

Supplementary data

Giardia and *Cryptosporidium* in mammalian wildlife – current status and future needs

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Table S1. A selection of worldwide prevalence studies of *Giardia* spp. in free-living mammalian wildlife. Prevalence data that included molecular analysis are indicated by an asterisk (*)

Country	Host species	% Positive (sample size)	Refs
Australia	feral cat (<i>felis spp.</i>)	21% (39)	[1]
	quenda (<i>Isoodon obesulus</i>)	1% (77)	[2]
	house mouse (<i>Mus musculus</i>)	25% (129)	[3]
Brazil	hairy-tailed bolo mouse (<i>Bolomys lasiurus</i>)	14% (7)	[4]
	water rat (<i>Nectomys squamipes</i>)	34% (168)	[4]
	black rat (<i>Rattus rattus</i>)	100% (3)	[4]
Canada	dall sheep (<i>Ovis dalli</i>)	40% (5)	[5]
	coyote (<i>Canis latrans</i>)	66% (3)	[5]
	wolf (<i>Canis occidentalis</i>)	33% (3)	[5]
	ringed seal (<i>Phoca hispida</i>)	20% (15)	[6]
	harp seal (<i>Phoca groenlandica</i>)	50% (30)	[7]
	harbour seal (<i>Phoca vitulina</i>)	25% (16)	[7]
	grey seal (<i>Halichoerus grypus</i>)	17% (6)	[7]
	brown bear (<i>Ursus arctos</i>)	100% (3)	[5]
	beaver (<i>Castor canadensis</i>)	15% (94)	[8]
	beaver (<i>Castor canadensis</i>)	4% (58)	[9]
	beaver (<i>Castor canadensis</i>)	4% (51)	[10]
	beaver (<i>Castor canadensis</i>)	14% (14)	[5]
	beaver (<i>Castor canadensis</i>)	33% (27)	[11]
	deer mouse (<i>Peromyscus maniculatus</i>)	10% (50)	[9]
	wood rat (<i>neotoma cinerea</i>)	7% (15)	[10]
	long-tailed vole (<i>Microtus longicaudus</i>)	33% (3)	[9]
	meadow vole (<i>Microtus pennsylvanicus</i>)	33% (6)	[9]
	meadow vole (<i>Microtus pennsylvanicus</i>)	75% (6)	[10]
	red-backed vole (<i>Clethrionomys gapperi</i>)	95% (21)	[9]
	red-backed vole (<i>Clethrionomys gapperi</i>)	86% (21)	[10]
heather vole (<i>phenacomys intermedius</i>)	50% (2)	[10]	
muskrat (<i>Ondatra zibethicus</i>)	25% (12)	[5]	

Egypt	Brown rat (<i>Rattus norvegicus</i>)	8% (39)	[12]
Germany	muskrat (<i>Ondatra zibethicus</i>)	75% (234)	[13]
Japan	large japanese field mouse (<i>Apodemus speciosus</i>)	62% (58)	[14]
	japanese field mouse (<i>Apodemus argenteus</i>)	14% (29)	[14]
	Japanese grass vole (<i>Microtus montebelli</i>)	100% (7)	[14]
Norway	beaver (<i>Castor fiber</i>)	0% (241)	[15]
Poland	field mouse (<i>Apodemus flavicollis</i>)	48% (209)	[16]
	bank vole (<i>Clethrionomys glareolus</i>)	94% (459)	[16]
	common vole (<i>Microtus arvalis</i>)	96% (274)	[16]
Rwanda	Mountain gorilla (<i>Gorilla gorilla beringei</i>)	3% (70)	[17]
Saudi Arabia	Hamadryas Baboon (<i>Papio hamadryas</i>)	9% (115)	[18]
	Hamadryas Baboon (<i>Papio hamadryas</i>)	26% (633)	[19]
Thailand	Leopard (<i>Panthera pardus</i>)	2% (54)	[20]
Uganda	Olive babboon (<i>Papio anubis</i>)	58% (140)	[21]
	Mountain gorilla (<i>Gorilla gorilla beringei</i>)	2% (100)*	[22,23]
USA	tule elk (<i>Cervus elaphus nannodes</i>)	4% (82)*	[24]
	elk (<i>spp.</i> not reported)	2% (115)	[25]
	white-tailed deer (<i>Odocoileus virginianus</i>)	1% (394)	[26]
	white-tailed deer (<i>Odocoileus virginianus</i>)	4% (28)*	[27]
	coyote (<i>Canis latrans</i>)	4% (22)*	[28]
	sea lion (<i>Zalophus californianus</i>)	33% (6)*	[29]
	northern racoon (<i>Procyon lotor</i>)	0% (128)	[30]
	water shrew (<i>Sorex palustris</i>)	1 (8)	[31]
	beaver (<i>Castor canadensis</i>)	33% (100)	[32]
	beaver (<i>Castor canadensis</i>)	37% (790)	[33]
	beaver (<i>Castor canadensis</i>)	0% (32)	[34]
	beaver (<i>Castor canadensis</i>)	47% (1257)	[35]
	beaver (<i>Castor canadensis</i>)	24% (313)	[25]
	pocket gopher (<i>Geomysidae sp.</i>)	4 (9)	[31]
	water vole (<i>Microtus richardsoni</i>)	100% (23)	[25]
	water vole (<i>Microtus richardsoni</i>)	4 (not reported)	[31]
	long-tailed vole (<i>Microtus longicaudus</i>)	100% (18)	[25]
	Montane vole (<i>Microtus montanus</i>)	100% (90)	[31]