but this species has never been found in naturally infected specimens. The multiple records of *Leishmania* spp. in golden jackals suggest a reservoir role for this carnivore, for both visceral and cutaneous leishmaniasis in humans, as well as for canine leishmaniasis. Infected jackals have been found also at the margin of the endemic area for canine leishmaniasis (i.e. Romania), where this finding has been temporally correlated with the re-emergence of the disease in domestic dogs [86]. Although there is no clear link between the emergence of leishmaniasis in dogs and the spreading of jackals, this is an issue to be further investigated, mainly as the jackal continues to spread into areas at the margin of canine leishmaniasis endemicity. This was previously demonstrated when infected dogs were newly introduced to non-endemic areas in Europe [87].

Tick-borne protists (Babesiidae, Theileriidae and Hepatozoidae)

Experimental evidence showed that golden jackals are receptive to the infection with *Babesia canis* [40] and *B. gibsoni* [43]. However, there are surprisingly few records of natural infections with piroplasms in golden jackals (Table 2) despite the large variety and number of studies on ticks (see below). In Europe, the only *Babesia* species molecularly confirmed in golden jackals is *B. canis*, recently reported in Romania [42]. The other report of *B. canis* in jackals is from Nigeria [41], but the species identification was based on blood smears and in captive animals. We consider this record doubtful, as the typical vector for *B. canis*, *Dermacentor reticulatus*, does not occur in Nigeria. Probably the species in this case belongs to the same complex group of large canine *Babesia* known in this area, *B. rossi* or *B. vogeli* [88]. *Babesia gibsoni*, which is widely distributed in Asia, has been reported only once in golden jackals, in India. Although *Babesia rossi* is common in domestic and wild carnivores in Africa [89], so far there are no records of this species in golden jackals. The scarcity of reports of *Babesia* spp. in this wild canid is probably related to the low number of studies and the lack of

Table 2 Protist parasites of the golden jackal, *Canis aureus*

Family	Species	Origin	Prevalence (%)	Frequency	Method	Reference
Phylum Apicomplexa						
Class Aconoidasida						
Babesiidae	*Babesia canis* (syn. *Piroplasma canis*)	na (as *P. canis*)	na	na	EI	[40]
		Nigeria[a]	na	1/6	BS	[41]
		Romania	9.2	5/54	MI	[42]
	Babesia gibsoni	na	na	na	EI	[43]
		India	na	na	BS	[44]
Theileriidae	"Theileria annae"	Romania	3.7	2/54	MI	[42]
Class Conoidasida						
Eimeriidae	*Eimeria* sp.[b]	Bulgaria	5.8	3/56	CO	[45]
	Eimeria aurei[b]	India	na	na	CO	[46]
	Isospora sp.	Bulgaria	5.8	3/56	CO	[45]
		India[a]	case report		CO	[47]
		Iran	7.1	4/56	CO	[48]
		Serbia	6.6	4/60	CO	[49]
	Isospora dutoiti	former USSR	na	na	CO	[50]
		Turkmenistan	na	na	CO	[51]
	Isospora kzilordiniensis	Kazakhstan	na	2/9	CO	[52]
	Isospora neorivolta	Russia	9.3	14/150	CO	[53]
	Isospora ohioensis	Russia	5.3	8/150	CO	[53]
	Isospora theileri	Azerbaijan	na	na	CO	[54]
		Turkmenistan	na	na	CO	[51]
Hepatozoidae	*Hepatozoon* sp.	Algeria	na	2/5	MI	[55]
		Mauritania	25.0	4/16	MI	[55]
	Hepatozoon canis	Austria	case report		MI	[56]
			case report		MI	[42]
		Croatia	30.4	14/46	MI	[57]
		Czech Republic	na	1/1	MI	[42]
		Hungary	57.9	33/57	MI	[57]
			60.0	na	MI	[58]
		Israel	2.1	1/46	BS	[19]
		Montenegro	na	2/2	MI	[57]
		Romania	72.2	39/54	MI	[42]
		Serbia	67.5	140/206	MI	[57]
Sarcocystidae	*Cystoisospora canis*	Hungary	15.0	3/20	CO	[59]
	Neospora caninum	Israel	1.7	2/114	IFAT	[60]
	Sarcocystis sp.	Bulgaria	1.9	1/56	CO	[45]
	Sarcocystis cruzi (syn. *S. bovicanis*)	Russia (as *S. bovicanis*)	20.0	30/150	CO	[53]
	Sarcocystis tenella (syn. *S. ovicanis*)	Russia (as *S. ovicanis*)	34.0	51/150	CO	[53]
	Sarcocystis tropicalis (syn. *Isospora tropicalis*)	India (as *I. tropicalis*)	case report		CO	[61]
		India	case report		CO	[62]
	Toxoplasma-type oocysts	Hungary	5.0	1/20	CO	[59]
	Toxoplasma gondii	Iran	33.3	na	LAST	[63]

Table 2 Protist parasites of the golden jackal, *Canis aureus (Continued)*

Family	Species	Origin	Prevalence (%)	Frequency	Method	Reference
			77.5	31/40	ELISA	[64]
"Flagellates"[c]						
Hexamitidae	*Giardia* sp.	Iraq[a]	100	4/4	CO	[65]
	Giardia duodenalis (syn. *G. canis*)	Croatia	12.5	1/8	IF, MI	[66]
		Iran	7.1	4/56	CO	[48]
		Russia (as *G. canis*)	1.3	2/150	CO	[53]
Trichomonadidae	*Pentatrichomonas hominis* (syn. *P. canis auri*)	India (as *P. canis auri*)	case report		CO	[67]
Trypanosomatidae	*Leishmania* sp.	Iran	2.5	4/161	SIO	[68]
			12.5	6/48	IFA	
		Serbia	6.9	15/126	MI	[69]
		Spain[a]	case report		H	[70]
	Leishmania donovani	Bangladesh	5 cases	na	MI	[71]
		Georgia	na	1/4	SIO	[72]
		Kazakhstan	na	na	na	[73]
		Iran	5.0	1/20	SIO	[74]
		na	na	na	EI	[75]
	Leishmania infantum	Algeria	case report		IFI, MI	[76]
		Georgia	2.5	1/39	IA	[77]
		Iran	10.0	1/10	DAT, ELISA, IFAT	[78]
			11.6	7/60	DAT	[78]
			1.6	1/60	SIO	
		Iraq	59.6	90/151	SIO, Cult, IFAT, ELISA	[79]
		Israel	7.6	4/53	ELISA	[80]
			6.5	3/46	ELISA	[19]
			1.3	1/77	MI	[81]
		Kazakhstan	na	na	na	[82]
		Romania	2.7	1/36	MI	[42]
		Tajikistan	na	na	na	[83]
		Turkmenistan	2 specimens	na	na	[84]
	Leishmania major	na	na	na	EI	[85]
	Leishmania tropica	Israel	6.5	5/77	na	[81]

Abbreviations: BS blood smear May-Grünwald-Giemsa stained, *CO* coprological examination, *Cult* cultures from the viscera, blood and other tissues, *DAT* direct agglutination test, *EI* experimental infection, *ELISA* enzyme-linked immunosorbent assay, *H* histopathology, *IA* immunochromatographic assay, *IF* immunofluorescence assay, *IFAT* indirect fluorescent antibody test, *IFI* indirect fluorescent immunoassay, *LAST* latex agglutination slide test, *MI-* molecular identification, *SIO* smears from internal organs stained with standard Giemsa, *na* not applicable/unknown

[a]Animals kept in captivity

[b]Doubtful record

[c]Various opinions on the higher taxonomy of these groups are available, hence we keep the generic term "flagellates"

more sensitive/specific methods, as the typical vector ticks [*D. reticulatus* for *B. canis*, *Rhipicephalus sanguineus* (*sensu lato*) for *B. vogeli* and *Haemaphysalis leachi* for *B. rossi*] have been reported on various occasions on these hosts.

An interesting recent report indicates the presence of "Theileria annae" in golden jackals from Romania [42]. Currently, the taxonomic status of this species is debated and it is most commonly referred to as "*Babesia microti*-like". This group has been reported predominantly in red foxes, but also in several other wild carnivores in North America, Asia and Europe [89]. However, so far, the role of golden jackals in its ecology remains unknown.

The first report of *Hepatozoon canis* in golden jackals is relatively recent [19] and has been followed in the last years by several records, mainly in Europe and North Africa (Table 2). Surprisingly, despite the wide distribution of *H. canis* in canids [90], this tick-borne apicomplexan has never been found in jackals from sub-Saharan Africa or Asia. Nevertheless, the large number of records and the presence of its main vector, *R. sanguineus* (*s.l.*) suggest a reservoir role of golden jackals for *H. canis* at least in Europe, Middle East and North Africa.

Intestinal homoxenous coccidia (Eimeriidae)

Various species of intestinal coccidia of the family Eimeriidae have been found in, or even described from jackals (Table 2). We consider all records of *Eimeria* as pseudoparasites, as previously suggested [91]. Three species of the genus *Isospora* have been described from golden jackals but currently their taxonomic status is listed as doubtful [91]: *Isospora dutoiti* is a misidentification with *Hammondia* spp. or *Neospora caninum*, while *I. theileri* and *I. kzilordiniensis* are probably invalid names (as they might be synonyms with other *Isospora* species from canids). Two other species, *I. neorivolta* and *I. ohioensis*, which are known to infect several species of canids [91], were reported in golden jackals. Interestingly, all these *Isospora* reports in golden jackals are from countries in the former USSR, and this probably reflects a greater interest of researchers from this area for this group of parasites rather than the real geographical distribution. Few reports of unnamed *Isospora* sp. in golden jackals are known from Asia and the Balkans (Table 2).

Heteroxenous coccidia (Sarcocystidae)

Various records list golden jackals host to Sarcocystidae. Sporocysts of *Sarcocystis* (*S. cruzi*, *S. tenella* and *S. tropicalis*) and oocysts of *Cystoisospora canis* have been reported in the faeces of golden jackals in Europe, Russia and India, suggesting their role as definitive hosts (Table 2). Although antibodies against *Neospora caninum* have been detected in *C. aureus* in Israel [60], the role of golden jackals as definitive hosts for this parasite has never been demonstrated and needs to be investigated. So far, various canid species were demonstrated to shed oocysts of *N. caninum*: dogs (*Canis familiaris*) [92], coyotes (*C. latrans*) [93], dingoes (*C. lupus dingo*) [94], and gray wolves (*C. lupus*) [95]. Interestingly, Takacs et al. [59] reported "*Toxoplasma*-like" oocysts in the faeces of jackals but, unfortunately, no morphometric data were provided and there was no attempt to characterize them molecularly. We can only assume that these were small oocysts which, in our opinion, could represent any of the small canine coccidia *N. caninum*, *Besnoitia* spp. or *Hammondia* spp., none of them confirmed so far in golden jackals.

Helminths

The highest number of studies on the parasitic fauna of golden jackals are related to helminths. Our literature survey found at least 178 publications in 38 countries reporting helminths in golden jackals, with 119 species belonging to three phyla: Platyhelminthes, Nematoda and Acanthocephala [96–119].

Trematodes

The diversity of trematodes in golden jackals is relatively high (27 species from nine families) (Table 3). Most of the studies originate in the countries of the former USSR, Asia and North Africa, with few scattered records in Europe. There are no trematodes recorded in golden jackals in sub-Saharan Africa. This situation reflects probably the impact of the Russian helminthological school and the lack of studies in other regions rather than the influence of ecological factors or feeding behaviour of jackals. Among the various records of trematodes in golden jackals, two groups could be identified: the canid- or Carnivora-specific trematodes and other trematodes (specific rather to other mammal groups or birds).

The most commonly reported and widely distributed trematode in golden jackals is *Alaria alata*, found in Caucasus, Russia and Central Asia to Middle East and the Balkans (Table 3). We consider the report of *Alaria americana* in Iran doubtful, as the species is known otherwise only in canids from North America [120].

Jackals have been commonly reported as hosts for fish-borne trematodes typically associated with carnivores. Such examples include species of the genera *Ascocotyle*, *Cryptocotyle*, *Heterophyes*, *Metagonimus* (Heterophyidae), *Echinochasmus*, *Euparyphium* (Echinostomatidae), *Pseudamphistomum*, *Opisthorchis* (Opisthorchiidae) mainly in Asia and northern Africa. The fish-borne *Nanophyetus salmincola* was identified in India, but its geographical distribution is limited to the Pacific Northwest of the USA [121]; with high probability, the report might represent a misidentification with *N. schikhobalowi*, an Asian troglotrematid [122]. The diversity of trematode species in golden jackals is completed by other groups which use various invertebrates (i.e. arthropods) (*Plagiorchis massino*, *Microphallus narii*) or non-fish small vertebrates (i.e. amphibians) (*Pharyngostomum cordatum*) as second intermediate hosts, reflecting the wide diet composition of this carnivore.

Interestingly, *Dicrocoelium dendriticum*, a hepatic fluke typically associated with herbivores, has been found on several occasions in the bile ducts of golden jackals [97, 98] in Russia. As the infection source for this parasite is represented by ant second intermediate hosts, the infection of jackals is probably accidental.

Several of these trematodes reported in golden jackals have zoonotic potential. Human alariosis caused by *Alaria* mesocercariae manifests in various clinical signs which range from cutaneous symptoms to respiratory disorders, a diffuse unilateral neuroretinitis even to an anaphylactic shock with fatal outcome [123]. However,

Table 3 A comprehensive list of trematode parasites of the golden jackal, *Canis aureus*

Family	Species	Origin	Prevalence (%)	Frequency	Intensity	Method	Reference
Phylum Platyhelminthes							
Class Trematoda							
Dicrocoeliidae	*Dicrocoelium dendriticum* (syn. *D. lanceatum*)	Russia	5.0	1/20	5.00 ± 4.45	necropsy	[96][a]
			26.1	na	na	necropsy	[97]
			na	na	na	necropsy	[98]
Diplostomidae	*Alaria alata*	Azerbaijan	22.4	20/89	2–30	necropsy	[99]
			na	na	na	necropsy	[100]
		Bulgaria	9.0	na	na	necropsy	[101]
			1.9	1/56	na	necropsy	[45]
		Croatia	na	na	na	na	[102]
		Chechnya	100	16/16	22–268	necropsy	[103]
		Greece	20.0	1/5	na	necropsy	[104]
		Hungary	10.0	2/20	na	necropsy	[59]
		Iran	na	na	na	necropsy	[105]
		Russia	10.0	2/20	3.00 ± 2.68	necropsy	[96]
			34.8	na	na	necropsy	[97]
			na	na	na	necropsy	[98]
			13.3	8/60	na	necropsy	[106]
			na	na	na	necropsy	[107]
			26.0	39/150	2–23	necropsy	[53]
		Serbia	0.9	4/447	19.00 ± 3.63	necropsy	[108]
			30.0	18/60	na	necropsy	[49]
		Uzbekistan	na	na	na	na	[109]
	Alaria americana (syn. *A. canis*)[b]	Iran	5.0	1/20	34	necropsy	[110]
			10.0	1/10	na	necropsy	[111]
	Pharyngostomum cordatum (syn. *P. fausti*)	Azerbaijan	na	na	na	necropsy	[100]
		Azerbaijan (as *P. fausti*)	8.3	1/12	2	necropsy	[99]
			na	na	na	necropsy	[100]
		Russia	6.6	4/60	na	necropsy	[106]
Echinostomatidae	*Echinochasmus corvus*	India	na	na	na	na	[112]
	Echinochasmus schwartzi	Iran	na	na	na	necropsy	[105]
	Euparyphium sp.	Iran	na	na	na	necropsy	[105]
	Euparyphium melis	Russia	16.6	10/60	na	necropsy	[106]

Table 3 A comprehensive list of trematode parasites of the golden jackal, *Canis aureus (Continued)*

Family	Species	Origin	Prevalence (%)	Frequency	Intensity	Method	Reference
Heterophyidae	*Ascocotyle italica* (syn. *Parascocotyle italica*)	Russia	8.3	5/60	na	necropsy	[106]
	Ascocotyle sinoecum (syn. *Phagicola sinoecum*)	Iran	na	na	na	necropsy	[105]
	Cryptocotyle lingua[b]	Russia	2.7	4/150	3–18	necropsy	[53]
	Heterophyes sp.	Egypt	na	3/5	na	necropsy	[113]
	Heterophyes aequalis	Egypt	na	na	na	necropsy	[113]
	Heterophyes dispar	Egypt	na	na	na	necropsy	[113]
	Heterophyes heterophyes	Egypt	2 specimens	na	na	necropsy	[113]
	Metagonimus ciureanus (syn. *Dexiogonimus ciureanus*)	Georgia	na	na	na	necropsy	[114]
	Metagonimus yokogawai	Iran	14.2	4/28	na	necropsy	[115]
		Italy	case report		6	necropsy	[116]
		Serbia	1.6	1/60	na	necropsy	[49]
Microphallidae	*Microphallus narii* (syn. *Spelotrema narii*)	India	na	na	na	na	[117]
			na	na	na	na	[112]
Opisthorchiidae	*Metorchis xanthosomus*[b]	Russia	21.8	na	na	necropsy	[97]
	Opisthorchis sp.	Bangladesh	na	1/5	na	necropsy	[118]
	Pseudamphistomum truncatum	Serbia	0.2	1/447	2	necropsy	[108]
			3.3	2/60	na	necropsy	[49]
Plagiorchiidae	*Plagiorchis* sp.	Iran	na	na	na	necropsy	[105]
	Plagiorchis elegans[b]	Russia	3.3	2/60	na	necropsy	[106]
	Plagiorchis massino	Uzbekistan	na	na	na	na	[109]
Schistosomatidae	*Schistosoma spindale*[b]	India	case report		na	CO	[119]
Troglotrematidae	*Nanophyetus salmincola*[b]	India	case report		na	CO	[47]

Abbreviations: *na* not applicable/unknown, *CO* coprological examination
[a]Unknown site of infection
[b]Doubtful record

all human cases originate in North America (and are probably caused by *A. americanum*). The zoonotic potential of *A. alata* in Eurasia remains unknown. Adults *Heterophyes dispar* and *H. heterophyes* may produce diarrhoea, abdominal pain and discomfort in humans [124], while *Metagonimus yokogawai* is considered to be the most common intestinal trematode infection in the Far East, highly important due to the ability of their eggs to invade the blood stream thus causing serious complications [125]. Hence, golden jackals might have a significant role in the environmental contamination with such parasites and represent an indirect source for human contamination. Hepatic and biliary trematodes *D. dendriticum*, *Pseudamphistomum truncatum* and *Opisthorchis felineus* are also able to infect humans, causing abdominal pain, weight loss, chronic relapsing watery diarrhea and hepatobiliary system damages [126, 127].

However, for many other trematode species, golden jackals, as other carnivores, are probably accidental hosts, or most likely, present a pseudoparasitism following ingestion of birds or rodents, as they typically infect other vertebrate groups. For instance, *Cryptocotyle lingua* is mainly a parasite of different gull species in Europe, North America and Japan [128]; *Plagiorchis elegans* is a parasite of raptors, waterfowl, passerines and several mammals as the wood mouse, rat, gerbil and hamster [129]; *Metorchis xanthosomus* is specific for birds in Anseriformes, Gaviiformes, Podicipediformes and Gruiformes [130]; and *Schistosoma spindale* has been described in ruminants and rodents in southeastern Asia [131].

Cestodes

Cestode infections in golden jackals have been recorded across all their distribution range, with a relatively high species diversity (Table 4) [132–152].

Among all the cestode species, *Aelurotaenia cameroni* is the only one known exclusively in the golden jackal. However, as the species was only recently described [132], its absence from other carnivores cannot be excluded until further studies. It is not surprising that all other identified tapeworm species are characteristic to carnivores, confirming the low specific affinity of the adult parasites [153]. As such species infect usually a wider range of canid or non-canid carnivores, this demonstrates a close environmental connection between multiple carnivore species and the use of the same trophic source.

The most commonly reported tapeworms in golden jackals are *Dipylidium caninum*, *Mesocestoides* spp., *Echinococcus granulosus* and *Taenia* spp., found across a wide geographical range (Europe, Asia and Africa). The cosmopolitan character of all these cestodes is attributed to the abundance and diversity of intermediate hosts and the lack of specificity for the definitive hosts [153]. Hence, the jackal, together with other carnivores, represents an important source of environmental contamination. Several of these species are known to be zoonotic, some with a minor impact (i.e. *D. caninum*), but other being a major public health threat (i.e. *E. granulosus*).

Dipylidium caninum occurs across the globe, human cases being reported in European and Asian countries after accidental ingestion of the infected cat and dog fleas with cysticercoid larvae [154]. Although the jackal is not a domestic species, hence not a direct source of infection to humans, it may transmit fleas to hunting, shepherd or stray dogs and participates together with other wild canids in the natural cycle of this cestode.

Several species of the genus *Mesocestoides* have been found in golden jackals in various regions. *Mesocestoides lineatus* is spread in Africa, Asia and Europe; it was rarely found in humans, with about 20 cases being described to date across the world [155]. Although the main definitive hosts are carnivores, humans can also act as accidental final hosts following ingestion of raw or undercooked meat of birds, amphibians, reptiles or small mammals [156]. The zoonotic potential of the other species of *Mesocestoides* in unknown.

The most well-represented family of tapeworms found in jackals is the Taeniidae. The high diversity of the Taeniidae in golden jackals reflects furthermore the wide range of mammalian prey species on which they feed. Golden jackals are hosts to both zoonotic species of *Echinococcus*. *Echinococcus granulosus* and *E. multilocularis* have been reported in this wild canid on multiple occasions and across a wide geographical range. The unilocular or cystic hydatidosis produced by larvae of *E. granulosus* (*sensu lato*) is a ubiquitous infection with high prevalence in various parts of the world [157]. Human multilocular or alveolar echinococcosis caused by *E. multilocularis* has recorded a significant increase in the incidence in northern Eurasia since 1990 [157, 158]. In several regions, high prevalences with both species were reported in golden jackals (Table 4). Reports of *Echinococcus* spp. in areas where this canid has recently spread or increased in abundance (i.e. central and eastern Europe) raise the important question on its role as a potentially new natural reservoir and infection source for humans and livestock.

Among species of genus *Taenia* and *Multiceps*, the most commonly reported species in golden jackals are *T. hydatigena*, *T. pisiformis*, *T. ovis* and *M. multiceps*. Other species (*T. polyacantha*, *T. taeniaeformis*, *T. krabbei*, *T. krepkogorski*, *T. crassiceps* and *M. serialis*) have been also found but only occasionally, mainly within the limited geographical range of Caucasus and central Asia (Table 4). The zoonotic potential of these species is limited, and only few human cases have been reported so far: *T. taeniaeformis* [159–162], *T. crassiceps* [163], *T. hydatigena* [164], *T. ovis* [165, 166], *M. multiceps* and *M. serialis* [167]. *Taenia krabbei*, *T. krepkogorski* and *T. polyacantha* are considered non-zoonotic

Table 4 A comprehensive list of cestode parasites of the golden jackal, *Canis aureus*

Family	Species	Origin	Prevalence (%)	Frequency	Intensity	Method	Reference
Phylum Platyhelminthes							
Class Cestoda							
Dilepididae	*Aelurotaenia cameroni*	India	na	na	na	na	[132]
Diphyllobothriidae	*Diphyllobothrium* sp.	India[a]	na	na	na	CO	[133]
	Diphyllobothrium latum	Bangladesh	20.0	6/30	na	necropsy	[134]
		India	na	na	na	na	[112]
	Spirometra sp.	India[a]	na	na	na	CO	[135]
		Iran	7.1	1/14	4	necropsy	[136]
	Spirometra erinaceieuropaei (syn. *S. erinacei*)	Azerbaijan	25.0	19/76	1–19	necropsy	[99]
			na	na	na	necropsy	[100]
		Azerbaijan (as *S. erinacei*)	3.5	4/114	2–21	necropsy	[137]
		Iran (as *S. erinacei*)	na	na	na	necropsy	[105]
	Spirometra houghtoni	Iran	na	na	na	necropsy	[105]
	Spirometra mansoni (syn. *Bothriocephalus mansoni*)	Italy	case report	na	necropsy	[138]	
Dipylidiidae	*Diplopylidium noelleri*	Iran	5.0	na	na	necropsy	[139]
		Tunisia	16.0	5/31	1–66	necropsy	[140]
	Dipylidium caninum (syns *Taenia elliptica*, *T. cucumerina*)	Azerbaijan	na	na	na	necropsy	[100]
		Bangladesh	26.6	8/30	na	necropsy	[134]
		Bulgaria	3.8	na	na	necropsy	[141]
			63.6	7/11	na	necropsy	[142]
		Chechnya	100	16/16	3–12	necropsy	[103]
		Hungary	5.0	1/20	4	necropsy	[59]
		India	na	na	na	na	[143]
			na	na	na	na	[112]
		India[a]	5.0	3/60	na	CO	[144]
		Iran	7.1	1/14	4	necropsy	[136]
			10.0	4/40	na	necropsy	[145]
			20.0	2/10	na	necropsy	[111]
			10.1	8/79	na	necropsy	[139]
			33.9	19/56	na	necropsy	[48]
		Israel	46.6	7/15	na	necropsy	[146]
			5.8	1/17	na	CO	[19]
		Italy	na	na	na	necropsy	[138]
		Kazakhstan	16.6	3/18	2–8	necropsy	[147]
		Russia	47.8	na	na	necropsy	[97]
			5.0	1/20	1.00 ± 0.25	necropsy	[96]
			10.0	6/60	na	necropsy	[106]
			na	na	na	necropsy	[107]
			8.0	12/150	1–13	necropsy	[53]
		Serbia	1.6	7/447	4.8 ± 0.6	necropsy	[108]
		Tajikistan	na	na	na	necropsy	[148]
		Tunisia	na	1/5	na	necropsy	[149]
			16.0	5/31	4–67	necropsy	[140]
		Turkey	na	na	na	necropsy	[150]
		Uzbekistan	na	na	na	necropsy	[151]

Table 4 A comprehensive list of cestode parasites of the golden jackal, *Canis aureus* *(Continued)*

Family	Species	Origin	Prevalence (%)	Frequency	Intensity	Method	Reference
			na	na	na	necropsy	[152]
	Joyeuxiella echinorhynchoides	Azerbaijan	30.2	23/76	1–30	necropsy	[99]
			na	na	na	necropsy	[100]
		Iran	27.8	5/18	na	necropsy	[334]
			7.5	3/40	na	necropsy	[145]
		Turkey	na	na	na	necropsy	[150]
	Joyeuxiella pasqualei	Iran	30.0	3/10	na	necropsy	[111]
Mesocestoididae	*Mesocestoides* sp. group A (oval to elongate cirrus-pouch and short cirrus)	Israel	8.1	7/86	na	necropsy, ME	[335]
	Mesocestoides sp. group B (broad-oval cirrus-pouch and long, more or less strongly coiled cirrus)	Israel	15.2	13/85	na	necropsy, ME	
	Mesocestoides sp.	Greece	na	3/5	na	necropsy	[104]
		Tunisia	na	2/5	na	necropsy	[149]
		Iran	na	1/1	na	necropsy	[336]
		Bulgaria	34.6	na	na	necropsy	[45]
	Mesocestoides corti	Azerbaijan	na	na	na	necropsy	[100]
		Tunisia	12.9	4/31	1–10	necropsy	[140]
	Mesocestoides lineatus (syn. *M. carnivoricolus*)	Azerbaijan	2.6	3/114	9–47	necropsy	[137]
			37.7	37/98	2–63	necropsy	[99]
			na	na	na	necropsy	[100]
		Bulgaria	27.0	na	na	necropsy	[101]
			72.7	8/11	na	necropsy	[142]
		Hungary	20.0	4/20	na	necropsy	[59]
		India	na	na	na	na	[112]
		India (as *M. carnivoricolus*)	na	na	na	necropsy	[337]
		Ingushetia	na	1/2	na	necropsy	[338]
		Iran	15.0	3/20	na	necropsy	[110]
			70.0	7/10	na	necropsy	[111]
			36.7	29/79	na	necropsy	[139]
			30.3	17/56	na	necropsy	[48]
			61.1	11/18	na	necropsy	[334]
		Russia	26.1	na	na	necropsy	[97]
			5.0	1/20	1.00 ± 0.53	necropsy	[96]
			40.0	24/60	na	necropsy	[106]
			na	na	na	necropsy	[339]
			na	na	na	necropsy	[98]
			40.0	60/150	1–128	necropsy	[53]
		Serbia	5.8	26/447	69.7 ± 9.3	necropsy	[108]
		Tajikistan	na	na	na	necropsy	[148]
		Tunisia	74.0	23/31	na	necropsy	[140]
		Turkey	na	na	na	necropsy	[340]
		Ukraine	na	1/1	5	necropsy	[341]
		Uzbekistan	na	na	na	necropsy	[151]
			na	na	na	necropsy	[152]

Table 4 A comprehensive list of cestode parasites of the golden jackal, *Canis aureus (Continued)*

Family	Species	Origin	Prevalence (%)	Frequency	Intensity	Method	Reference
	Mesocestoides litteratus	Serbia	4.7	21/447	64.3 ± 15.1	necropsy	[108]
		Tunisia	23.0	7/31	6–130	necropsy	[140]
	Mesocestoides petrowi	Azerbaijan	na	na	na	necropsy	[100]
		Russia	na	na	na	necropsy	[342]
	Mesocestoides zacharovae	Azerbaijan	case report	na	necropsy	[343]	
Taeniidae	*Echinococcus granulosus*	Azerbaijan	16.3	16/98	2–400	necropsy	[99]
			na	na	na	necropsy	[100]
		Bangladesh	20.0	6/30	na	necropsy	[134]
		Bulgaria	23.0	na	na	necropsy	[101]
			na	3/3	na	PCR	[344]
			9.0	1/11	na	necropsy	[142]
			1.9	na	na	necropsy	[45]
		Ceylon	case report	7	necropsy	[345]	
		Chad	1.2	1/82	na	necropsy	[346]
		Chechnya	na	na	na	necropsy	[347]
			12.0	2/16	8–16	necropsy	[103]
		Chechnya, Ingushetia	na	2/7	74–217	necropsy	[348]
		Hungary	10.0	2/20	na	necropsy	[59]
		India	na	na	na	CO	[349]
		Iran	5.0	1/20	48	necropsy	[110]
			na	na	na	necropsy	[105]
			16.0	na	na	necropsy	[350]
			2.3	2/86	na	necropsy	[351]
			40.0	16/40	na	necropsy	[145]
			40.0	16/40	na	necropsy	[352]
			8.9	7/79	na	necropsy	[139]
			20.0	2/10	na	necropsy	[353]
			66.7	6/9	na	CO	[353]
			na	1/1	na	PCR	[354]
			3.5	2/56	na	necropsy	[48]
			na	na	na	PCR	[355]
		Italy	case report	1	necropsy	[356]	
		Kazakhstan	5.9	na	3–29	necropsy	[147]
		Kenya	27.2	6/22	< 200	necropsy	[357]
		Palestine	na	na	na	na	[358]
		Pakistan	9.0	9/100	na	necropsy	[359]
		Russia	12.5	2/16	na	necropsy	[360]
			82.6	na	na	necropsy	[97]
			69.8	na	na	necropsy	[361]
			5.0	1/20	4.00 ± 2.36	necropsy	[96]
			66.0	10/15	na	CO	[362]
			3.3	2/60	na	necropsy	[106]
			na	na	na	necropsy	[107]
		Tajikistan	30.7	4/13	> 1,000	necropsy	[363]
		Tunisia	na	1/5	72	necropsy	[149]
			na	2/2	na	PCR	[364]

Table 4 A comprehensive list of cestode parasites of the golden jackal, *Canis aureus (Continued)*

Family	Species	Origin	Prevalence (%)	Frequency	Intensity	Method	Reference
			9.7	3/31	11–98	necropsy	[140]
	E. multilocularis (syn. *Alveococcus multilocularis*)	Azerbaijan	3.7	2/54	3–5	necropsy	[99]
		Hungary	9.0	1/11	412	necropsy	[365]
		Ingushetia	na	1/2	na	necropsy	[338]
		Iran	16.0	4/25	na	necropsy	[366]
			50.0	5/10	na	necropsy	[353]
			na	9/9	na	CO	[353]
		Russia (as *Alveococcus multilocularis*)	18.7	3/16	na	necropsy	[360]
		Serbia	14.3	4/28	4–57	necropsy	[367]
		Tajikistan	7.7	1/13	na	necropsy	[363]
		Uzbekistan	na	1/4	na	necropsy	[368]
	Multiceps multiceps (syn. *Taenia multiceps*	Azerbaijan	8.9	8/89	2–11	necropsy	[99]
			na	na	na	necropsy	[100]
		Bangladesh (as *T. multiceps*)	10.0	3/30	na	necropsy	[134]
		Bulgaria	9.0	na	na	necropsy	[101]
			9.0	1/11		necropsy	[142]
		Chechnya	na	na	na	necropsy	[347]
		Iran	7.5	3/40		necropsy	[145]
		India	na	na	na	necropsy	[369]
		Kazakhstan	11.1	2/18	4–16	necropsy	[147]
		Russia	39.1	na	na	necropsy	[97]
		Serbia	1.6	7/447	3.00 ± 0.53	necropsy	[108]
		Tajikistan	na	2/6	na	necropsy	[370]
		Ukraine	na	1/1	na	necropsy	[341]
	Taenia serialis	Kazakhstan	5.5	1/18	10	necropsy	[147]
		Kenya	na	2/2	42	PCR	[371]
		Serbia	1.1	5/447	2.7 ± 0.2	necropsy	[108]
	Taenia sp.	Bulgaria	23.0	na	na	necropsy	[141]
		Greece	na	1/5	na	necropsy	[104]
		India	na	na	na	na	[143]
		India[a]	11.6	7/60	na	CO	[144]
		Iran[a]	na	2/2	11 ± 2 epg	CO	[372]
		Kenya	60.0	3/5	na	necropsy	[373]
		Tunisia	19	6/31	1–29	necropsy	[140]
	Taenia crassiceps	Azerbaijan	na	na	na	necropsy	[100]
		Hungary	40.0	8/20	na	necropsy	[59]
		Russia	25.0	15/60	na	necropsy	[106]
	Taenia hydatigena (syn. *T. marginata*)	Azerbaijan	15.3	14/91	1–18	necropsy	[99]
			na	na	na	necropsy	[100]
		Bulgaria	55.0	na	na	necropsy	[101]
			27.2	3/11	na	necropsy	[142]
		Chechnya	na	na	na	necropsy	[347]
			50.0	8/16	3–6	necropsy	[103]
		Hungary	15.0	3/20	na	necropsy	[59]
		India	na	na	na	necropsy	[369]

Table 4 A comprehensive list of cestode parasites of the golden jackal, *Canis aureus (Continued)*

Family	Species	Origin	Prevalence (%)	Frequency	Intensity	Method	Reference
		Iran	7.1	1/14	2	necropsy	[136]
			40.0	16/40	na	necropsy	[145]
			10.0	1/10	na	necropsy	[111]
			7.6	6/79	na	necropsy	[139]
			7.1	4/56	na	necropsy	[48]
			5.6	1/18	na	necropsy	[334]
		Italy (as *T. marginata*)	na	na	na	na	[138]
		Kazakhstan	22.0	4/18	2–8	necropsy	[147]
		Russia	6.2	1/16	na	necropsy	[360]
			36.8	14/38	1–3	necropsy	[374]
			34.8	na	na	necropsy	[97]
			5.0	1/20	3.00 ± 2.18	necropsy	[96]
			1.6	1/60	na	necropsy	[106]
			na	na	na	necropsy	[98]
			na	na	na	necropsy	[107]
		Serbia	0.9	4/447	3.75 ± 1.80	necropsy	[108]
		Tajikistan	na	na	na	necropsy	[148]
		Uzbekistan	na	na	na	necropsy	[152]
	Taenia krabbei	Azerbaijan	0.8	1/114	3	necropsy	[137]
			na	na	na	necropsy	[100]
	Taenia krepkogorski (syn. *Hydatigera krepkogorski*)	Azerbaijan	na	na	na	necropsy	[100]
	Taenia ovis	Azerbaijan	5.1	2/39	1–2	necropsy	[99]
			na	na	na	necropsy	[100]
		Bulgaria	case report		na	necropsy	[375]
		Iran	5.6	1/18		necropsy	[334]
		Russia	39.1	na	na	necropsy	[97]
		Tajikistan	na	na	na	necropsy	[148]
		USSR (former)	na	na	na	necropsy	[376]
	Taenia pisiformis (syn. *T. serrata*)	Azerbaijan	15.7	14/89	1–6	necropsy	[99]
			na	na	na	necropsy	[100]
		Bulgaria	18.0	na	na	necropsy	[101]
			54.5	6/11		necropsy	[142]
		Chechnya	100	16/16	3–18	necropsy	[103]
		Greece	na	1/5	na	necropsy	[104]
		Hungary	20.0	4/20	na	necropsy	[59]
		India (as *T. serrata*)	na	na	na	na	[377]
			na	na	na	necropsy	[369]
		Iran	na	na	na	necropsy	[105]
		Kazakhstan	5.5	1/18	3	necropsy	[147]
		Russia	17.4	na	na	necropsy	[97]
			3.3	2/60		necropsy	[106]
			na	na	na	necropsy	[107]
			16.7	25/150	1–3	necropsy	[53]
		Serbia	1.8	8/447	10.1 ± 2.1	necropsy	[108]
		Tajikistan	na	na	na	necropsy	[148]

Table 4 A comprehensive list of cestode parasites of the golden jackal, *Canis aureus (Continued)*

Family	Species	Origin	Prevalence (%)	Frequency	Intensity	Method	Reference
		Tunisia	3.2	1/31	1	necropsy	[140]
	Taenia polyacantha (syn. *Tetratirotaenia polyacantha*)	Azerbaijan (as *Tetratirotaenia polyacantha*)	na	na	na	necropsy	[100]
		Turkey	na	na	na	necropsy	[340]
	Taenia taeniaeformis (syn. *Hydatigera taeneiformis*)	Azerbaijan (as *H. taeneiformis*)	na	na	na	necropsy	[100]
		Tajikistan	na	na	na	necropsy	[148]
		Uzbekistan	na	na	na	necropsy	[152]

Abbreviations: *CO* coprological examination; *ME* microscopic/morphological examination; *PCR* polymerase chain reaction; *epg* eggs per gram faeces; *na* not applicable/not available
[a]Animals kept in captivity

tapeworms [158, 168]. Considering the common findings of a wide range of Taeniidae in golden jackals, the high spatial mobility of these hosts and the high resistance of taeniid eggs in the environment [169], the role of jackals as natural reservoirs and infection source for humans and domestic animals should be considered potentially important.

Species of *Spirometra* (Diphyllobothriidae) identified in golden jackals from Europe and Asia (*S. mansoni*, *S. houghtoni* and *S. erinaceieuropaei*) cause sparganosis in intermediate hosts. Humans may acquire the infection after drinking water contaminated with infected copepods or by ingestion of uncooked meat, and occasionally may lead to blindness, paralysis, and death [170, 171]. *Diphyllobothrium latum* is also reported in humans due to consumption of raw or undercooked fish, in cold water areas from the Holarctic Eurasia, overlaid to those regions where the species is recorded in jackal [172]. However, due to the limited number of reports, the role of golden jackals in the natural cycle of these diphyllobothriid cestodes remains unknown.

Tapeworm species with a limited geographic distribution are also reported in jackals. *Diplopylidium noelleri* and *Joyeuxiella* spp. are spread only in warm regions from Asia and Europe, probably due to the high abundance and diversity of reptiles, known as common intermediate hosts [173].

Acanthocephalans

Although the diet of golden jackals generally includes invertebrates, wild birds, reptiles and small mammals which are intermediate or paratenic hosts in the life-cycle of thorny-headed worms [174–176], compared to other groups of helminths, there are only few and geographically limited reports of acanthocephalans in golden jackals. The diversity of acanthocephalans identified in this canid includes at least six species (Table 5) [176–181].

Macracanthorhynchus catulinus has been reported on several occasions in jackals in former USSR and Bulgaria, while the congeneric species *M. hirudinaceus* was found only in Tunisia and Iran. It is unclear if the reports of *M. hirudinaceus* (a parasite typically found in pigs; [155]) represent cases of pseudoparasitism or misidentifications with *M. catulinus* (a parasite typically found in canids), as most papers referring to these findings do not provide details on the identification methods. There are few scattered records of other carnivore-specific acanthocephalan species in golden jackals (*Oncicola canis*, *Pachysentis canicola*, *Centrorhynchus itatsinis* and *Echinorhynchus pachyacanthus*) in central Asia and Italy (Table 5).

Nematodes

Nematodes constitute the most well-represented group of parasites in golden jackals, with 41 species identified (28 species in Chromadorea and 13 species in Enoplea) (Table 6) [182–256].

Ascarids

Ascarids, primarily considered heteroxenous nematodes, have lost their intermediate hosts and have adapted to direct transmission or through paratenic hosts [257]. Four species are reported in golden jackals, with *Toxocara canis* and *Toxascaris leonina* being ubiquitous. *Baylisascaris devosi* is a species typically found in mustelids inhabiting the northern hemisphere [258]. Its presence in golden jackals has been reported only once, in Azerbaijan [99]. This broad distribution and common presence of ascarids in this wild canid can be explained by the intervention of numerous paratenic hosts, possible preys for jackals, in the life-cycle of these nematode species (mostly rodents and invertebrates such as earthworms and insects) [259].

Strongyloides

The cosmopolitan and zoonotic *Strongyloides stercoralis* infects about 200 million people, more commonly in tropical and subtropical climates [260]. Despite the large number of records in domestic dogs from various countries, the species has been reported only once in golden jackals (Table 6). The lack of reports in other parts of the jackal's range could be explained by a low receptivity of this host or by failures of finding the parasites during necropsy due to their small size. A moderate prevalence of 5.6% is also recorded in dogs from northeastern Iran [261]

Table 5 Acanthocephalan parasites of the golden jackal, *Canis aureus*

Family	Species (synonym)	Origin	Prevalence (%)	Frequency	Intensity	Method	Reference
Class Archiacanthocephala							
Oligacanthorhynchidae	*Macracanthorhynchus* sp.	Iran	10.0	1/10		necropsy	[111]
	Macracanthorhynchus catulinus	Azerbaijan	0.8	1/114	24	necropsy	[137]
			17.0	14/82	1–6	necropsy	[99]
			na	na	na	necropsy	[100]
		Bulgaria	3.8	na	na	necropsy	[45]
		Kazakhstan	5.5	1/18	3	necropsy	[147]
		Russia	6.6	4/60	n/a	necropsy	[106]
			6.7	10/150	1–6	necropsy	[53]
		Tajikistan	na	na	na	necropsy	[148]
		Turkmenistan	na	na	na	necropsy	[177]
	Macracanthorhynchus hirudinaceus[a]	Tunisia	na	1/5	na	necropsy	[149]
			3.2	1/31	6	necropsy	[140]
		Iran	case report		na	necropsy	[178]
			62.5	25/40	na	necropsy	[179]
			30.0	3/10	na	necropsy	[111]
			5.0	4/79	na	necropsy	[139]
			3.5	2/56	na	necropsy	[48]
	Oncicola sp.	Iran	na	na	na	necropsy	[178]
	Oncicola canis	Iran	case report		na	necropsy	[178]
			12.6	10/79	na	necropsy	[139]
	Pachysentis canicola	Iran	case report		na	necropsy	[180]
Class Palaeacanthocephala							
Centrorhynchidae	*Centrorhynchus itatsinis*	Azerbaijan	1.4	1/71	na	necropsy	[181]
			na	na	na	necropsy	[100]
Incertae sedis	*Echinorhynchus pachyacanthus*	Italy	na	na	na	necropsy	[138]

Abbreviation: *na* not applicable/not available/no answer
[a]Doubtful record

which is higher than estimated prevalence in humans across the country that ranges between 0.1 and 0.3% [262]. Although carnivores can be a source of infection for humans via larvae that develop in the environment, the principal reservoirs of *S. stercoralis* are humans. The role of domestic and wild carnivores in the epidemiology of strongyloidiasis remains to be clarified [155].

Hookworms and other digestive tract strongylids

Several hookworm (Ancylostomatidae) species have been reported in golden jackals, with *Ancylostoma caninum* and *Uncinaria stenocephala* commonly reported across the entire geographical range of these hosts. Additionally, *A. guentini* was described from golden jackals in India, being so far the only known host for this parasite [191]. The remaining two records (*Placoconus lotoris*, known otherwise only from new world procyonids, and *Ancylostoma braziliense*, typically found in the Americas) we list as doubtful and as these are probably misidentifications of other hookworm species. The opportunistic behaviour of the golden jackals leads them to venture close to human habitats to feed [2]. The proximity with domestic dogs allows interspecific transmission of ancylostomid species, due to the high rate of soil and grass contamination [263]. In this regard, increased prevalence recorded in Russia, ranging between 5.0 and 52.2%, is correlated with similar values in dogs, between 2.06 and 62.3% [264]. *Ancylostoma caninum* and *U. stenocephala* possess a zoonotic potential causing dermal larva migrans in humans [260]. Although a direct relationship between the numerous reports in golden jackals and the presence of disease in humans cannot be established, this carnivore species probably contributes to the presence of Ancylostomatidae larvae in rural and peri-urban areas.

Molineus patens is a hookworm commonly reported in a wide range of carnivores in the Palaearctic and Nearctic [265], including two records from jackals in Russia. However, its zoonotic role has not been documented.

Table 6 Nematode parasites of the golden jackal, *Canis aureus*

Family	Species (synonym)	Origin	Prevalence (%)	Frequency	Intensity	Method	Reference
Phylum Nematoda							
Class Chromadorea							
Ancylostomatidae	*Ancylostoma* sp.	India[a]	na	3/3	na	CO	[182]
			na	5/5	na	CO	[183]
			31.6	19/60	na	CO	[144]
			case report		700 epg	CO	[184]
			case report		na	CO	[47]
		Iran[a]	na	2/2	10.5 epg	CO	[372]
	Ancylostoma/Uncinaria sp.	Bulgaria	84.6	na	na	necropsy	[141]
		India[a]	na	na	na	CO	[135]
		India	na	3/6	na	CO	[185]
		Iran	na	na	na	necropsy	[105]
		Serbia	33.3	20/60	na	necropsy	[49]
		Tunisia	na	5/5	na	necropsy	[149]
	Ancylostoma braziliense[b]	India	na	na	na	na	[117]
	Ancylostoma caninum	Azerbaijan	17.3	17/98	1–20	necropsy	[99]
			na	na	na	necropsy	[100]
		Bangladesh	46.6	14/30	na	necropsy	[134]
		Bulgaria	54.5	6/11	na	necropsy	[142]
			11.5	na	na	necropsy	[45]
		Chechnya	50.0	8/16	3–18	necropsy	[103]
		Egypt	na	na	na	necropsy	[186]
		Greece	na	1/5	na	necropsy	[104]
		Hungary	40.0	8/20	na	necropsy	[59]
		India	na	na	na	na	[187]
			na	na	na	na	[143]
			na	na	na	na	[188]
		India[a]	na	na	na	CO	[189]
			100	12/12	100–400 epg	CO	[190]
		Iran	100	20/20	27.1	necropsy	[110]
			7.1	1/14	4	necropsy	[136]
			2.5	2/79	na	necropsy	[139]
			case report		na	necropsy	[155]

Table 6 Nematode parasites of the golden jackal, *Canis aureus (Continued)*

Family	Species (synonym)	Origin	Prevalence (%)	Frequency	Intensity	Method	Reference
			3.5	2/56	na	necropsy	[48]
		Israel	33.3	5/15	na	necropsy	[146]
			76.0	13/17	50–800 epg	CO	[19]
		Russia	52.2	na	na	necropsy	[97]
			5.0	3/60	na	necropsy	[106]
			na	na	na	necropsy	[107]
			12.0	18/150	3–265	necropsy	[53]
		Serbia	0.2	1/447	2	necropsy	[108]
		Tajikistan	na	na	na	necropsy	[148]
		Tunisia	9.7	3/31	2–4	necropsy	[140]
		Uzbekistan	na	na	na	necropsy	[151]
	Ancylostoma guentini	India	na	na	na	necropsy	[191]
	Placoconus lotoris (syn. *Uncinaria lotoris*)[b]	Russia	16.6	2/12	4	necropsy	[98]
	Uncinaria stenocephala	Afghanistan	na	na	na	necropsy	[192]
		Azerbaijan	50.0	49/98	1–404	necropsy	[99]
			na	na	na	necropsy	[100]
		Bulgaria	64.0	na	na	necropsy	[101]
			na	na	na	necropsy	[237]
			45.4	5/11	na	necropsy	[142]
			84.6	na	na	necropsy	[45]
		Chechnya	50.0	8/16	4–23	necropsy	[103]
		Greece	na	4/5	na	necropsy	[104]
		Hungary	40.0	8/20	na	necropsy	[59]
		Iran	85.0	17/20	11.1	necropsy	[110]
			6.3	5/79	na	necropsy	[139]
		Russia	34.8	na	na	necropsy	[97]
			na	na	na	necropsy	[339]
			30.0	18/60	na	necropsy	[106]
			na	na	na	necropsy	[107]
			89.3	134/150	3–550	necropsy	[53]
		Tajikistan	na	na	na	necropsy	[148]
		Tunisia	68.0	21/31	1–54	necropsy	[140]

Table 6 Nematode parasites of the golden jackal, *Canis aureus (Continued)*

Family	Species (synonym)	Origin	Prevalence (%)	Frequency	Intensity	Method	Reference
		Turkey	na	na	na	necropsy	[150, 194]
		Uzbekistan	na	na	na	necropsy	[151]
			na	na	na	necropsy	[152]
Ascarididae	*Baylisascaris devosi*	Azerbaijan	17.7	14/79	1–16	necropsy	[99]
	Toxascaris sp.	Kazakhstan	11.1	2/18	2–8	necropsy	[147]
	Toxascaris leonina	Afghanistan	na	na	na	necropsy	[192]
		Armenia[a]	case report		na	CO	[195]
		Azerbaijan	0.8	1/114	1	necropsy	[137]
			31.8	29/91	1–19	necropsy	[99]
			na	na	na	necropsy	[100]
		Bulgaria	36.0	na	na	necropsy	[101]
			5.8	na	na	necropsy	[141]
		Chechnya	100	16/16	1–12	necropsy	[103]
		Egypt	na	na	na	necropsy	[186]
		Hungary	15.0	3/20	na	necropsy	[59]
		Iran	30.0	3/10	na	necropsy	[111]
		Iran[a]	na	2/2	166.5 epg	CO	[372]
		Kazakhstan	11.1	2/18	2–11	necropsy	[147]
		Russia	43.5	na	na	necropsy	[97]
			10.0	2/20	4.00 ± 3.14	necropsy	[96]
			15.0	9/60	na	necropsy	[106]
			na	na	na	necropsy	[98]
			na	na	na	necropsy	[107]
			4.7	7/150	2–23	necropsy	[53]
		Tajikistan	na	na	na	necropsy	[148]
		Tunisia	6.5	2/31	1–7	necropsy	[140]
		Turkey	na	na	na	necropsy	[150]
		Uzbekistan	na	na	na	necropsy	[151]
			na	na	na	necropsy	[152]
	Toxocara sp.	India[a]	21.6	13/60	na	CO	[144]
			na	na	na	CO	[196]
			na	2/2	40–700 epg	CO	[197]

Table 6 Nematode parasites of the golden jackal, *Canis aureus (Continued)*

Family	Species (synonym)	Origin	Prevalence (%)	Frequency	Intensity	Method	Reference
			na	3/6	na	CO	[185]
	Toxocara canis (syn. *Belascaris marginata*)	Azerbaijan	32.6	32/98	1–21	necropsy	[99]
			na	na	na	necropsy	[100]
		Bangladesh	40.0	12/30	na	necropsy	[134]
			na	2/5	na	CO	[118]
		Bulgaria	54.5	6/11	na	necropsy	[142]
			7.7	na	na	necropsy	[45]
		Chechnya	50.0	8/16	3–18	necropsy	[103]
		Greece	na	2/5	na	necropsy	[104]
		Hungary	20.0	4/20	na	necropsy	[59]
		India (as *B. marginata*)	na	na	na	na	[187]
			na	na	na	na	[143]
			na	na	na	na	[112]
		India[a]	na	na	na	CO	[189]
		Iran	10.0	2/20	na	necropsy	[110]
			7.1	1/14	10	necropsy	[136]
			10.0	1/10	na	necropsy	[111]
			5.0	4/79	na	necropsy	[139]
			12.5	7/56	na	necropsy	[48]
		Iran[a]	na	2/2	25 ± 5 epg	CO	[372]
		Russia	60.9	na	na	necropsy	[97]
			5.0	1/20	2.00 ± 2.13	necropsy	[96]
			6.6	4/60	na	necropsy	[106]
			na	na	na	necropsy	[98]
			na	na	na	necropsy	[107]
			23.3	35/150	1–22	necropsy	[53]
		Serbia	1.6	7/447	7.8 ± 2.1	necropsy	[108]
			23.3	14/60	na	necropsy	[49]
		Tajikistan	na	na	na	necropsy	[148]
		Tunisia	16.0	5/31	1–9	necropsy	[140]
		Turkey	na	na	na	necropsy	[150]
		Uzbekistan	na	na	na	necropsy	[151]

Table 6 Nematode parasites of the golden jackal, *Canis aureus (Continued)*

Family	Species (synonym)	Origin	Prevalence (%)	Frequency	Intensity	Method	Reference
			na	na	na	necropsy	[152]
	Toxocara cati (syns *Ascaris mystax, T. mystax*)[b]	Italy	na	na	na	necropsy	[138]
		Russia	26.1	na	na	necropsy	[97]
			5.0	1/20	2.0 ± 1.9	necropsy	[96]
		Uzbekistan	na	na	na	necropsy	[152]
Crenosomatidae	*Crenosoma vulpis*	Azerbaijan	14.6	12/82	1–19	necropsy	[99]
			na	na	na	necropsy	[100]
		Bangladesh	na	1/5	na	necropsy	[118]
		Chechnya	100	16/16	10–23	necropsy	[103]
		Hungary	30.0	6/20	na	necropsy	[59]
		Russia	26.1	n/a	na	necropsy	[97]
			10.0	6/60	na	necropsy	[106]
			na	na	na	necropsy	[107]
			12.0	18/150	6–297	necropsy	[53]
	Crenosoma petrowi	Chechnya	37.5	6/16	16–38	necropsy	[103]
Diaphanocephalidae	*Kalicephalus schadi fotedari*[b]	India	na	na	na	necropsy	[198]
Dracunculidae	*Dracunculus medinensis*	India	na	na	na	na	[112]
		Kazakhstan	16.6	3/18	2–4	necropsy	[147]
		Tajikistan	na	na	na	necropsy	[148]
Gnathostomatidae	*Gnathostoma spinigerum*	India, Bangladesh, Burma	na	na	na	na	[112]
		Bangladesh	26.6	8/30	na	necropsy	[134]
Gongylonematidae	*Gongylonema* sp.[b]	Serbia	0.4	2/447	1	necropsy	[108]
Metastrongylidae	*Angiostrongylus vasorum*	na	na	1/1	na	EI	[199]
		Hungary	10.0	2/20	na	necropsy	[59]
Molineidae	*Molineus patens*	Russia	8.3	5/60	na	necropsy	[106]
			26.0	39/150	3–104	necropsy	[53]
Onchocercidae	*Acanthocheilonema reconditum* (syn. *Dipetalonema reconditum*)	Bulgaria	30.0	3/10	na	K	[200]
		Kenya (as *Dipetalonema reconditum*)	na	na	na	na	[201]
	Dirofilaria immitis	Azerbaijan	na	na	na	necropsy	[100]
		Bangladesh	na	4/5	na	necropsy	[118]
		Bulgaria	8.9	5/56	2–16	necropsy/K	[202]
			9.6	na	na	necropsy	[45]

Table 6 Nematode parasites of the golden jackal, *Canis aureus (Continued)*

Family	Species (synonym)	Origin	Prevalence (%)	Frequency	Intensity	Method	Reference
			70.0	7/10	na	K	[200]
			37.5	122/325	1–19	necropsy	[203]
		Greece	case report		4	necropsy	[204]
		Hungary	7.4	2/27	1–10	necropsy	[205]
		India[a]	na	na	na	na	[206]
		Iran	28.5	4/14	13	necropsy	[136]
			na	na	na	necropsy	[207]
			11.4	9/79	na	necropsy	[139]
			1.7	1/56	na	necropsy	[48]
			8.9	4/45	1–10	necropsy, molecular	[208]
		Romania	18.52	10/54	1–7	necropsy	[209]
			9.26	5/54	na	molecular	[209]
		Russia	8.3	1/12	29	necropsy	[98]
			8.3	5/60	na	necropsy	[106]
			20.0	na	na	necropsy	[339]
			22.7	34/150	2–23	necropsy	[53]
		Serbia	7.3	32/437	na	necropsy	[210]
		Uzbekistan	na	na	na	necropsy	[152]
	Dirofilaria repens	Egypt	na	na	na	necropsy	[186]
		Iran	10.0	2/20	na	necropsy	[110]
		Romania	1.8	1/54	na	molecular	[209]
		Russia	3.3	2/60	na	necropsy	[106]
		Uzbekistan	na	na	na	necropsy	[152]
Oxyuridae	*Syphacia* sp.[b]	Kazakhstan	5.5	1/18	7	necropsy	[147]
Physalopteridae	*Physaloptera* sp.	Iran	na	na	na	necropsy	[105]
		Kazakhstan	5.5	1/18	4	necropsy	[147]
	Physaloptera sibirica	Azerbaijan	na	na	na	necropsy	[100]
		Kazakhstan	11.1	2/18	1–3	necropsy	[147]
Rictulariidae	*Rictularia* sp.	Egypt	na	na	na	necropsy	[186]
		Greece	na	1/5	na	necropsy	[104]
	Rictularia affinis (syn. *Pterygodermatites affinis*)	Azerbaijan	36.3	28/77	1–29	necropsy	[99]
			na	na	na	necropsy	[100]

Table 6 Nematode parasites of the golden jackal, *Canis aureus* *(Continued)*

Family	Species (synonym)	Origin	Prevalence (%)	Frequency	Intensity	Method	Reference
		Bulgaria	7.7	na	na	necropsy	[45]
		India (as *P. affinis*)	na	na	na	na	[117]
			na	na	na	na	[188]
			na	na	na	na	[112]
		Iran	50.0	5/10	na	necropsy	[111]
			5.0	4/79	na	necropsy	[139]
		Kazakhstan	11.1	2/18	1–3	necropsy	[147]
		Tunisia (as *P. affinis*)	6.5	2/31	1	necropsy	[140]
		Turkmenistan	na	na	na	necropsy	[177]
		Uzbekistan	na	na	na	necropsy	[151]
			na	na	na	necropsy	[152]
	Rictularia cahirensis	Egypt	na	na	na	necropsy	[186]
		Iran	10.0	2/20	na	necropsy	[110]
		Turkey	na	na	na	necropsy	[340]
		Uzbekistan	na	na	na	necropsy	[151]
Spirocercidae	*Spirocerca arctica*	Azerbaijan	16.6	2/12	5–14	necropsy	[99]
			na	na	na	necropsy	[100]
	Spirocerca lupi (syn. *Filaria sanguinolenta*)	Azerbaijan	23.4	23/98	1–29	necropsy	[99]
			na	na	na	necropsy	[100]
		India	case report		na	necropsy	[211]
			na	na	na	na	[112]
		India[a]	case report		na	necropsy	[212]
		Iran	2.5	2/79	na	necropsy	[139]
		Italy (as *F. sanguinolenta*)	na	na	na	necropsy	[138]
		Uzbekistan	na	na	na	necropsy	[151]
	Spirocerca sanguinolenta	India	na	na	na	necropsy	[213]
Strongyloididae	*Strongyloides* sp.	India[a]	na	na	na	CO	[214]
		Iran[a]	na	2/2	5.5 ± 0.7 epg	CO	[372]
	Strongyloides stercoralis	Iran	na	na	na	necropsy	[105]
Subuluridae	*Oxynema linstowi*	Tunisia	3.2	1/31	2	necropsy	[140]
Thelaziidae	*Thelazia callipaeda*	Romania	1.6	1/64	70	necropsy	[215]
Class Enoplea							

Table 6 Nematode parasites of the golden jackal, *Canis aureus (Continued)*

Family	Species (synonym)	Origin	Prevalence (%)	Frequency	Intensity	Method	Reference
Capillariidae	*Capillaria* sp.	India[a]	na	na	na	CO	[214]
		Russia	2.7	4/150	1–45	necropsy	[53]
	Eucoleus aerophilus (syn. *Thominx aerophilus*)	Azerbaijan (as *T. aerophilus*)	na	na	na	necropsy	[100]
		Hungary	5.0	1/20	na	necropsy	[59]
		Russia	8.3	5/60	na	necropsy	[106]
			37.3	56/150	1–6	necropsy	[53]
	Capillaria boehmi	Russia	30.0	45/150	1–11	necropsy	[53]
	Capillaria plica	Azerbaijan	14.8	4/27	1–4	necropsy	[99]
			na	na	na	necropsy	[100]
		Bulgaria	16.4	na	na	necropsy	[45]
		Hungary	45.0	9/20	na	necropsy	[59]
		Russia	11.6	7/60	na	necropsy	[106]
			33.3	50/150	1–123	necropsy	[53]
	Capillaria putorii	Azerbaijan	na	na	na	necropsy	[100]
Dioctophymatidae	*Dioctophyme renale*	Azerbaijan	3.5	4/114	1	necropsy	[137]
		Iran	35.0	7/20	na	necropsy	[110, 216]
		Russia	3.3	2/60	na	necropsy	[106]
		Tajikistan	na	na	na	necropsy	[148]
		Uzbekistan	na	na	na	necropsy	[151]
			na	na	na	necropsy	[152]
	Dioctophyme skrjabini	Russia	17.4	na	na	necropsy	[97]
Trichinellidae	*Trichinella* sp.	Armenia	33.3	5/15	na	TRIC	[217]
		Azerbaijan	30.1	na	na	TRIC	[218]
			28.6	na	na	TRIC	[219]
		Bulgaria	50.0	na	na	TRIC	[220]
			33.3	15/45	na	TRIC	[221]
			21.2	7/33	na	TRIC	[222]
		Croatia	na	na	na	AD	[102]
		Georgia	80.0	na	na	TRIC	[218]
		Romania	53.7	29/54	na	TRIC	[223]
		Russia	14.3	na	na	TRIC	[224]
			case report		na	AD	[225]

Table 6 Nematode parasites of the golden jackal, *Canis aureus (Continued)*

Family	Species (synonym)	Origin	Prevalence (%)	Frequency	Intensity	Method	Reference
			25.0	75/302	na	TRIC	[226]
			case report		na	AD	[227]
		Tajikistan	na	na	na	TRIC	[228]
		Thailand	case report		na	TRIC	[229]
			case report		na	TRIC	[230]
		USSR (former)	36.5	na	na	TRIC	[231]
		Yugoslavia (former)	25.0	na	na	TRIC	[232]
	Trichinella britovi	Algeria	case report		na	PCR	[233]
		Azerbaijan	case report		na	AD	[234]
		Iran	11.1	2/18	na	AD, PCR	[235]
		Kazakhstan	na	na	na	TRIC	[234]
		Lithuania	na	3/4	0.9–1.4 lpg	AD, PCR	[236]
		Romania	case report		55 lpg	AD, PCR	[237]
		Serbia	4.7	2/42	na	AD, PCR	[238]
			15.4	2/13	na	AD, PCR	[239]
			27.8	25/90	1.1–57.6 lpg	AD, PCR	[240]
		Turkmenistan	case report		na	AD	[234]
		Uzbekistan	case report		na	AD	[234]
	Trichinella nativa	Kazakhstan	18.9	4/18	7 lpg	AD	[147]
		Lithuania	n/a	1/4	0.9–1.4 lpg	AD, PCR	[236]
		URSS (former)	61.5	na	na	TRIC	[241]
	Trichinella nelsoni	Iran	na	2/2	na	TRIC	[242]
		Kazakhstan	16.2	3/18	6 lpg	na	[147]
	Trichinella pseudospiralis	Russia	2.7	4/150	na	TRIC	[53]
	Trichinella spiralis	Afghanistan	case report		214 lpg	TRIC	[243]
		Azerbaijan	20.4	17/83	1–7 lpg	TRIC	[244]
			21.1	25/114	1–22 lpg	TRIC	[137]
			17.5	16/91	1–44 lpg	TRIC	[99]
		Bulgaria	na	na	na	TRIC	[245]
			45.0	na	na	TRIC	[101]
			40.0	na	na	AD	[45]
		Georgia	36.6	na	na	TRIC	[246]

Table 6 Nematode parasites of the golden jackal, *Canis aureus (Continued)*

Family	Species (synonym)	Origin	Prevalence (%)	Frequency	Intensity	Method	Reference
		Hungary	9.0	1/11	na	AD, PCR	[365]
		Iran	60.3	38/63	na	TRIC	[247]
			55.5	10/18	na	TRIC	[248]
			na	3/3	na	TRIC	[249]
			55.7	59/106	na	TRIC	[250]
			84.0	na	na	TRIC	[251]
		Kazakhstan	5.5	1/18	3 lpg	TRIC	[147]
		Russia	43.5	na	na	TRIC	[97]
			21.6	13/60	na	TRIC	[106]
			55.3	83/150	na	TRIC, AD	[53]
		Senegal	33.0	na	na	TRIC	[252]
		Serbia	na	3/3	1.9–21.4 lpg	AD, PCR	[253]
			8.3	1/12	3 lpg	AD, PCR	[254]
			7.9	3/38	3 lpg	AD, PCR	[255]
			14.2	6/42	na	AD, PCR	[238]
			38.4	5/13	na	AD, PCR	[239]
			71.1	64/90	0.59–152.8 lpg	AD, PCR	[240]
		Tunisia	na	2/2	na	TRIC	[256]
Trichuroididae	*Trichuris* sp.	India[a]	15.0	9/60	na	CO	[144]
	Trichuris georgicus (syn. *Trichocephalus georgicus*)	Azerbaijan	14.4	12/83	1–12	necropsy	[99]
			na	na	na	necropsy	[100]
	Trichuris vulpis (syn. *Trichocephalus vulpis*)	Azerbaijan (as *Trichocephalus vulpis*)	11.2	11/98	1–11	necropsy	[99]
			na	na	na	necropsy	[100]
		Bangladesh	na	1/5	na	CO	[118]
		Bulgaria	30.7	na	1–156	necropsy	[141]
			36.3	4/11	na	necropsy	[142]
		Russia (as *Trichocephalus vulpis*)	21.6	13/60	na	necropsy	[106]
			35.3	53/150	1–70	necropsy	[53]
		Serbia	11.6	4/60	na	necropsy	[49]
		Hungary	10.0	2/20	na	necropsy	[59]

Abbreviations: *AD* artificial digestion, *CO* coprological examination, *EI* experimental infection, *epg* eggs per gram faeces, *lpg* larvae per gram tissue, *K* Knott test, *PCR* polymerase chain reaction, *TRIC* trichinelloscopy, *na* not applicable/not available

[a]Animals kept in captivity

[b]Doubtful record

Metastrongyloids

Compared to foxes, little is known about the respiratory and cardiovascular strongylids of golden jackals. *Crenosoma vulpis* has been reported on several occasions in Asia and Europe, with variable prevalence (Table 6). There is a single report of *Crenosoma petrowi* in golden jackals, a parasite otherwise known mainly from mustelids in North America [266], one report from bears (also in North America) and another one from stone martens in Italy [267]. Surprisingly, there is only one record of *Angiostrongylus vasorum* in golden jackals, suggesting either a lack of habitat overlap or a low detection sensitivity during necropsy.

Filarioids

Zoonotic filarioids *Acanthocheilonema reconditum*, *Dirofilaria immitis* and *D. repens* have been all reported in golden jackals in various countries (Table 6). They have been found both as adults during necropsies but also as microfilariae demonstrating the reservoir role of jackals. *Dirofilaria* spp. are responsible in humans of conjunctivitis, focal pulmonary infarction with granuloma formation and subcutaneous and submucosal lesions in the lung and conjunctiva [268–270]. A recent review listed 1782 human *Dirofilaria* spp. infections, out of which 372 were pulmonary (in Australia, North and South America) and 1410 were subcutaneous/ocular cases (mostly in Europe and Asia) [271]. *Acanthocheilonema reconditum* is considered non-pathogenic for canids [155], but a single human case is well documented as being caused by this species and at least other two, by other *Acanthocheilonema* species [270, 272, 273]. The recorded prevalence of *D. immitis* has significantly varied in different areas between 7.3% in Serbia and 80.0% in Bangladesh, and seems to be consistent with the prevalence registered in dogs, generally between 40 and 70% in endemic areas [155]. The prevalence of *D. repens* in golden jackals ranged between 3.3 and 10.0%, resembling that recorded in dogs, generally varying from 5 to 20% [155].

The oriental eye-worm *Thelazia callipaeda* has been identified in golden jackals only in Romania [215], but this is probably due to lack of proper examinations of the eyes during the necropsy in other studies rather than a resistance of this host. Dogs originating in the Far East were initially considered the main host of the nematode [257]. Over the last 15 years, *T. callipaeda* has shown an increase in the distribution area mainly in Europe, with many new host records [274]. Human thelaziosis followed the same geographical spreading, with recent cases of infection diagnosed [274]. In this epidemiological picture, the golden jackal occurs as a new reservoir host.

Capillariids

Respiratory capillariids of carnivores (*C. aerophila*, *C. boehmi* and *C. putorii*) are considered primarily homoxenous, but the earthworms often act as facultative intermediate hosts [1, 275]. Along with the heteroxenous species *Capillaria plica* found in the urinary bladder, all species are cosmopolitan [257]. They have been found in golden jackals in Russia and other former Soviet Union countries. Only *C. plica* and *C. aerophila* are known to be zoonotic [276, 277], but their public health impact is minor. As the primary source of infection with *Capillaria* is the soil contaminated by infective eggs [155], the jackal can play an epidemiological role and secondary source of infection for domestic carnivores and humans.

Trichinella

Trichinellids are an important group of meat-borne zoonotic parasites [278] for which the golden jackals represent an important reservoir. Five species, *T. britovi*, *T. nativa*, *T. nelsoni*, *T. pseudospiralis* and *T. spiralis*, were recorded in mountainous and lowland regions across the distribution range of the golden jackal in Europe and Asia. However, only three of these (*T. britovi*, *T. nativa* and *T. spiralis*) have been confirmed molecularly (Table 6). We consider all the records by artificial digestion or trichinelloscopy (see Table 6) where the species is named as hypothetic, as there is no reliable morphological means of differentiation between species, hence we recommend to consider these as *Trichinella* sp. Nevertheless, the zoonotic potential have been shown for most *Trichinella* species, hence, the golden jackal represents an important natural sylvatic reservoir for these nematodes [240].

Other nematodes

Various other groups of nematodes have been found in golden jackals (families Spirocercidae, Dracunculidae, Gnathostomatidae, Physalopteridae, Rictulariidae, Subuluridae), but the reports are occasional (Table 6). Other groups (*Kalicephalus*, *Syphacia* and *Gongylonema*) are with high probability pseudoparasites, originating in prey hosts.

Spirocerca lupi is a rare zoonotic nematode species also identified in golden jackals in Europe, central and southern Asia (Table 6). Although a single human infection has been reported [279], the jackal may represent a reservoir host that maintains the life-cycle of the parasite in a certain region. Two other species of the genus *Spirocerca* (*S. arctica* and *S. sanguinolenta*, both described from domestic dogs) have been also reported in jackals, but their taxonomic status and biology are unknown.

Dracunculus medinensis has been identified in the golden jackal from several central and southern Asian countries. Currently the disease in humans has been declared extinct in the vast majority of the countries, with only three (Chad, South Sudan and Ethiopia) reporting cases in 2016 [280]. Dogs are considered to be important reservoirs for human infection [155, 281, 282]. In 2016, more than 1000 dogs in Chad, 14 dogs in Ethiopia, and 11 dogs in Mali were reported with guinea-worm [280]. In this context, understanding the role of wild canids (including golden jackals) remains a crucial aspect in the management of the ongoing eradication campaign.

Another zoonotic species identified in golden jackals from tropical Asian countries (India, Bangladesh, Myanmar) is *Gnathostoma spinigerum*. Gnathostomiasis, a major food-borne parasitic zoonosis and a significant public health problem, is considered an emerging imported disease in Europe and a common human infection in central and South America, and Asia [283]. Domestic and wild mammals are the final hosts and numerous intermediate and paratenic hosts are the source for the human infection. The golden jackals maintain the sylvatic focus of the parasites and interfere with the domestic cycle, at least in several Asian countries (Table 6).

Various other carnivore-specific spirurids have been found in golden jackals (*Physaloptera sibirica*, *Rictularia affinis*, *R. cahirensis* and *Oxynema linstowi*), but the role of this host species in their natural cycle remains unknown.

The cosmopolitan species *Dioctophyme renale* causes a severe kidney destruction in the carnivore definitive hosts. Although with limited zoonotic importance, so far around 20 human cases have been reported [284]. American minks seem to be the main reservoirs of the parasite [257], but an increased prevalence is also recorded in other wild and domestic carnivores. In golden jackals, *D. renale* has been reported in Asia, where the prevalence ranged between 3.3–35.0% (Table 6). Interestingly, this wild canid has shown a twice higher prevalence than stray dogs in the same geographical region [110], demonstrating the role of the jackal in the development of parasite's cycle in nature.

Trichuris vulpis has been found on various occasions in golden jackals in Europe and Asia (Table 6). The high prevalence of *T. vulpis* infection in golden jackals (10.0–36.3%) is in line with the value recorded in dogs originating from the same areas: 25% in India [285], 20% in Bulgaria [286] and 8.95% in Russia [264]. Although the prevalence of *T. vulpis* in domestic and wild canids is generally high, only around 60 human cases have been recorded [155].

Arthropods

A great variety of Arthropods have been found in golden jackals (Table 7) [287–328].

Ticks

Due to the large geographical range, the diversity of ticks parasitizing golden jackals is high. Ticks from 37 species belonging to six genera have been recorded in jackals throughout Europe, Asia and Africa. Nevertheless, the number of studies on tick-borne pathogens is surprisingly low. The common tick species found in golden jackals in Europe, i.e. *Dermacentor reticulatus*, *D. marginatus*, *Haemaphysalis concinna*, *H. punctata*, *Ixodes canisuga*, *I. hexagonus*, *I. ricinus* and *Rhipicephalus sanguineus* (*s.l.*), show that they share these ticks with other wild canids, like foxes [329] or with domestic dogs [330]. The two most commonly reported ticks in golden jackals from Europe are *D. reticulatus* and *I. ricinus*. These ticks are known to be important vectors for *Babesia canis* and important tick-borne bacteria, *Borrelia burgdorferi* (*s.l.*) and *Anaplasma phagocytophilum*. However, the reports of these pathogens in *C. aureus* are scarce (a single report of *Babesia canis* from Romania [42]). In Asia, the most common ticks on jackals are several species of genus *Haemaphysalis*, with a high diversity of species reported: *H. leachi*, *H. adleri*, *H. bispinosa*, *H. canestrinii*, *H. flava*, *H. indoflava*, *H. intermedia*, *H. kutchensis* and *H. parva*. However, studies on the pathogens they might transmit are absent. Several of these *Haemaphysalis* species are shared with domestic dogs or other wild carnivores, raising the question of the reservoir role of jackals for certain tick-borne pathogens. Except for *Haemaphysalis* ticks, another commonly reported tick on golden jackals from Asia is *Rhipicephalus haemaphysaloides*, a tick which prefers ungulates and known as vector of several viral and protozoan diseases [331]. Studies in golden jackals from arid regions (northern Africa and Middle East) demonstrated the predominant presence of ticks from the genus *Rhipicephalus*: *R. sanguineus* (*s.l.*), *R. turanicus* and *R. leporis*. Surprisingly, there are no reports of ticks on golden jackals in sub-Saharan Africa.

Mites

Compared to foxes, jackals seem to be less affected by mange-causing mites (Table 7). So far, there is a single report of *Sarcoptes scabiei* in golden jackals, in Israel [287] and a single report of *Otodectes cynotis*, in Iran [295]. It is unclear if the scarcity of data regarding *Sarcoptes* is because of the low prevalence or because of the lack of studies and/or reports. Except sarcoptid mites, there are few records of *Demodex* in golden jackals, but its clinical significance is not known (Table 7).

Fleas and lice

The diversity of fleas reported in golden jackals is relatively high, with at least seven species reported (Table 7), with the most common being *Pulex irritans*, *Ctenocephalides canis* and *C. felis*. Most of the reports of fleas in golden jackals originate in Russia and other former USSR countries and western and southern Asia. Surprisingly, there are no reports of fleas in golden jackals in Europe. The reports of lice in golden jackals are scarce with only three species occasionally reported (Table 7).

Table 7 Arthropod parasites of the golden jackal, *Canis aureus*

Family	Species	Origin	Prevalence (%)	Frequency	Intensity (A, ♂, ♀, N, L)[b]	Reference
Class Arachnida						
Demodecidae	*Demodex* spp.	Israel	na	1/1	na	[287]
	Demodex canis	Russia	3.3	5/150	na	[53]
	Demodex folliculorum	Bangladesh	na	na	na	[118]
Ixodidae	*Amblyomma* sp.	Nepal	na	na	na	[288]
	Amblyomma varanense (syn. *Aponomma gervaisi lucasi*)	India	na	na	na	[289]
	Amblyomma variegatum	Haute-Volta	na	na	7 N	[290]
		Senegal	na	na	54 L	[291]
	Dermacentor marginatus	Russia	15.3	23/150	1–26	[53]
		Serbia	45.0	9/20	na	[292]
	Dermacentor reticulatus	Austria	na	1/1	17 ♂; 2 ♀	[56]
		Hungary	na	4/4	10 A	[293]
		Italy	na	1/1	na	[116]
		Romania	12.6	10/79	46 ♂; 25 ♀	[294]
		Russia	62.0	93/150	1–26	[53]
	Haemaphysalis sp.	Iran	1.7	1/56	na	[48, 295, 296]
		Nepal	na	na	na	[288]
	Haemaphysalis adleri	Iraq	na	na	na	[297]
		Israel	na	2/2	4 ♂; 1 ♀	[298]
			na	3/3	na	[299]
	Haemaphysalis bispinosa	India	na	na	na	[300]
		Nepal	na	na	na	[288]
	Haemaphysalis canestrinii	India	na	1/1	9 ♂; 3 ♀,	[301]
			na	na	na	[300]
		Pakistan	na	3/3	3 ♂; 1 ♀	[301]
	Haemaphysalis concinna	Austria	na	1/1	1 N	[56]
		Hungary	na	4/4	7 N; 4 L	[293]
		Romania	1.2	1/79	1 N	[294]
	Haemaphysalis flava	India	na	na	A	[289]
	Haemaphysalis indoflava	India	na	na	na	[302]
	Haemaphysalis intermedia	India	na	2/2	8 ♂; 17♀; 28 N; 13 L	[303]
			na	na	na	[300]
	Haemaphysalis kutchensis	India	na	na	10 ♂; 1 ♀	[348]
	Haemaphysalis leachii (syns *H. leachii leachii*, *H. leachii indica*)	Egypt (as *H. leachii leachii*)	na	na	na	[305]
		India	na	1/1	9 ♂; 3 ♀	[306]
		India (as *H. leachii indica*)	na	na	na	[289]
			na	2/2	7 ♂; 2♀; 4 N; 1 L	[307]
		Nepal (as *H. leachii indica*)	na	3/3	6 N	[307]
	Haemaphysalis longicornis (syn. *H. neumanni*)	Ceylon	na	na	na	[308]
	Haemaphysalis paraleachi	Sudan	100	10/10	42 ♂; 4 ♀	[309]

Table 7 Arthropod parasites of the golden jackal, *Canis aureus (Continued)*

Family	Species	Origin	Prevalence (%)	Frequency	Intensity (A, ♂, ♀, N, L)[b]	Reference
	Haemaphysalis parva (syn. *H. otophila*)	India	na	na	na	[310]
		Israel	na	3/3	na	[299]
		Israel (as *H. otophila*)	na	6/6	37	[311]
	Haemaphysalis punctata	Romania	na	4/4	na	[312]
			2.5	2/79	1 ♂; 2 N	[294]
	Hyalomma sp.	Russia	0.7	1/150	1	[53]
		Tajikistan	na	na	na	[148]
	Hyalomma aegyptium	USSR (former)	na	na	na	[313]
	Hyalomma anatolicum	Tajikistan	na	na	na	[148]
	Hyalomma asiaticum	Tajikistan	na	na	na	[148]
	Hyalomma scupense	Tajikistan	na	na	na	[148]
	Ixodes sp.	Iran	na	1/1	na	[314]
		Russia	na	na	na	[339]
		Tajikistan	na	na	na	[148]
	Ixodes acuminatus (syn. *I. redikorzevi theodori*)	Israel	na	6/6	1	[311]
	Ixodes canisuga	Hungary	na	4/4	1 N	[293]
	Ixodes hexagonus	Romania	10.1	8/79	2 ♂; 11 ♀; 24 N; 12 L	[294]
	Ixodes ovatus	Nepal	na	1/1	6 ♀	[315]
	Ixodes ricinus	Hungary	na	4/4	3 A	[293]
		Iran	3.5	2/56	na	[48, 295, 296]
		Italy	na	1/1	na	[116]
		Romania	na	1/1	na	[316]
			na	4/4	na	[312]
			26.5	21/79	54 ♂; 45♀; 3 N; 4 L	[294]
		Russia	68.7	103/150	1–62	[53]
		Serbia	55.0	11/20	na	[292]
	Rhipicephalus sp.	Iran	1.7	1/56	na	[48, 295, 296]
		Tajikistan	na	na	na	[148]
	Rhipicephalus annulatus (syn. *Boophilus calcaratus*)	Russia	1.3	2/150	1–2	[53]
	Rhipicephalus cuspidatus	Haute-Volta	na	na	na	[290]
	Rhipicephalus haemaphysaloides	India	na	na	na	[289]
			na	1/1	4 ♂	[306]
			na	2/2	1 ♀; 2 N	[303]
			na	na	na	[300]
		Nepal	na	na	na	[288]
	Rhipicephalus leporis	Iraq	na	na	na	[297]
		Tajikistan	na	na	na	[148]
	Rhipicephalus pumilio	Tajikistan	na	na	na	[148]
		Uzbekistan	na	na	na	[152]
	Rhipicephalus rossicus	Tajikistan	na	na	na	[148]
	Rhipicephalus sanguineus	Algeria	na	2/2	15 ♂; 8 ♀	[317]
		Burma, Ceylon, India	na	na	na	[289]

Table 7 Arthropod parasites of the golden jackal, *Canis aureus (Continued)*

Family	Species	Origin	Prevalence (%)	Frequency	Intensity (A, ♂, ♀, N, L)[b]	Reference
		India	na	na	na	[300]
		Iran	na	na	na	[314]
		Israel	na	6/6	na	[311]
		Nepal	na	na	na	[288]
		Nigeria[a]	na	3/6	na	[41]
		Romania	na	1/1	na	[316]
			na	4/4	na	[312]
			1.2	1/79	1 ♂	[294]
		Serbia	0.5	1/20	na	[292]
		Tajikistan	na	na	na	[148]
		Turkey	na	na	na	[150]
			na	na	na	[318]
	Rhipicephalus schulzei	Tajikistan	na	na	na	[148]
	Rhipicephalus simus	Kenya	na	na	na	[319]
	Rhipicephalus sulcatus	Haute-Volta	na	na	5 ♂	[290]
	Rhipicephalus turanicus	Iraq	na	na	na	[320]
			100	14/14	na	[297]
		Tajikistan	na	na	na	[148]
		Uzbekistan	na	na	na	[152]
Psoroptidae	*Otodectes cynotis*	Iran	1.7	1/56	na	[48, 295, 296]
Sarcoptidae	*Sarcoptes scabiei*	Israel	na	1/1	na	[287]
Class Insecta						
Boopiidae	*Heterodoxus spiniger*	Africa (North, East); Asia (South); Europe (Southeast)	na	na	na	[321]
		Uganda	na	1/1	1 ♂; 2 ♀	[322]
Ceratophyllidae	*Paraceras melis*	Russia	10.0	15/150	1–12	[53]
			3.3	5/150	na	[323]
Coptopsyllidae	*Coptopsylla lamellifer dubinini*	Uzbekistan	na	na	na	[152]
Hippoboscidae	*Hippobosca longipennis*	Russia	2.7	4/150	1–2	[53]
Linognathidae	*Linognathus setosus*	Afrotropical Region	na	na	na	[324]
		Nepal	na	na	na	[288]
Pediculidae	*Pediculus* sp.	Bangladesh	na	na	na	[118]
Pulicidae	*Pulex irritans*	Afghanistan	na	na	2 ♂; 1 ♀	[325]
		Iran	na	na	3 ♂; 1 ♀	[326]
		Israel	na	6/6	36	[311]
		Russia	24.0	36/150	1–15	[53]
			14.0	21/150	na	[323]
		Tajikistan	na	na	na	[148]
		Uzbekistan	na	na	na	[152]
	Ctenocephalides canis	Afghanistan	na	na	10 ♂; 38 ♀	[325]
		Iran	na	na	13 ♂; 25 ♀	[326]
			10.8	6/56	na	[48, 295, 296]
		Israel	na	4/6	27	[311]

Table 7 Arthropod parasites of the golden jackal, *Canis aureus (Continued)*

Family	Species	Origin	Prevalence (%)	Frequency	Intensity (A, ♂, ♀, N, L)[b]	Reference
		Nigeria[a]	na	1/6	na	[41]
		Russia	48.0	72/150	1–28	[53]
			17.3	30/150	na	[323]
		Tajikistan	na	na	na	[148]
		Turkey	na	na	na	[150]
		Uzbekistan	na	na	na	[152]
	Ctenocephalides felis (syn. *C. felis felis*)	Ethiopia	na	na	na	[327]
		India (as *C. felis felis*)	na	na	na	[328]
		Iran (as *C. felis felis*)	na	na	2 ♂; 2 ♀	[326]
		Israel	50.0	3/6	6	[311]
		Russia	3.3	5/150	1–4	[53]
		Tajikistan	na	na	na	[148]
		Uzbekistan	na	na	na	[152]
	Echidnophaga gallinacea	Afghanistan	na	na	1 ♂	[325]
		Ethiopia	na	na	na	[327]
	Xenopsylla nesokiae	Tajikistan	na	na	na	[148]
Trichodectidae	*Trichodectes canis*	Russia	13.3	20/150	1–34	[53]
		Tajikistan	na	na	na	[148]
Vermipsyllidae	*Chaetopsylla globiceps*	Russia	27.3	41/150	1–19	[53]
			6.7	10/150	na	[323]
Class Maxillopoda						
Linguatulidae	*Linguatula serrata*	Romania	1.3	1/73	1 ♂	Our unpublished data

Abbreviation: na not applicable/not available
[a]Animals kept in captivity
[b]A, adults; ♂, male; ♀, female; N, nymphs; L, larvae

Other arthropods

Although relatively common in most wild carnivores and domestic dogs (Mihalca, personal observation), there is only a single report of *Hippobosca longipennis* in golden jackals (Table 7). This species is an important vector for *Acanthocheilonema dracunculoides*, a filarioid widely distributed in canids across Africa [332]. However, this vector-borne nematode was never reported in golden jackals.

Conclusions

This is the first comprehensive checklist summarizing the data on parasites of golden jackals. The large variety of parasites reported in golden jackals is caused by multiple factors, including their large geographical range, their extensive territorial mobility and wide food spectrum. Moreover, like in other carnivores, the predator behaviour of golden jackals is the cause of common records of pseudoparasites. Nevertheless, even in such cases, although these parasites do not infect jackals, they can be spread and can remain infective for their natural hosts. Considering that jackals share their habitats with domestic dogs and a wide variety of wild carnivores across their distribution range and the high similarity with canine parasites [333], the risk of interspecific transmission among canid species, and the continued spread of the species, is likely to be associated with future territorial expanding of different parasitic diseases. The vast majority of parasites recorded in golden jackals are shared with domestic dogs or even domestic cats. Other parasites of jackals can use a wide variety of other domestic species, including livestock, as intermediate hosts. Hence, jackals are an important source of infection for domestic animals and might be directly or indirectly responsible for economic losses. Probably the most important aspect regarding the parasites of golden jackal is the large number and common occurrence of zoonotic parasites. Among these, several are with high public health impact: *Leishmania*, *Echinococcus*, hookworms, *Toxocara*, and *Trichinella*. Our review brings overwhelming evidence on the importance of *Canis aureus* as wild reservoir of human parasites.

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References

1. Viranta S, Atickem A, Werdelin L, Stenseth NC. Rediscovering a forgotten canid species. BMC Zoology. 2017;2(1):6.
2. Jhala YV, Moehlman PD. Golden jackal *Canis aureus* Linnaeus, 1758. Least Concern (2004). In: Sillero-Zubiri C, Hoffman M, DW MD, editors. Status Survey and Conservation Action Plan. Canids: Foxes, Wolves, Jackals and Dogs: Gland: IUCN; 2004. p. 156–61.
3. Koepfli KP, Pollinger J, Godinho R, Robinson J, Lea A, Hendricks S, Schweizer RM, et al. Genome-wide evidence reveals that African and Eurasian golden jackals are distinct species. Curr Biol. 2015;25(16):2158–65.
4. Nagy J. Régibb és újabb adatok a nádifarkasok és a sakálok előfordulásairól. Nimród Vadászlap. 1942;30(35):554–6.
5. Wozencraft WC. Order Carnivora. In: Wilson DE, Reeder DM, editors. Mammal species of the world: a taxonomic and geographic reference. Baltimore: Johns Hopkins University Press; 2005. p. 532–629.
6. Khalaf-Sakerfalke VJ, Taher NABA. *Canis aureus palaestina* Khalaf, 2008: a new golden jackal subspecies from the Gaza strip, Palestine. Gazelle Palestinian Biol Bul. 2008;80:1–13.
7. Rueness EK, Asmyhr MG, Sillero-Zubiri C, Macdonald DW, Bekele A, Atickem A, Stenseth NC. The cryptic African wolf: *Canis aureus lupaster* is not a golden jackal and is not endemic to Egypt. PLoS One. 2011;6(1):e16385.
8. Lindblad-Toh K, Wade CM, Mikkelsen TS, Karlsson EK, Jaffe DB, Kamal M, Clamp M, et al. Genome sequence, comparative analysis and haplotype structure of the domestic dog. Nature. 2005;438:803–19.
9. Sommer R, Benecke N. Late-Pleistocene and early Holocene history of the canid fauna of Europe (Canidae). Mamm Biol. 2005;70:227–41.
10. Trouwborst A, Krofel M, Linnell JDC. Legal implications of range expansions in a terrestrial carnivore: the case of the golden jackal (*Canis aureus*) in Europe. Biodivers Conserv. 2015;24:2593–610.
11. Šálek M, Červinka J, Banea OC, Krofel M, Ćirovic´ D, Selanec I, Penezić A, Grill S, Riegert J. Population densities and habitat use of the golden jackal (Canis aureus) in farmlands across the Balkan peninsula. Eur J Wildl Res. 2014;60: 193–200.
12. Giannatos G. Conservation action plan for the golden jackal (*Canis aureus* L., 1758) in Greece. Athens:WWF Greece; 2004.
13. Arnold J, Humer A, Heltai M, Murariu D, Spassov N, Hackländer K. Current status and distribution of golden jackals *Canis aureus* in Europe. Mamm Rev. 2012;42:1–11.
14. Kryštufek B, Tvrtkovič N. Range expansion by Dalmatian jackal population in the twentieth century (*Canis aureus* L., 1758). Folia Zool. 1990;39:291–6.
15. Nowak RM, Paradiso JL. Walker's mammals of the world. 4th ed. Baltimore and London: John Hopkins University Press; 1983.
16. Van Lawick H, Van Lawick-Goodall J. Innocent killers. Boston: Houghton Mifflin; 1970.
17. Kingdon J. East African mammals: an atlas of evolution in Africa, volume 3, Part A: Carnivores. Chicago: University of Chicago Press; 1977.
18. Yakobson B, Manalo DL, Bader K, Perl S, Haber A. An epidemiological retrospective study of rabies diagnosis and control in Israel, 1948–1997. Isr J Vet Med. 1998;53:114–26.
19. Shamir M, Yakobson B, Baneth G, King R, Dar-Verker S, Markovics A, Aroch I. Antibodies to selected canine pathogens and infestation with intestinal helminths in golden jackals (*Canis aureus*) in Israel. Vet J. 2001;162(1):66–72.
20. Aguirre AA. Wild canids as sentinels of ecological health: a conservation medicine perspective. Parasit Vectors. 2009;(Suppl. 1):S7.
21. National Center for Biotechnology Information. U.S. National Library of Medicine, Rockville Pike. 2003. https://www.ncbi.nlm.nih.gov/pubmed. Accessed 20 Sept 2016.
22. Science Direct. Amsterdam: Elsevier B.V.; 1997. http://www.sciencedirect.com/. Accessed 1 Aug 2016.
23. Web of Science. Institute for Scientific Information. New York: Thomson Reuters; 1964. http://apps.webofknowledge.com/. Accessed 1 Sept 2016.
24. Helminthological Abstracts. Wallingford: CABI; 1910. http://www.cabi.org/publishing-products/online-information-resources/helminthological-abstracts/. Accessed 27 July 2016.
25. Biological Abstracts. BIOSIS. New York: Thomson Reuters; 1926. https://www.ebscohost.com/academic/biological-abstracts. Accessed 15 Aug 2016
26. BioOne, Washington, DC. 1999. http://www.bioone.org/. Accessed 15 Sept 2016.
27. Host-Parasite Database. London: Natural History Museum; 1922. http://www.nhm.ac.uk/research-curation/scientific-resources/taxonomy-systematics/host-parasites/database/. Accessed 15 July 2016.
28. Scholar G. Bibliographic database. Mountain View: Google; 2004. https://scholar.google.ro/. Accessed 30 Sept 2016
29. Scientific Electronic Library "Kiberleninka", Moscow. 2012. http://cyberleninka.ru. Accessed 1 July 2016.
30. Scientific Library Earth Papers. http://earthpapers.net/. Accessed 30 June 2016.
31. Adl SM, Simpson AG, Lane CE, Lukeš J, Bass D, Bowser SS, Brown MW, et al. The revised classification of eukaryotes. J Eukaryot Microbiol. 2012;59(5):429–93.
32. Gibson DI, Jones A, Bray RA, editors. Keys to the Trematoda, vol. 1. Wallingford: CAB International; 2002.
33. Jones E, Bray RA, Gibson DI, editors. Keys to the Trematoda, vol. 2. Wallingford: CAB International; 2005.
34. Bray RA, Gibson DI, Jones A, editors. Keys to the Trematoda, vol. 3. Wallingford: CAB International; 2008.
35. Kahlil LF, Jones A, Bray RA, editors. Keys to the cestode parasites of vertebrates. Wallingford: CAB International; 1994.
36. Nakao M, Lavikainen A, Iwaki T, Haukisalmi V, Konyaev S, Oku Y, Okamoto M, Ito A. Molecular phylogeny of the genus *Taenia* (Cestoda: Taeniidae): proposals for the resurrection of *Hydatigera* Lamarck, 1816 and the creation of a new genus *Versteria*. Int J Parasitol. 2013;43(6):427–37.
37. De Ley P, Blaxter M. A new system for Nematoda: combining morphological characters with molecular trees, and translating clades into ranks and taxa. In: Cook R, Hunt DJ, editors. Nematology monographs and perspectives, vol. 2. Leiden: E.J. Brill; 2004. p. 633–53.
38. Amin OM. Classification of the Acanthocephala. Folia Parasitol. 2013;60(4): 273–305.
39. Roskov Y, Abucay L, Orrell T, Nicolson D, Flann C, Bailly N, Kirk P, Bourgoin T, DeWalt RE, Decock W, De Wever A. (editors) 2016. Species 2000 & ITIS Catalogue of Life, 28th July 2016. Digital resource at www.catalogueoflife.org/col. Species 2000: Naturalis, Leiden, the Netherlands ISSN 2405-8858. Accessed 11 August 2016.
40. Rau MAN. Experimental infection of the jackal (*Canis aureus*) with *Piroplasma canis* Prana & Gallivalerio, 1895. A preliminary note. Indian J Med Res. 1926;14:243–4.
41. Mbaya AW, Aliyu MM, Nwosu CO, Ibrahim UI. Captive wild animals as potential reservoirs of haemo- and ectoparasitic infection of man and domestic animals in the arid-region of northeastern Nigeria. Vet Arhiv. 2008;78:429–40.
42. Mitková B, Hrazdilová K, D'Amico G, Duscher GG, Suchentrunk F, Forejtek P, Gherman CM, et al. Eurasian golden jackal as host of canine vector-borne protists. Parasit Vectors. 2017;10(1):183.
43. Maronpot RR, Guindy E. Preliminary study of *Babesia gibsoni* Patton in wild carnivores and domesticated dogs in Egypt. Am J Vet Res. 1970;31:797–9.
44. Patton WS. Preliminary report on a new piroplasm ("*Piroplasma gibsoni*" sp. nov.) found in the blood of hounds of the madras hunt and subsequently

discovered in the blood of the jackal "*Canis aureus*". Bull Soc Pathol Exot. 1910;3:271–81.
45. Kirkova Z, Raychev E, Georgieva D. Studies on feeding habits and parasitological status of red fox, golden jackal, wild cat and stone marten in Sredna Gora, Bulgaria. J Life Sci. 2011;5:264–70.
46. Bhatia BB, Chauhan PPS, Agrawal RD, Ahluwalia SS. *Eimeria aurei* n. sp. from jackal. Indian J Parasitol. 1979;3:49–50.
47. Latchumikanthan A, Vimalraj PG, Gomathinayagam S, Jayathangaraj MG. Concurrent infection of *Nanophyetus* (*Troglotrema*) *salmincola*, *Ancylostoma* sp. and *Isospora* sp. in a captive jackal (*Canis aureus*). J Vet Parasitol. 2012;26(1):87–8.
48. Razmjoo M, Bahrami AM, Shamsollahi M. Seroepidemiological survey of important parasitic infections of wild carnivores. IJABBR. 2014;2(3):783–92.
49. Ilić T, Becskei Z, Petrović T, Polaček V, Ristić B, Milić S, et al. Endoparasitic fauna of red foxes (*Vulpes vulpes*) and golden jackals (*Canis aureus*) in Serbia. Acta Parasitol. 2016;61(2):389–96.
50. Yakimoff WL, Matikaschwili IL, Rastegaieff EF. Zur Frage über die Coccidien der Schakale, *Eimeria dutoiti* n. sp. Arch Protistenkd. 1933;80:177–8.
51. Glebezdin VS. On the fauna of coccidia wild mammals Southwest Turkmenistan. Izvestiya Akademii Nauk Turkmeniskoi SSR Seriya Biologicheskih Nauk. 1978;3:71–8. (In Russian).
52. Dzerzhinsky VA, Musabekov KS. Findings of coccidians of the genus *Isospora* (Coccidiida) in the Central Asian jackal. Parazitologiya. 1985;19(4):318–20. (In Russian).
53. Tulov AV. Parasitocenoses of jackal (*Canis aureus* L.) in ecosystems of the north-west Caucasus. Krasnodar: Kuban State Agrarian University, Dissertation for the Degree of Candidate of Biological Sciences; 2013. (In Russian).
54. Yakimoff WL, Lewkowitsch EN. *Isospora theileri* n. Sp., coccidie de Schakale. Arch Protistenkd. 1932;77:533–7.
55. Maia JP, Alvares F, Boratyński Z, Brito JC, Leite JV, Harris DJ. Molecular assessment of *Hepatozoon* (Apicomplexa: Adeleorina) infections in wild canids and rodents from north Africa, with implications for transmission dynamics across taxonomic groups. J Wildl Dis. 2014;50(4):837–48.
56. Duscher GG, Kübber-Heiss A, Richter B, Suchentrunk F. A golden jackal (*Canis aureus*) from Austria bearing *Hepatozoon canis* - import due to immigration into a non-endemic area? Ticks Tick Borne Dis. 2013;4(1–2):133–7.
57. Duscher G, Ćirović D, Heltai M, Szabo L, Lanszki J, Bošković I, et al. Hepatozoonosis in golden jackals (*Canis aureus*) from southeastern and central Europe: prevalence data from a first molecular screening. Book of Abstracts of First International Jackal Symposium; Oct 13–16, 2014. Veliko Gradiste; 2014. pp. 70–1.
58. Farkas R, Solymosi N, Takács N, Hornyák Á, Hornok S, Nachum-Biala Y, Baneth G. First molecular evidence of *Hepatozoon canis* infection in red foxes and golden jackals from Hungary. Parasit Vectors. 2014;7:303.
59. Takács A, Szabó L, Juhász L, Takács AA, Lanszki J, Takács PT, Heltai M. Data on the parasitological status of golden jackal (*Canis aureus* L., 1758) in Hungary. Acta Vet Hung. 2014;62(1):33–41.
60. Steinman A, Shpigel NY, Mazar S, King R, Baneth G, Savitsky I, Shkap V. Low seroprevalence of antibodies to *Neospora caninum* in wild canids in Israel. Vet Parasitol. 2006;137(1–2):155–8.
61. Mukherjea AK, Krassner SM. A new species of coccidia (protozoa: Sporozoa) of the genus *Isospora* Schneider, 1881, from the jackal, *Canis aureus* Linnaeus. Proc Zool Soc Calcutta. 1965;18:35–40.
62. Levine ND, Tadros W. Named species and hosts of *Sarcocystis* (protozoa: Apicomplexa: Sarcocystidae). Syst Parasitol. 1980;2:41–59.
63. Ghorbani M, Hafizi A, Shegerfcar MT, Rezaian M, Nadim A, Anwar M, Afshar A. Animal toxoplasmosis in Iran. J Trop Med Hyg. 1983;86(2):736.
64. Namroodi S, Yousefi MR, Milanloo D. *Toxoplasma gondii* serosurvey in golden jackals from Golestan province, Iran. IJMCM. 2014;2:446–50.
65. Radhy AM, Khalaf JM, Faraj AA. Some gastro-intestinal protozoa of zoonotic importance observed in captive animals of al- Zawraa zoo in Baghdad. Int J Sci Nat. 2013;4(3):567–70.
66. Beck R, Sprong H, Lucinger S, Pozio E, Cacciò SM. A large survey of Croatian wild mammals for *Giardia duodenalis* reveals a low prevalence and limited zoonotic potential. Vector Borne Zoonotic Dis. 2011;11(8):1049–55.
67. Chatteriee GC, Roy H, Mitra AN. Notes on *Pentatrichomonas canis-auri* n. sp., found in cecal contents of an Indian jackal (*Canis aureus*), its cultivation in vitro and its method of multiplication. J Dept Sc Calcutta Univ. 1926;8:11.
68. Hamidi AN, Nadim A, Edrissian GH, Tahvildar-Bidruni G, Javadian E. Visceral leishmaniasis of jackals and dogs in northern Iran. Trans R Soc Trop Med Hyg. 1982;76(6):756–7.
69. Ćirović D, Chochlakis D, Tomanović S, Sukara R, Penezić A, Tselentis Y, Psaroulaki A. Presence of *Leishmania* and *Brucella* species in the golden jackal *Canis aureus* in Serbia. Biomed Res Int. 2014;2014:728516.
70. Hervás J, Méndez A, Carrasco L, Gómez-Villamandos JC. Pathological study of visceral leishmaniasis in a jackal (*Canis aureus*). Vet Rec. 1996; 139(12):293–5.
71. Khan MAHNA, Khanm SS, Bashu J, Rima UK, Pervin M, Hossain MZ, et al. Visceral leishmaniasis is endemic in golden jackals of Bangladesh agricultural university campus, a threat for expanding future zoonotic visceral leishmaniasis. Bangl J Vet Med. 2012;10(1&2):101–9.
72. Maruashvili GM, Bardzhadze BG. New natural reservoir of *Leishmania donovani* in Georgia. Med Parazitol. 1980;6:77–8. (In Russian).
73. Musabekov KS, Novak MD, Farizova OM. Jackal as a potential source of leishmaniasis in the south-southeast of Kazakhstan. Math KazSSR Ser Biol Nauk. 1987;4:86–7. (In Russian).
74. Nadim A, Navid-Hamidid A, Javadian E, Bidruni GT, Amini H. Present status of kala-azar in Iran. Am J Trop Med Hyg. 1978;27(1):25–8.
75. Jarallah HM. Dissemination of canine visceral leishmaniasis to different organs of jackals experimentally infected with *Leishmania donovani*. Pak Vet J. 2015;35(1):98–100.
76. Bessad A, Mouloua K, Kherrachi I, Benbetka S, Benikhlef R, Mezai G, Harrat Z. *Leishmania infantum* MON-1 isolated from a golden jackal (*Canis aureus*) in Grande Kabylie (Algeria). Bull Soc Pathol Exot. 2012;105(1):5–7. (In French).
77. Babuadze G, Alvar J, Argaw D, de Koning HP, Iosava M, Kekelidze M, Tsertsvadze N, et al. Epidemiology of visceral leishmaniasis in Georgia. PLoS Negl Trop Dis. 2014;8(3):e2725.
78. Mohebali M, Arzamani K, Zarei Z, Akhoundi B, Hajjaran H, Raeghi S, Heidari Z, et al. Canine visceral leishmaniasis in wild canines (fox, jackal, and wolf) in northeastern Iran using parasitological, serological, and molecular methods. J Arthropod-Borne Dis. 2015;10(4):538–45.
79. Niazi AD. Studies in epidemiology and seroepidemiology of visceral leishmaniasis in Iraq. Doctoral thesis. London: London School of Hygiene Tropical Medicine, 1980. doi:10.17037/PUBS.00682256.
80. Baneth G, Dank G, Keren-Kornblatt E, Sekeles E, Adini I, Eisenberger CL, Schnur LF, King R, Jaffe CL. Emergence of visceral leishmaniasis in central Israel. Am J Trop Med Hyg. 1998;59(5):722–5.
81. Talmi-Frank D, Kedem-Vaanunu N, King R, Bar-Gal GK, Edery N, Jaffe CL, Baneth G. Leishmania tropica infection in golden jackals and red foxes, Israel. Emerg Infect Dis. 2010;16(12):1973–5.
82. Lubova VV. Study of Kzyl-Orda foci. Communication 1 and 2. Voprosy Medizinskykh i Biologicheskykh Issledovaniy, Moskva. 1972;49–52 (In Russian).
83. Latyshev NI, Kryukova AP, Povalishina TP. Essays on the regional parasitology of Middle Asia. I. Leishmaniasis in Tajikistan. Materials for the medical geography of Tadjik SSR. (Results of expeditions in 1945–1+7). Problems of Regional, General and Experimental Parasit Med Zoo., Moscow. 1951;7:35–62. (In Russian).
84. Dursunova SM, Ponirovskii EN, Afanasiev NP. Possible role of wild animals in epidemiology of visceral leishmaniasis in Turkmen SSR. Trudy Ashkhabadskogo Inst Epidem i Gig. 1964;6:157–8. (In Russian).
85. Jarallah HM. Experimental innoculation of jackals with *Leishmania major* and their susceptibility by histopathological lesions. Indian Vet J. 2015b;92(1):90–1.
86. Mircean V, Dumitrache MO, Mircean M, Bolfă P, Györke A, Mihalca AD. Autochthonous canine leishmaniasis in Romania: neglected or (re)emerging? Parasit Vectors. 2014;7:135.
87. Espejo LA, Costard S, Zagmutt FJ. Modelling canine leishmaniasis spread to non-endemic areas of Europe. Epidemiol Infect. 2014;27:1–14.
88. Sasaki M, Omobowale O, Tozuka M, Ohta K, Matsuu A, Nottidge HO, et al. Molecular survey of *Babesia canis* in dogs in Nigeria. J Vet Med Sci. 2007; 69(11):1191–3.
89. Alvarado-Rybak M, Solano-Gallego L, Millán J. A review of piroplasmid infections in wild carnivores worldwide: importance for domestic animal health and wildlife conservation. Parasit Vectors. 2016;9(1):538.
90. Baneth G. Perspectives on canine and feline hepatozoonosis. Vet Parasitol. 2011;181(1):3–11.
91. Duszynski DW, Couch L, Upton SJ. Coccidia (Eimeriidae) of Canidae and Felidae. Supported by NSF-PEET DEB 9521687. 2000. http://biology.unm.edu/coccidia/carniv1.html. Accessed 22 Aug 2017.
92. McAllister MM, Dubey JP, Lindsay DS, Jolley WR, Wills RA, McGuire AM. Dogs are definitive hosts of *Neospora caninum*. Int J Parasitol. 1998;28:1473–8.
93. Gondim LF, McAllister MM, Pitt WC, Zemlicka DE. Coyotes (*Canis latrans*) are definitive hosts of *Neospora caninum*. Int J Parasitol. 2004;34:159–61.

94. King JS, Slapeta J, Jenkins DJ, Al-Qassab SE, Ellis JT, Windsor PA. Australian dingoes are definitive hosts of *Neospora caninum*. Int J Parasitol. 2010;40:945–50.
95. Dubey JP, Jenkins MC, Rajendran C, Miska K, Ferreira LR, Martins J. Gray wolf (*Canis lupus*) is a natural definitive host for *Neospora caninum*. Vet Parasitol. 2011;181:382–7.
96. Gadzhiev IG, Ataev AM, Gazimagomedov MG. Fauna of helminthes of domestic and wild Canidae in the plane zone of Dagestan. Russian J Parasitol. 2010;4:12–5. (In Russian).
97. Atalay MM. The main helminth infections of wild carnivores and principles of prevention in Dagestan offensive. Vet Pathol Moscow. 2010;2(33):5–10. (In Russian).
98. Hajiyev IG. Helminthiases of dogs in the territory of the Terek-Kuma Lowland and improvement of control measures. Thesis for the degree of candidate of veterinary sciences. Makhachkala 2011, pp. 148.
99. Fataliyev GG. Helminthofauna of wild dogs in Azerbaijan and the ways of its formation. Parasitologyia. 2011;45(2):129–39. (In Russian).
100. Ibrahimova RS, Fataliyev GH. Current state of helminthofauna of canids (Canidae) in Azerbaijan. Proc Azerbaijan Natnl Acad Sci Biological Med Sci. 2015;70(1):35–8. (In Azerbaijani).
101. Trifonov T, Meskov S, Stoimenov K. Helminth fauna of the jackal (*Canis aureus*) in the Strandzha Mountains. Vet Med Nauki. 1970;7(6):51–4. (In Bulgarian).
102. Florijančić T, Ozimec S, Bošković I, Degmečić D, Urošević B, Nekvapil N, et al. Survey on sylvatic parasitosis in Podunavlje Region of Croatia. In: Popović Z, Beuković M, Dordević M, Beuković D, editors. Proceedings of International symposium on hunting "Modern aspects of sustainable management of game population". Zemun: University of Belgrade, Faculty of Agriculture; 2012. p. 118–21.
103. Shahba HK. Hookworm and uncinariosis of carnivores. Ivanovo: Thesis for the degree of candidate of veterinary sciences; 2010 (In Russian).
104. Papadopoulos H, Himonas C, Papazahariadou M, Antoniadou-Sotiriadou K. Helminths of foxes and other wild carnivores from rural areas in Greece. J Helminthol. 1997;71(3):227–31.
105. Dalimi A, Mobedi I. Helminth parasites of carnivores in northern Iran. Ann Trop Med Parasitol. 1992;86(4):395–7.
106. Itin GS, Kravchenko VM. Ecological-faunistic characteristics of helminthcoenosis of jackals (Canis aureus) at the Krasnodar Territory. Theory Pract of Parasitic Dis Animals-Biology. 2011;12:224–7. (In Russian).
107. Kruchkova EN. Helminth fauna of carnivores in the European region of Russia. Theory Pract Parasitic Dis Animals. 2012;13:205–8. (In Russian).
108. Ćirović D, Pavlović I, Penezić A, Kulišić Z, Selaković S. Levels of infection of intestinal helminth species in the golden jackal *Canis aureus* from Serbia. J Helminthol. 2015a;89(1):28–33.
109. Shakarboev EB. The trematodes of vertebrates in Uzbekistan (species composition, ways of circulation and ecological-biological peculiarities). Tashkent: Abstract of Doct thesis; 2009 (In Russian).
110. Sadighian A. Helminth parasites of stray dogs and jackals in Shahsavar area, Caspian region. Iran J Parasitol. 1969;55(2):372–4.
111. Dalimi A, Sattari A, Motamedi G. A study on intestinal helminthes of dogs, foxes and jackals in the western part of Iran. Vet Parasitol. 2006;142(1–2):129–33.
112. Chowdhury N. Indian subcontinent. In: Chowdhury N, Alonso Aguirre A, editors. Helminths of wildlife. Enfield: Science Publishers Inc; 2001. p. 287–371.
113. Wells WH, Randal BH. New hosts for trematodes of the genus *Heterophyes* in Egypt. J Parasitol. 1956;42(3):287–92.
114. Rodonaya TE. On the detection of the USSR fluke *Dexiogonimus ciureanus* Witenberg, 1929. Helminthofauna of animals and plants in Georgia: Collection Institute of Zoology, Tbilisi. 1967;95–97 (In Russian).
115. Massoud J, Jalali H, Reza M. Studies on trematodes of the family Heterophyidae (Odhner, 1914) in Iran: 1. Preliminary epidemiological surveys in man and carnivores in Khuzestan. J Helminthol. 1981;55(4):255–60.
116. Lapini L, Molinari P, Dorigo L, Are G, Beraldo P. Reproduction of the golden jackal (*Canis aureus moreoticus* i. Geoffroy Saint Hilaire, 1835) in Julian pre-Alps, with new data on its range-expansion in the high-Adriatic hinterland (Mammalia, Carnivora, Canidae). Boll Mus Civ St Nat Venezia. 2009;60:169–86.
117. Rao BV. Helminth parasites from an Indian jackal (*Canis aureus narid*): *Ancylostoma braziliense* (Gomez 1910) Leiper 1915, *Rictularia affinis* (Jagerskiold, 1904) (Nematoda): and *Spelotrema narii* n. sp. (Trematoda). Ind J Helminthol. 1965;17:6884.
118. Yousuf MA, Bashu J, Pervin M, Islam MT, Das PM, Khan MAHNA. Identifying diseases of golden jackals of Bangladesh Agricultural University campus, Mymensingh, Bangladesh. Bangl J Vet Med. 2014;12(2):217–24.
119. Vimalraj PG, Latchumikanthan A. *Schistosoma spindale* infection in a captive jackal (*Canis aureus*). J Parasit Dis. 2015;39(1):120–1.
120. Roberts L, Janovy J Jr. Foundations of parasitology. 8th ed. New York: McGraw Hill Publishers; 2009.
121. Olsen OW. Animal parasites: their life cycles and ecology. New York: Dover Publications; 1986.
122. Filimonova LV. Experimental study of the biology of *Nanophyetus schikhobalowi* Skryabin & Podyapolskaya, 1931 (Trematoda, Nanophyetidae). Trudy Gel'mintologicheskoi Laboratorii. 1965;15:172–84. (In Russian).
123. Möhl K, Grosse K, Hamedy A, Wüste T, Kabelitz P, Lücker E. Biology of *Alaria* spp. and human exposition risk to *Alaria* mesocercariae - a review. Parasitol Res. 2009;105(1):1–15.
124. Chai JY, Seo BS, Lee SH, Hong SJ, Sohn WM. Human infections by *Heterophyes heterophyes* and *H. dispar* imported from Saudi Arabia. Korean J Parasitol. 1986;24(1):82–6.
125. Uppal B, Wadhwa V. Rare case of *Metagonimus yokogawai*. Indian J Med Microbiol. 2005;23(1):61–2.
126. Cengiz ZT, Yilmaz H, Dulger AC, Cicek M. Human infection with *Dicrocoelium dendriticum* in Turkey. Ann Saudi Med. 2010;30(2):159–61.
127. Khamidullin RI, Liubina VS, Khamidullin IR, Medinskiĭ BL. Trematodiases in Tataria. Med Parazitol (Moscow). 1991;2:60–1. (In Russian).
128. Dawes B. The Trematoda, with special reference to British and other European forms. Cambridge: Cambridge University Press; 1968.
129. Gorman AM. Studies on the biology of *Plagiorchis elegans* (Rudolphi, 1802), (Trematoda: Digenea) in its mammalian and molluscan hosts. Leeds: PhD Thesis, University of Leeds. 1980.
130. Sitko J, Bizos J, Sherrard-Smith E, Stanton DW, Komorová P, Heneberg P. Integrative taxonomy of European parasitic flatworms of the genus *Metorchis* Looss, 1899 (Trematoda: Opisthorchiidae). Parasitol Int. 2016;65(3):258–67.
131. Kumar V. Trematode infections and diseases of man and animals. Dordrecht: Springer Science+Business Media; 1999.
132. Gupta V, Parmar S. On two new species of cestodes of the families Hymenolepididae and Dilepididae from mammals of India. Indian J Helminthol. 1989;40(2):165–71.
133. Gawande P, Baviskar B, Umale N, Gandhe A, Baviskar P, Bawaskar S, Maske DK. Survey of gastrointestinal helminths in captive mammals and birds at Maharajbagh Zoo. Nagpur Zoo's Print J. 2010;25(4):21–2.
134. Shaikh H, Huq MM, Karim MJ, Khan MMM. Indicence of helminth parasites of domestic and wild cats and jackals in Bangladesh. Indian J Parasitol. 1982;6(2):245–7.
135. Niphadkar SM, Narsapur VS, Deshpande VS, Nehete RS. Parasitic infections of zoo animals in Bombay. J Bombay Vet Col. 1989;1(1):37–40.
136. Farahnak A, Mobedi I, Mohamadi F. Study of zoonotic helminths of carnivores in Khuzestan, Iran. Iran J Public Health. 1998;27(3–4):15–20.
137. Litvinov VF, Litvinov VP. Helminths of carnivores in East Azerbaijan. Parazitologiya. 1981;15(3):219–23. (In Russian).
138. Sonsino P. Studi e notizie elmintologiche. Atti Soc Tosc Sc Nat. Proc Verb. 1889;6:224–37.
139. Meshgi B, Eslami A, Bahonar AR, Kharrazian-Moghadam M, Gerami-Sadeghian A. Prevalence of parasitic infections in the red fox (*Vulpes vulpes*) and golden jackal (*Canis aureus*) in Iran. Iran J Vet Res. 2009;10/4(29):387–91.
140. Lahmar S, Boufana B, Ben Boubaker S, Landolsi F. Intestinal helminths of golden jackals and red foxes from Tunisia. Vet Parasitol. 2014;204(3–4):297–303.
141. Kirkova Z, Georgieva D, Raychev E. Study on the prevalence of trichurosis in different categories of dogs and wild carnivores. Bulg J Vet Med. 2006;9(2):141–7.
142. Kamenov Y, Kanchev K, Radev V. Study on the helminth infection in canids in North-West Bulgaria. Sofia: Proceedings of Anniversary Conference of Faculty of Veterinary Medicine, University of Forestry; 2009. p. 298–303.
143. Ray DK, Negi SK, Srivastava PS. Occurrence of helminth parasites of zoonotic nature in wildlife in the Tarai. Indian J Anim Res. 1975;92:75–8.
144. Patel PV, Patel AI, Sabapara RH, Sahu RK, Vyas R. Helminthic infection in wild canids in zoological gardens of Gujarat. Zoo's Print J. 2003;18(4):1084.
145. Arbabi M, Doroudgar A, Hooshyar H, Mobedi I. A survey of cestode infections of carnivores in the Kashan region. A survey on carnivore's cestodes contamination in Kashan region. J Vet Res. 2004;59(3):289–93.
146. Hoida G, Greenberg Z, Furth M, Malsha Y, Craig PS, Schantz PM, Sneir R, El-on J. An epidemiological survey of *Echinococcus granulosus* and other helminths in animal populations in northern Israel. J Helminthol. 1998;72(2):127–31.

147. Musabekov KS. [Diseases and parasites of jackal (*Canis aureus* L., 1758) from South Kazakhstan.] Proceedings of the NAS RK, ser. biological and medical. 2008;3:10–13 (In Russian).
148. Chernyshev VI. [On the ecology and parasites of the jackal in Tadzhikistan.] Trudy Akademii Nauk Tadzhikskoy SSR Dushanbe. 1954;21:151 (In Russian).
149. Lahmar S, Boufana BS, Lahmar S, Inoubli S, Guadraoui M, Dhibi M, et al. *Echinococcus* in the wild carnivores and stray dogs of northern Tunisia: the results of a pilot survey. Ann Trop Med Parasitol. 2009;103(4):323–31.
150. Merdivenci A. Yabanıl Hayvanlarda Pazarizolojik Araştırmalar. Izmir: Proceedings of The 6th National Congress of Biology; 1968. pp 81–101.
151. Irgashev IK. [The helminth fauna of domestic and wild carnivores in the Samarkand region.] Uzbekskii Biologicheskii Zhurnal. 1958;5:39–45 (In Russian).
152. Tariannikov T. [Parasites of the jackal (*Canis aureus aureus*) from the region of middle Syr Daria.] Parazitologiya. 1983;17(6):478–480 (In Russian).
153. Baer JG. The origin of human tapeworms. J Parasitol. 1940;26(2):127–34.
154. Turner JA. Human dipylidiasis (dog tapeworm infection) in the United States. J Pediatr. 1962;61:763–8.
155. Acha PN, Szyfres B. Zoonoses and communicable diseases common to man and animals. Volume 3. Parasitoses. 3rd ed. Washington DC: PAHO (Pan American Health Organization [PAHO]). Scientific and Technical Publication No. 580; 2003.
156. Dhaliwal BBS, Juyal PD. Parasitic zoonoses. New Delhi: Springer; 2013.
157. Deplazes P, Rinaldi L, Alvarez Rojas CA, Torgerson PR, Harandi MF, Romig T, et al. Global distribution of alveolar and cystic echinococcosis. Adv Parasitol. 2017;95:315–493.
158. Romig T, Bilger B, Mackenstedt U. Current spread and epidemiology of *Echinococcus multilocularis*. Dtsch Tierarztl Wochenschr. 1999;106(8):352–7. (In German)
159. Bacigalupo J. Sobre una nueva especie de *Taenia, Taenia infantis*. Semana Med. 1922;26:726.
160. Morishita K, Sawada I. On tapeworms of the genus *Multiceps* hitherto unrecorded from man. Jap J Parasitol. 1966;15:495–501.
161. Spassky AA, Spasskaia LP, Reznik VN. On the biological polyvalence of *Hydatigera taeniaeformis* and its occurrence in man. Med Parazitol Mosk. 1968;37(3):339–43. (In Russian).
162. Sterba J, Barus V. First record of *Strobilocercus fasciolaris* (Taeniidae-larvae) in man. Folia Parasitol. 1976;23:221–6.
163. Hoberg EP, Ebinger W, Render JA. Fatal cysticercosis by *Taenia crassiceps* (Cyclophyllidea: Taeniidae) in a presumed immunocompromised canine host. J Parasitol. 1999;85:1174–8.
164. Slais J. Befunde von fruhen Entwicklungsstadien des *Cysticercus* in der Liber des Menschen. Zbl allg Path path Anat. 1965;108:316–21.
165. Sadykov VM. [Epizootiological and epidemiological significance of *Cysticercus ovis*.] Sb Rab Gel'mintologii Izdatel'stvo "Kolos". 1971;344–350 (In Russian).
166. Beugnet E, Gevrey J, Messouak A. The *Cysticercus ovis* cysticercosis: a non zoonotic muscular cysticercosis. Rev Med Vet. 1996;147(7):547–52.
167. Ing MB, Schantz PM, Turner JA. Human coenurosis in North America: case reports and review. Clinic Infect Dis. 1998;27:519–23.
168. Nguyen MT, Gabriël S, Abatih EN, Dorny P. A systematic review on the global occurrence of *Taenia hydatigena* in pigs and cattle. Vet Parasitol. 2016;226:97–103.
169. Heyneman D. Cestodes. In: Baron S, editor. Medical Microbiology. 4th ed. Galveston: University of Texas Medical Branch at Galveston; 1996. Chapter 89.
170. Yoon KC, Seo MS, Park SW, Park YG. Eyelid sparganosis. Am J Ophthalmol. 2004;2004(138):5–873.
171. Cho JH, Lee KB, Yong TS, Kim BS, Park HB, Ryu KN. Subcutaneous and musculoskeletal sparganosis: imaging characteristics and pathologic correlation. Skelet Radiol. 2000;29:402–8.
172. Dick TA, Nelson PA, Choudhury A. Diphyllobothriasis: update on human cases, foci, patterns and sources of human infections and future considerations. Southeast Asian J Trop Med Public Health. 2001;32(2):59–76.
173. Bowman DB, Hendrix CM, Lindsay DS, Barr SC. Feline clinical parasitology. Ames: Iowa State University Press; 2002.
174. Borkowski J, Zalewski A, Manor R. Diet composition of golden jackals in Israel. Ann Zool Fennici. 2011;48:108–18.
175. Nadeem MS, Naz R, Shah SI, Beg MA. Season- and locality-related changes in the diet of Asiatic jackal (*Canis aureus*) in Potohar, Pakistan. Turk J Zool. 2012;36(6):798–805.
176. Radović A, Kovačić D. Diet composition of the golden jackal (*Canis aureus* L.) on the Peljeac Peninsula, Dalmatia, Croatia. Period Biol. 2010;112(2):219–24.
177. Babaev Y. Data on the helminth fauna of wild mammals in the Karakumskii Canal zone. Izvestiya Akademii Nauk Turkmenskoi SSR. Biol Nauk. 1976;4:68–74.
178. Zariffard MR. Study on helminth parasites of carnivores of East Azerbaijan Province of Iran with focus on *Echinococcus multilocularis* and its importance in public health. Tehran: University of Tehran, Doctor of Philosophy dissertation; 1994.
179. Arbabi M, Droudgar A, Houshyar H, Mobedi E. Prevalence of *Macracanthorhynchus hirudinaceus* in Caniidae in Kashaniran. Vet J (Tehran). 2002;15(2):55–7.
180. Nabavi R, Hajinezhad M, Jamshidian A. Detection of *Pachysentis canicola* (Acanthocephala: Oligacanthorhynchida) in Iranian golden jackal, Sistan, Iran. IJAPBS. 2015;4(8):70–2.
181. Elchuev MS. A first finding of *Centrorhynchus itatsinis* Fukui, 1929 in a jackal in the Azerbaijan SSR. Izvestiya Akademii Nauk Azerbaĭdzhanskoĭ SSR. Biologicheskikh Nauk. 1986;6:47–51. (In Russian).
182. Varadharajan A, Pythal C. Parasites of wildlife - I. A preliminary investigation on the parasites of wild animals at the zoological Farden, Thiruvananthapuram, Kerala. Zoo's Print J. 1999;14(3–12):159–64.
183. Varadharajan A, Kandasamy A. A survey of gastro-intestinal parasites of wild animals in captivity in the V.O.C. Park and mini zoo, Coimbatore. Zoo's Print J. 2000;15(5):257–8.
184. Ghoke SS, Naikwade BS, Thorat KS, Jogdand NK, Kalaskar PS. Incidence of helminthic infection in captive carnivores of Sidhharth municipal zoo, Aurangabad, Maharashtra. Zoos Print J. 2012;27(3):25–6.
185. Javaregowda AK. Studies on prevalence of endo-parasitic infection in wild carnivores maintained under captive state. J Parasit Dis. 2016;40(4):1155–8.
186. Myers BJ, Kuntz RE, Wells WH. Helminth parasites of reptiles, birds, and mammals in Egypt: VII. Check list of nematodes collected from 1948 to 1955. Can J Zool. 1962;40(4):531–8.
187. Baylis MA. Sewell RBS, editor. The fauna of British India, including Ceylon and Burma. In: Nematoda. Vol. II. (Filarioidea, Dioctophymoidea and Trichinelloidea). London: Taylor and Francis; 1939.
188. Gupta NK, Kalia DC. Remarks on two already known nematode parasites from an Indian jackal. Res Bull Panjab Univ Sci. 1988;39(34):227–31.
189. Nashiruddullah N, Chakraborty A. Parasites of captive wild carnivores of Assam state zoo. Intas Polivet. 2001;2:173–81.
190. Singh T, Gupta MP, Singla LD, Singh N, Sharma DR. Prevalance and chemotherapy of gastrointestinal helminthic infections in wild carnivores of Mahendra Choudhury Zoological Park, Punjab. J Vet Parasitol. 2006;20(1):17–23.
191. Gupta NK, Kalia DC. Two new species of *Ancylostoma* (Nematoda) along with a key to the species of the genus possessing three pairs of ventral teeth. Rev Iber Parasitol. 1984;44(4):337–46.
192. Barus V, Kullmann E, Tenora F. Parasitische nematoden aus wirbeltieren Afghanistans. Acta Sci Nat Brno. 1972;6:1–46.
193. Yanchev Y. Morphology, taxonomy and distribution of species of *Uncinaria* (Frölich, 1789) from carnivores in Bulgaria. Khelmintologiya. 1986;22:55–66.
194. Merdivenci A, Buyurman Ü. Turkiye'de çakalda Uncinariasis olgusu. Turk Biol Derg. 1966;15(1–2):52–9.
195. Movsessian SO, Manassian JS, Hovhannissian RL. Specific composition of animal helminths in the Yerevan Zoo. Academy of Sciences of Armenian SSR. Institute of Zoology. Zoological Papers. 1987;21:81–97. (In Russian).
196. Pradhan S, Sharma D, Subba B, Chettri V. Preliminary investigation on the parasites of mammals at Padmaja Naidu Himalayan Zoological Park, Darjeeling. Zoo's Print J. 2011;26(8):11–3.
197. Thawait VK, Maiti SK, Dixit AA. Prevalence of gastro-intestinal parasites in captive wild animals of Nandan Van Zoo, Raipur, Chhattisgarh. Vet World. 2014;7(7):448–51.
198. Kalia DG, Nayital AK. A new subspecies record of *Kalicephalus* Molin, 1861 (Nematoda: Diaphanocephaloidea) from jackal; hitherto a cosmopolitan parasite of snakes. Indian J Parasitol. 1989;13:135–8.
199. Guilhon J. Transmission d'*Angiostrongylus vasorum* (Baillet, 1866) aux canides sauvages. Compt Rend Hebd Seanc Acad Sci Paris. 1965;261(21):4496–7.
200. Panayotova-Pencheva M, Trifonova A, Mirchev R, Movsesyan S. Diversity and morphometric data of blood filarial larvae in carnivorous from Bulgaria. Rossiĭskiĭ Parazitologicheskiĭ Zhurnal. 2014;1:14–23. (In Russian).
201. Nelson GS. *Dipetalonema reconditum* (Grassi, 1889) from the dog with a note on its development in the flea, *Ctenocephalides felis* and the louse, *Heterodoxus spiniger*. J Helminthol. 1962;36(03):297–308.
202. Kirkova Z., Ivanov A., Georgieva D. Dirofilariosis in dogs and wild carnivores in Bulgaria. In: Genchi C, Rinaldi L, Cringoli G, editors. Mappe Parassitologiche 8 "*Dirofilaria immitis* and *D. repens* in dog and cat and human Infections". Zagreb: Rolando Editore; 2007. p. 204.

203. Panayotova-Pencheva MS, Mirchev RL, Trifonova AP. Dirofilaria immitis infection in carnivores from Bulgaria: 2012–2013 update. Bulg J Vet Med. 2016;19(2):153–62.
204. Diakou A, Migli D, Spiridakis G. *Dirofilaria immitis* (heartworm) in a golden jackal (*Canis aureus*) in Greece. In: Poulakakis N, Antoniou A, Karameta E, Psonis N, Vardinoyannis K, editors. Book of abstracts, 13th International Congress on the Zoogeography and Ecology of Greece and Adjacent Regions, University of Crete. Irakleio Hellenic Zoological Society; 2015 p. 27.
205. Tolnai Z, Széll Z, Sproch Á, Szeredi L, Sréter T. *Dirofilaria immitis*: an emerging parasite in dogs, red foxes and golden jackals in Hungary. Vet Parasitol. 2014; 203(3–4):339–42.
206. Rao AT, Acharjyo LN. Incidence of heartworm in captive wild carnivores. Indian J Parasitol. 1993;17:201–2.
207. Meshgi B, Eslami A, Helan JA. Epidemiological survey of blood filariae in rural and urban dogs of Tabriz. J Fac Vet Med Tehran Univ. 2002;57(4):59–63. (In Persian).
208. Heidari Z, Kia EB, Arzamani K, Sharifdini M, Mobedi I, Zarei Z, Kamranrashani B. Morphological and molecular identification of *Dirofilaria immitis* from jackal (*Canis aureus*) in North Khorasan, northeast Iran. J Vector Borne Dis. 2015;52(4):329–33.
209. Ionică AM, Matei IA, D'Amico G, Daskalaki AA, Juránková J, Ionescu DT, et al. Role of golden jackals (*Canis aureus*) as natural reservoirs of *Dirofilaria* spp. in Romania. Parasit Vectors. 2016;9(1):240.
210. Penezić A, Selaković S, Pavlović I, Ćirović D. First findings and prevalence of adult heartworms (*Dirofilaria immitis*) in wild carnivores from Serbia. Parasitol Res. 2014;113(9):3281–5.
211. Agrawal RD, Ahluwalia SS, Chauhan PPS. Occurrence of aortic spirocercosis in jackal. Indian J Anim Sci. 1986;56:402–3.
212. Islam S, Nashiruddullah N. *Spirocerca lupi* in a wild jackal (*Canis aureus*) from Assam. J Vet Parasitol. 2000;14(2):127128.
213. Acharya SK. Incidence of helminth parasites in indigenous dogs and jackals with special reference to hookworms. Indian Vet J. 1939;16:7–9.
214. Varadharajan A, Pythal C, Subramanian H. Investigation on the prevalence of helminth parasites of wild mammals in the Thrissur Zoo, Kerala. Cheiron. 2001;B:12–15.
215. Mihalca AD, Ionică AM, D'Amico G, Daskalaki AA, Deak G, Matei IA, et al. *Thelazia callipaeda* in wild carnivores from Romania: new host and geographical records. Parasit Vectors. 2016;9(1):350.
216. Sadighian A, Amini F. *Dioctophyma renale* (Goeze, 1782) stiles, 1901 in stray dogs and jackals in Shahsavar area, Caspian region. Iran J Parasitol. 1967;53(5):961.
217. Asatrian AM. Spread and specific composition of *Trichinella* in Armenia. Academy of Sciences of Armenian SSR. Institute of Zoology. Zoological Papers. 1987;21:34–40. (In Russian).
218. Bessonov AS. Trichinellosis in the former USSR. Epidemic situation (1988–1992). In: Campbell WC, Pozio E, Bruschi F, editors. Trichinellosis. Rome: Istituto Superiore di Sanità Press; 1994. p. 505–10.
219. Sadikhov IA, Elchuev MS. [The situation for trichinosis in Sheki-Zagatala region of Azerbaijan.] Proceedings of the 7th All-Russia Conf for trichinosis, Moscow. 1996. p. 72–73 (In Russian).
220. Guenov G, Boeva V, Georgieva M, Bankov D, Stoimenov K. Organization and results of trichinellosis control in Bulgaria. In: Kim CW, Ruitenberg EJ, Teppema JS, editors. Proceedings of the fifth international conference on Trichinellosis. Surrey: Reedbooks; 1981. p. 387–9.
221. Georgieva D, Koinarski VT, Ivanov AI, Prelesov PN, Kirkova ZT. Role of wild carnivores in the epizootology and epidemiology of trichinellosis. Bulg J Vet Med. 2000;3(4):199–204.
222. Zelyazkov P, Todev I, Ivanov L, Mirchev R, Lalkovski N. Epizootological studies on trichinelosis (*Trichinella* sp.) among wild carnivores in Bulgaria. In: Proceedings. Traditional and contemporary veterinary medicine, Bulgaria, 2009. Sofia: Lesotekhnicheski Universitet; 2009. p. 335–40. (In Bulgarian).
223. Marian I, Mihalca AD, Gherman CM. Prevalence of *Trichinella* spp. infection in large wild carnivore species from Romania between Jan 2014 and July 2015. Bulletin UASVM Vet Med. 2015;72(2):438–40.
224. Sapunov AY, Andryushchenko VG. Proceedings of the 6th Scientific Conference on Trichinellosis. In: Spreading of trichinellosis among domestic and wild animals in Krasnodar territory. Moscow: Kirov; 1992. p. 177–9.
225. Ozeretskovskaya NN, Mikhailova LG, Sabgaida TP, Dovgalev AS. New trends and clinical patterns of human trichinellosis in Russia at the beginning of the XXI century. Vet Parasitol. 2005;132:167–71.
226. Kushnarev JV. [Epizootology, epidemiology and improvement measures against trichinosis in the Republic of North Ossetia-Alania.] Abstract of the Dissertation for the degree of candidate of Biological Sciences, All-Russian Scientific Research Institute of Helminthology "KN Skryabiia", Moscow; 2007 (In Russian).
227. Odoevskaia IM, Kurnosova OP, Klinkov AV, Bocharova MM. Biological properties of the isolate of *Trichinella* spp. from a jackal in the North Caucasian Region. Med Parazitol (Moscow). 2009;4(3):326. (In Russian).
228. Komardin HK, Didkovskaya LF. Trichinosis in Tajikistan. Health Tajikistan. 1985;6:46–9. (In Russian).
229. Boonthanom P, Nawarat A. The outbreaks of trichinosis at Amphur Mae Sarialng. Bull Pub Health. 1963;33:301–8.
230. Doege TC, Thienprasit P, Headington JT, Pongprot B, Tarawanich S. Trichinosis and raw bear meat in Thailand. Lancet. 1969;1(7592):459–61.
231. Bessonov AS. Epizoology and epidemiology of trichinellosis in the USSR: Prospects for eradication of the infection. In: Kim CW, editor. Trichinellosis. New York: Intext; 1974. p. 557–62.
232. Rukavina J, Brglez J. Trichinellosis of some species of wild animals in Yugoslavia. Wiad Parazytol. 1970;16(1):79.
233. Nezri M, Ruer J, De Bruyne A, Cohen-Valensi R, Pozio E, Dupouy-Camet J. First report of a human case of trichinellosis due to *Trichinella britovi* after jackal (*Canis aureus*) meat consumption in Algeria. Bull Soc Pathol Exot. 2006;99(2):94–5. (In French).
234. Shaikenov BS, Boev SN. Distribution of *Trichinella* species in the Old World. Wiad Parazytol. 1983;29:595–608.
235. Mirjalali H, Rezaei S, Pozio E, Naddaf SR, Salahi-Moghaddam A, Kia EB, et al. *Trichinella britovi* in the jackal *Canis aureus* from south-west Iran. J Helminthol. 2014;88(4):385–8.
236. Deksne G, Segliņa Z, Jahundoviča I, Esīte Z, Bakasejevs E, Bagrade G, et al. High prevalence of *Trichinella* spp. in sylvatic carnivore mammals of Latvia. Vet Parasitol. 2016;231:118–23.
237. Blaga R, Gherman C, Seucom D, Cozma V, Boireau P. First identification of *Trichinella* sp. in golden jackal (*Canis aureus*) in Romania. J Wildl Dis. 2008; 44(2):457–9.
238. Živojinović MŽ. 2013. Epizootiological, serological and molecular investigtions of *Trichinella* species. Belgrade: University of Belgrade, Faculty of Veterinary Medicine. PhD thesis; 2013. doi:10.2298/BG20131225ZIVOJINOVIC. (In Serbian).
239. Živojinović M, Sofronic-Milosavljevic L, Cvetkovic J, Pozio E, Interisano M, Plavsic B, et al. *Trichinella* infections in different host species of an endemic district of Serbia. Vet Parasitol. 2013;194(2–4):136–8.
240. Ćirović D, Teodorović V, Vasilev D, Marković M, Ćosić N, Dimitrijević M, et al. A large-scale study of the *Trichinella* genus in the golden jackal (*Canis aureus*) population in Serbia. Vet Parasitol. 2015b;212(3–4):253–6.
241. Merkushev AV. 100 years of the research on trichinosis in the USSR. Zool Zhurnal. 1965;11(4):229–31. (In Russian).
242. Massoud J, Mahdavi M. Characterization of northern and southern isolates of *Trichinella* in Iran. Iran J Publ Health. 1987;16(1–4):91–100.
243. Kullmann E. Über den ersten Nachweis von *Trichinella spiralis* (Owen) in Afghanistan. Z Parasitenkd. 1965;25:393–8.
244. Feizullaev NA, Litvinov VP, Litvinov VF. *Trichinella spiralis* in predatory mammals at the Kyzyl-Agach reserve. Doklady Akademii Nauk Azerbaidzhanskoi SSR. 1977;33(2):61–2. (In Russian).
245. Matov K, Varadinov A, Genov T. On the distribution of *Trichinella spiralis* (Owen, 1835) in domestic and wild carnivores, rodents and insectivores in Bulgaria. Izvestiya na Tsentralnata Khelmintologichna Laboratoriya. 1960;5:61–5. (In Bulgarian).
246. Kurashvili BE, Rodonaya TE, Matsaberdize GV, Gurchiani KR, Savvateeva IA, Dzhaparidze LA, Petriashvili LI. Trichinelliasis of animals in the Georgian SSR. Parazitologicheskii Sbornik, Tbilisi. 1971;2:19–48. (In Georgian).
247. Mobedi I, Arfaa F, Madadi H, Movafagh K. Sylvatic focus of trichiniasis in the Caspian region, northern Iran. Am J Trop Med Hyg. 1973;22(6):720–2.
248. Sadighian A, Arfaa F, Movafagh K. *Trichinella spiralis* in carnivores and rodents in Isfahan. J Parasitol. 1973;59(6):986.
249. Hamidi AN, Mobedi I. Sylvatic focus of trichiniasis in Bandar Abbas area south of Iran. Iran J Public Health. 1977;6(1):30–3.
250. Massoud J. Trichinellosis in carnivores in Iran. In: Kim CW, Pawlowski ZS, editors. Trichinellosis. Hanover: University Press of New England; 1978. p. 551–4.
251. Hamidi AN. Trichiniasis among the animals in north eastern Iran, 1969, 1976, 1977. Bull Soc Pathol Exot. 1979;72(3):254–7.
252. Gretillat S. Epidemiologie de la trichinellose sauvage au Senegal. Wiad Parazytol. 1970;16(1):109–10.

253. Cvetkovic J, Teodorovic V, Marucci G, Vasilev D, Vasilev S, Cirovic D, Sofronic-Milosavljevic L. First report of *Trichinella britovi* in Serbia. Acta Parasitol. 2011;56(2):232–5.
254. Petrović J, Pušić I, Apić J, Milanov D, Grgić Ž, Đorđević V, Matekalo-Šverak V. Sylvatic trichinosis - role of wild animals in cycle of spread of trichinosis in Serbia. Vet Glas. 2012;66(3–4):175–83. (In Serbian).
255. Petrović J, Grgić Ž, Živkov-Baloš M. Molecular diagnostics of *Trichinella* species: new data on *Trichinella* life cycle in Vojvodina region. In: Lilić S, Đorđević V, editors. Proceedings of the 57th International Meat Industry Conference: Meat and meat products - perspectives of sustainable production. Belgrade: Institute of Meat Hygiene and Technology; 2013. p. 152–7.
256. Fassbender CP, Mayer P. Uber die Verteilung von *Trichinella spiralis* in der Muskulatur einiger nordafrikanischer Carnivoren. Dtsch Tierarztl Wochenschr. 1974;81:284–7.
257. Anderson RC. Nematode parasites of vertebrates. Their development and transmission, 2nd Ed. New York: CABI Publishing; 2000.
258. Sprent JFA. Notes on *Ascaris* and *Toxascaris*, with a definition of *Baylisascaris* gen. nov. Parasitology. 1968;58(1):185–98.
259. Despommier D. Toxocariasis: clinical aspects, epidemiology, medical ecology, and molecular aspects. Clin Microbiol Rev. 2003;16(2):265–72.
260. Marquardt WC, Demaree RS Jr, Grieve RB. Parasitology and vector biology. 2nd ed. San Diego: Academic Press; 2000.
261. Razmi GHR. Survey of dogs' parasites in Khorasan Razavi Province, Iran. Iran J Parasitol. 2009;4(4):48–54.
262. Rokni MB. The present status of human helminthic diseases in Iran. Ann Trop Med Parasitol. 2008;102(4):283–95.
263. Traversa D, Frangipane di Regalbono A, Di Cesare A, La Torre F, Drake J, Pietrobelli M. Environmental contamination by canine geohelminths. Parasit Vectors. 2014;7:67.
264. Moskvina TV, Ermolenko AV. Helminth infections in domestic dogs from Russia. Vet World. 2016;9(11):1248–58.
265. Popiołek M, Jarnecki H, Łuczyński T. The first record of *Molineus patens* (Dujardin, 1845) (Nematoda, Molineidae) in the ermine (*Mustela erminea* L.) in Poland. Wiad Parazytol. 2009;55(4):433–5.
266. Addison EM, Fraser GA. Life cycle of *Crenosoma petrowi* (Nematoda: Metastrongyloidea) from black bears (*Ursus americanus*). Can J Zool. 1994;72(2):300–2.
267. Ribas A, Milazzo C, Foronda P, Casanova JC. New data on helminths of stone marten, *Martes foina* (Carnivora, Mustelidae), in Italy. Helminthologia. 2004; 41(1):59–61.
268. Merrill JR, Otis J, Logan WD Jr, Davis MB. The dog heartworm (*Dirofilaria immitis*) in man. An epidemic pending or in progress? JAMA 1980;243(10):1066–8.
269. Pampiglione S, Rivasi F. Human dirofilariasis due to *Dirofilaria* (*Nochtiella*) *repens*: an update of world literature from 1995 to 2000. Parassitologia. 2000;42:231–54.
270. Huynh T, Thean J, Maini R. *Dipetalonema reconditum* in the human eye. Br J Ophthalmol. 2001;85:1384.
271. Simón F, Siles-Lucas M, Morchón R, González-Miguel J, Mellado I, Carretón E, Montoya-Alonso JA. Human and animal dirofilariasis: the emergence of a zoonotic mosaic. Clin Microbiol Rev. 2012;25(3):507–44.
272. Burns RP, Helzerman R, Patrick M, Gerhardt N, Beaver PC. Intraocular filiariasis (a motion picture). Trans Sect Ophthalmol Am Acad Ophthalmol Otolaryngol. 1975;79(5):745–8.
273. Beaver PC, Meyer EA, Jarroll EL, Rosenquist RC. *Dipetalonema* from the eye of a man in Oregon, USA. A case report. Am J Trop Med Hyg. 1980;29(3): 369–72.
274. Otranto D, Cantacessi C, Dantas-Torres F, Brianti E, Pfeffer M, Genchi C, et al. The role of wild canids and felids in spreading parasites to dogs and cats in Europe. Part II: helminths and arthropods. Vet Parasitol. 2015;213(1–2):24–37.
275. Campbell B, Little MD. Identification of the eggs of a nematode (*Eucoleus boehmi*) from the nasal mucosa of north American dogs. J Am Vet Med Assoc. 1991;198:1520–3.
276. Cross JH. Intestinal capillariasis. Clin Microbiol Rev. 1992;5(2):120–9.
277. Lalosević D, Lalosević V, Klem I, Stanojev-Jovanović D, Pozio E. Pulmonary capillariasis miming bronchial carcinoma. Am J Trop Med Hyg. 2008;78(1):14–6.
278. Guiliano DB, Oksov Y. *Trichinella* and the nurse cell. In: Schaible UE, Haas A, editors. Intracellular niches of microbes: a pathogens guide through the host cell. Weinheim: Wiley-Blackwell; 2009.
279. Beaver PC, Jung RC, Cupp EW. Clinical parasitology. 9th ed. Philadelphia: Lea and Febiger; 1984.
280. World Health Organization: Dracunculiasis (guinea-worm disease). http://www.who.int/mediacentre/factsheets/fs359/en/ (Updated January 2017). Accessed 10 April 2017.
281. Genis DE. New cases of detection of *Dracunculus medinensis* L. 1758 in domestic animals (cats and dogs) in Kazakhstan. Med Parazitol (Moscow). 1972;41(3):365. (In Russian).
282. Cairncross S, Muller R, Zagaria N. Dracunculiasis (Guinea worm disease) and the eradication initiative. Clin Microbiol Rev. 2002;15(2):223–46.
283. Waikagul J, Diaz Chamacho SP. Gnathostomiasis. In: Murrell KD, Fried B, editors. Food-borne parasitic zoonoses: fish and plant-borne parasites. New York: Springer; 2007. p. 235–61.
284. Ignjatovic I, Stojkovic I, Kutlesic C, Tasic S. Infestation of the human kidney with *Dioctophyma renale*. Urol Int. 2003;70(1):70–3.
285. Traub RJ, Robertson ID, Irwin P, Mencke N, Thompson RC. The role of dogs in transmission of gastrointestinal parasites in a remote tea-growing community in northeastern India. Am J Trop Med Hyg. 2002;67(5):539–45.
286. Radev V, Lalkovski N, Zhelyazkov P, Kostova T, Sabev P, Nedelchev N, Vassileva R. Prevalence of gastrointestinal parasites and *Dirofilaria* spp. in stray dogs from some regions in Bulgaria. Bulg J Vet Med. 2016; 19(1):57–62.
287. Berkovitz A, Waner T, King R, Perl S. Concurrent parasitation with *Sarcoptes* and *Demodex* in a golden jackal. Israel J Vet Med. 2009;64(1):10–1.
288. Mitchell RM. A list of ectoparasites from nepalese mammals, collected during the Nepal ectoparasite program. J Med Entomol. 1979;16(3):227–33.
289. Sharif M. A revision of the Indian Ixodidae with special reference to the collection in the Indian museum. Rec Indian Museum. 1928;30:217–344.
290. Morel PC. Tiques d'animaux sauvages en Haute-Volta. Rev Elev Med Vet Pays Trop. 1978;31(1):69–78.
291. Camicas JL. Contribution a l'étude des tiques du Sénégal (Acarina, Ixodoidea). I. Les larves d'*Amblyomma* Koch et de *Hyalomma* Koch. Acarologia. 1970;12(1):71–102.
292. Stojanov I, Pušić I, Pavlović I, Prodanov Radulović J, Kapetanov M, Ratajac R. Findings of ticks in some species of wild carnivores. In: Mihajla D, editor. Proceedings of International Symposium on Hunting: Modern aspects of sustainable management of game population. Novi Sad: Visio Mundi Academic Media Group; 2014. p. 154–8.
293. Hornok S, Fuente J, Horváth G, Fernández de Mera IG, Wijnveld M, Tánczos B, et al. Molecular evidence of *Ehrlichia canis* and *Rickettsia massiliae* in ixodid ticks of carnivores from South Hungary. Acta Vet Hung. 2013;61(1): 42–50.
294. D'Amico G, Dumitrache MO, Matei IA, Ionică AM, Gherman CM, Sándor AD, et al. Ixodid ticks parasitizing wild carnivores in Romania. Exp Appl Acarol. 2017;71(2):139–49.
295. Razmjoo M, Bahrami AM, Hosseini E. Ectoparasitic species from red fox and jackal in western of Iran. Glob Vet. 2013a;10(6):626–9.
296. Razmjoo M, Bahrami AM, Hosseini E. Infestation diagnosis of ectoparasitism in red fox and jackals in south-west of Iran. Adv Biores. 2013b;4(3):123–6.
297. Shubber HWK, Al-Hassani NA, Mohammad MK. Ixodid ticks diversity in the middle and south of Iraq. Int J Recent Sci Res. 2014;5(9):1518–23.
298. Feldman-Muhsam B. A note on East Mediterranean species of the *Haemophysalis*. Bull Res Counc Isr. 1951;1:96–107.
299. Keysary A, Eremeeva ME, Leitner M, Din AB, Wikswo ME, Mumcuoglu KY, et al. Spotted fever group rickettsiae in ticks collected from wild animals in Israel. Am J Trop Med Hyg. 2011;85(5):919–23.
300. Kaul HN, Dhanda V, Mishra AC. A survey of ixodid ticks in Orissa state, India. Indian J Anim Sci. 1979;49:707–12.
301. Hoogstraal H. Identity, hosts and distribution of *Haemaphysalis* (*Rhipistoma*) *canestrinii* (Supino) (resurrected), the postulated Asian progenitor of the African Leachi complex (Ixodoidea: Ixodidae). J Parasitol. 1971;57(1):161–72.
302. Geevarghese G, Fernandes S, Kulkarni SM. A checklist of Indian ticks (Acari: Ixodoidea). Indian J Anim Sci. 1997;67(5):566–74.
303. Rebello MJ, Reuben R. A report of ticks collected from birds and small mammals in North Arcot and Chittoor districts, South India. J Bombay Natural Hist Soc. 1966;63(2):283–9.
304. Hoogstraal H, Trapido H. *Haemaphysalis kutchensis* sp. n., a common larval and nymphal parasite of birds in northwestern India (Ixodoidea, Ixodidae). J Parasitol. 1963;49(3):489–97.
305. Hoogstraal H. Notes on African *Haemaphysalis* ticks. IV. Description of Egyptian populations of the yellow dog-tick, *H. leachii leachii* (Audouin, 1827) (Ixodoidea, Ixodidae). J Parasitol. 1958;44(5):548–58.

306. Mitchell CJ, Hoogstraal H, Schaller GB, Spillet J. Ectoparasites from mammals in Kanha National Park, Madhya Pradesh, India, and their potential disease relationships. J Med Ent. 1966;3(2):113–24.
307. Hoogstraal H. Identity, distribution, and hosts of *Haemaphysalis* (*Rhipistoma*) *indica* Warburton (resurrected) (Ixodoidea: Ixodidae), a carnivore parasite of the Indian subregion. J Parasitol. 1970;56(5):1013–22.
308. Galli VB. Notes de parasitologie et de technique parasitologique. Zbl Bakteriol. 1909;51:538–45.
309. El Kammah KM, Hoogstraal H, Camicas JL. Notes on African *Haemaphysalis* ticks: XI. *H.* (*Rhipistoma*) *paraleachi* (Ixodoidea: Ixodidae) distribution and hosts of adults. Int J Acarol. 1992;18(3):205–12.
310. Dias Travassos Santos JA. Contribuição para o conhecimento da fauna ixodológica da Índia portuguesa. An Inst Med Trop. 1954;11(2):361–439.
311. Theodor O, Costa M. A survey of the parasites of wild mammals and birds in Israel. Part one. Ectoparasites. The Israel Academy of Sciences and Humanities: Jerusalem; 1967.
312. Mihalca AD, Dumitrache MO, Magdaş C, Gherman CM, Domşa C, Mircean V, et al. Synopsis of the hard ticks (Acari: Ixodidae) of Romania with update on host associations and geographical distribution. Exp Appl Acarol. 2012;58:183–206.
313. Abusalimov NS. [Cattle, pigs, wild deer and jackals as hosts of *Hyalomma aegyptium* Linne 1758.] Doklady Akademii Nauk Azerbaijan SSR. 1958;14:543–545 (In Russian).
314. Abbassian-Lintzen R. A preliminary list of ticks (Acariña: Ixodoidea) occurring in Iran and their distributional data. Acarologia. 1960;2(1):43–61.
315. Hoogstraal H, Clifford CM, Saito Y, Keirans JE. *Ixodes* (*Partipalpiger*) *ovatus* Neumann, subgen. Nov.: identity, hosts, ecology, and distribution (Ixodoidea: Ixodidae). J Med Entomol. 1973;10(2):157–64.
316. Dumitrache MO, Gherman CM, Cozma V, Mircean V, Györke A, Sándor AD, Mihalca AD. Hard ticks (Ixodidae) in Romania: surveillance, host associations, and possible risks for tick-borne diseases. Parasitol Res. 2012;110(5):2067–70.
317. Leulmi H, Aouadi A, Bitam I, Bessas A, Benakhla A, Raoult D, Parola P. Detection of *Bartonella tamiae*, *Coxiella burnetii* and rickettsiae in arthropods and tissues from wild and domestic animals in northeastern Algeria. Parasit Vectors. 2016;9:27.
318. Bursali A, Keskin A, Tekin S. A review of the ticks (Acari: Ixodida) of Turkey: species diversity, hosts and geographical distribution. Exp Appl Acarol. 2012;57:91–104.
319. Aneurin LE. Some tick investigations in Kenya Colony. Parasitology. 1932;24(2):175–82.
320. Hubbard CA. Some ticks from Iraq. Ent News. 1955;66(7):189–91.
321. Emerson KC, Price RD. A host-parasite list of the Mallophaga on mammals. Miscell Publ Entomol Soc America Washington. 1981;12:1–72.
322. Plomley NJB. Notes on the systematics of two species of *Heterodoxus* (Mallophaga, Boopidae). Pap Proc Roy Soc Tasmania. 1939;1940:19–26.
323. Tulov AV, Zverjanovskii MI, Zabashta SN. [Associations of consorts in populations of flea at common jackal (*Canis aureus* L.) in the conditions of Krasnodar Region.] Current Issues in Veterinary Biology. 2013;1(17): 31 (In Russian).
324. Pajot FX. Les poux (Insecta, Anoplura) de la région afrotropicale. Paris: IRD. Collection Faune et Flore tropicales; 2000.
325. Lewis RE. Siphonaptera collected during the 1965 Street Expedition to Afghanistan. Fieldiana Zool. 1973;64:1–161.
326. Farhang-Azad A. The flea fauna of Iran. II. A collection of fleas from Esfahan (Central Iran). Ann Mag Nat Hist. 1966;13(9:103–105):343–6.
327. Haeselbarth E, Segerman J, Zumpt Fritz KE. The arthropod parasites of vertebrates in Africa south of the Sahara (Ethiopian region). Volume III (Insecta excl. Phthiraptera). Publ South African Inst Med Res. 1966;13(52):1–283.
328. Kulkarni SM, Bhat HR, Dhanda V. A survey of haematophagous arthropods in western Himalayas, Sikkim and hill districts of West Bengal fleas (Siphonaptera). Indian J Med Res. 1974;62(7):1061–88.
329. Dumitrache MO, Kiss B, Dantas-Torres F, Latrofa MS, D'Amico G, Sándor AD, Mihalca AD. Seasonal dynamics of *Rhipicephalus rossicus* attacking domestic dogs from the steppic region of southeastern Romania. Parasit Vectors. 2014;7:97.
330. Földvári G, Farkas R. Ixodid tick species attaching to dogs in Hungary. Vet Parasitol. 2005;129(1–2):125–31.
331. Walker JB, Keirans JE, Horak IG. The genus *Rhipicephalus* (Acari, Ixodidae): a guide to the brown ticks of the world. New York: Cambridge University Press; 2000.
332. Albrechtová K, Sedlák K, Petrželková KJ, Hlaváč J, Mihalca AD, Lesingirian A, et al. Occurrence of filaria in domestic dogs of Samburu pastoralists in northern Kenya and its associations with canine distemper. Vet Parasitol. 2011;182(2–4):230–8.
333. Taylor MA, Coop RL, Wall RL. Veterinary parasitology. 3rd ed. Oxford: Blackwell Publishing; 2007.
334. Nabavi R, Manouchehri Naeini K, Zebardast N, Hashemi H. Epidemiological study of gastrointestinal helminthes of canids in Chaharmahal and Bakhtiari Province of Iran. Iran J Parasitol. 2014;9(2):276–81.
335. Loos-Frank B. Cestodes of the genus *Mesocestoides* (Mesocestoididae) from carnivores in Israel. Israel J Zool. 1990;37(1):3–13.
336. Zare-Bidaki M, Mobedi I, Sadeghieh Ahari S, Habibizadeh S, Naddaf SR, Siavashi MR. Prevalence of zoonotic intestinal helminths of canids in Moghan plain, northwestern Iran. Iran J Parasitol. 2010;5(2):42–51.
337. Nama HS. Comparative study of the cestodes *Mesocestoides carnivoricolus* and *M. lineatus*. Biology. 1981;3(3):31–4.
338. Gasarov MI, Plieva AM. Helminth fauna of carnivores caught at the territory of the Republic of Ingushetia. Theor Pract Parasit Dis Anim. 2010;11:112–6. (In Russian).
339. Zverzhanovsky MI, Basova NY, Tulov AV. Parasitocenosis of jackals (*Canis aureus* L.) with participation of *Dirofilaria immitis* (Leidy, 1856) in trophic-epizootoloical chains of premountain zone of the Krasnodar Territory. Theor Pract Parasit Dis Animals - Biology. 2011;12:212–5 (In Russian).
340. Mimioğlu MM, Güralp N, Tolgay N, Sayn F. Ankara civarnda tilkilerde (*Vulpes vulpes*) bulduğumuz helmintler. Ankara Univ Vet Fak Derg. 1965;12:164–90.
341. Kornyushin VV, Malyshko (Varodi) EI, Malega AM. The helminths of wild predatory mammals of Ukraine. Cestodes Vestn Zool. 2011;45(6):e1–8.
342. Sadykhov IA. A new cestode species - *Mesocestoides petrowi* nov. sp. - from the intestine of fox (*Vulpes vulpes*). Sb Rab Gel'mintol. 1971:351–3. (In Russian).
343. Chertkova AN, Kosupko GA. Cestodes of the genus *Mesocestoides* found in domestic and wild animals in USSR and some principles of their systematics. Trudy Vsesoyuznogo Instituta Gel'mintologii im KI Skryabina Teoreticheskie Problemy Veterinarnoi Gel'mintologii. 1975;22:193–211. (In Russian).
344. Breyer I, Georgieva D, Kurdova R, Gottstein B. *Echinococcus granulosus* strain typing in Bulgaria: the G1 genotype is predominant in intermediate and definitive wild hosts. Parasitol Res. 2004;93(2):127–30.
345. Dissanaike AS, Paramananthan DC. On the occurrence of *Echinococcus granulosus* (Batsch,1786) in a Ceylon jackal. Ceylon Vet J. 1960;8(3/4):82–7.
346. Troncy P, Graber M. L'échinococcose-hydatidose en Afrique centrale. III. - Teniasis des carnivores à *Echinococcus granulosus* (Bats& 1186 - Rudolphi, 1801). Rev Elev Méd Vet Pays Trop. 1969;22(1):75–84.
347. Yandarhanov HS. Species composition, ecological and biological characteristics and communication biocenotic trematodes and cestodes mining of the Chechen Republic. The South of Russia: ecology, development. 2010;3:94–9. (In Russian).
348. Belyaeva AM. The role of wildlife (carnivores, cloven-hoofed animals and rodents) in the epizootology of echinococcosis. Vet Pathol Moscow. 2006;2(17):117–9.
349. Rao AT, Acharjyo LN. Diagnosis and classification of common diseases of captive animals at Nandankanan zoo in Orissa (India). Indian J Anim Health. 1984;2:147–52.
350. Zariffard MR. A study on helminthic parasites of wild carnivorous of east Azarbaijan with emphasis on *Echinococcus multilocularis*. Tehran: Tehran University of Medical Sciences. PhD Thesis; 1993.
351. Dalimi A, Motamedi G, Hosseini M, Mohammadian B, Malaki H, Ghamari Z, Ghaffari FF. Echinococcosis/hydatidosis in western Iran. Vet Parasitol. 2002;105(2):161–71.
352. Arbabi M, Hooshyar H. Survey of echinococcosis and hydatidosis in Kashan region, central Iran. Iran J Publ Health. 2006;35(1):75–81.
353. Beiromvand M, Akhlaghi L, Fattahi Massom SH, Mobedi I, Meamar AR, Oormazdi H, et al. Detection of *Echinococcus multilocularis* in carnivores in Razavi Khorasan province, Iran using mitochondrial DNA. PLoS Negl Trop Dis. 2011;5(11):e1379.
354. Mobedi I, Zare-Bidaki M, Siavashi MR, Naddaf SR, Kia EB, Mahmoudi M. Differential detection of *Echinococcus* spp. copro-DNA by nested-PCR in domestic and wild definitive hosts in Moghan plain, Iran. Iran J Parasitol. 2013;8(1):107–13.
355. Gholami S, Jahandar H, Abastabar M, Pagheh A, Mobedi I, Sharbatkhori M. *Echinococcus granulosus sensu stricto* in dogs and jackals from Caspian Sea region, northern Iran. Iran J Parasitol. 2016;11(2):186–94.
356. Panceri P. Due fatti relativi ai Cestodi. Rend dell'Acad Sci Ficici e Mat Napoli. 1868;6:32–4.

357. Macpherson CNL, Karstad L. The role of jackals in the transmission of *Echinococcus granulosus* in the Turkana District of Kenya. In: Karstad L, Nestel B, Graham M, editors. Wildlife disease research and economic development. Ottawa: International Development Research Centre; 1980. p. 53–6.
358. Witenberg G. Zur Kenntnis der Verbreitung von Echinokokkus und Trichinen in Palastina. Arch Schiffs- Tropenhyg. 1933;37:37–41.
359. Iqbal Z, Danso P, Hayat CS, Khan MN. Epidemiology of hydatid disease. Echinococcosis in dogs and jackals in Faisalabad (Pakistan). Indian Vet J. 1996;73(6):620–2.
360. Ulyanov SD. A study on the role of wolves and jackals in spreading larval cestodosis animals. Tr NIVI Kazakh Phil Academy of Agricultural Sciences. 1957;9:402–4. (In Russian).
361. Elkanova ZZ. [Epizootological and epidemiological characteristics of foci of echinococcosis in animals and humans in the ecosystem of the Kabardino-Balkarian Republic.] Moscow: Thesis for the degree of candidate of biological sciences; 2010 (In Russian).
362. Bichieva MM, Atabieva JA, Levchenko NV, Bittirov AM, Shikhaliyev MA, Sarbasheva MM. Epizootological features of Echinococcosis in dogs and wild carnivores in the foothills of the North Caucasus. Vet Pathol. (Moscow). 2011;4(38):103–5. (In Russian).
363. Razikov S, Shodmonov IS, Adylov MH. The role of wild animals (carnivorous, artiodactyl and rodents) in epizootology of echinococcosis in Tadjikistan. Russian Parasitol J. 2010;4:59–63. (In Russian).
364. Boufana B, Lahmar S, Rebaï W, Safta ZB, Jebabli L, Ammar A, et al. Genetic variability and haplotypes of *Echinococcus* isolates from Tunisia. T Roy Soc Trop Med H. 2014;108(11):706–14.
365. Széll Z, Marucci G, Pozio E, Sréter T. *Echinococcus multilocularis* and *Trichinella spiralis* in golden jackals (*Canis aureus*) of Hungary. Vet Parasitol. 2013;197(1–2):393–6.
366. Zariffard MR, Massoud J. Study of *Echinococcus granulosus* and *Echinococcus multilocularis* infections in Canidiae in Ardabile province of Iran. Arch Inst RAZI. 1998;48/49:47–52.
367. Lalošević D, Lalošević V, Simin V, Miljević M, Čabrilo B, Bjelić ČO. Spreading of multilocular echinococcosis in southern Europe: the first record in foxes and jackals in Serbia, Vojvodina Province. Eur J Wildl Res. 2016;62(6):793–6.
368. Kairov IK. [A study of multilocular hydatidosis in Karakalpakiya.] Sovremennoe sostoyanie prirodnykh resursov Karakalpakii. 1977;177–189 (In Russian).
369. Acharjyo LN. Helminthiasis in captive wild carnivores and its control in India. Zoo's Print J. 2004;19(7):1540–3.
370. Polishchuk VI, Dolgov VV. *Multiceps* infection in carnivores and coenuriasis in sheep in southern and central Tadzhikistan, USSR. Trudy NauchnoIssledovatel'skogo Veterinarnogo Instituta Tadzhikskoi SSR. 1979;9:78–80. (In Russian).
371. Zhang L, Hu M, Jones A, Allsopp BA, Beveridge I, Schindler AR, Gasser RB. Characterization of *Taenia madoquae* and *Taenia regis* from carnivores in Kenya using genetic markers in nuclear and mitochondrial DNA, and their relationships with other selected taeniids. Mol Cell Probes. 2007;21(5–6):379–85.
372. Shemshadi B, Ranjbar-Bahadori S, Jahani S. Prevalence and intensity of intestinal helminths in carnivores and primates at Vakilabad zoo in Mashhad, Iran. Comp Clin Pathol. 2014;24(2):387–91.
373. Nelson GS, Pester FRN, Rickman R. The significance of wild animals in the transmission of cestodes of medical importance in Kenya. Trans R Soc Trop Med Hyg. 1965;59(6):507–24.
374. Balkizova ZV, Chilayev SS. Hydatid teniasis of carnivores in the ecosystem of the Central Caucasus region. Bull Krasnoyarsk State Agrarian Univ. 2008;2: 179–82. (In Russian).
375. Kamburov P, Georgieva D. Some data on *Taenia ovis* and *Cysticercus ovis* morphology. Helminthologia. 1984;21(3):195–8.
376. Abuladze KI. [Principles of cestodology. Volume IV. Taeniata. Cestodes of animals and man and the diseases caused by them.] Moscow: Izdatel'stvo 'Nauka'; 1964 (In Russian).
377. Nama HS. Cestode parasites of Indian mammals. New Delhi: Scientific Publishers; 1990.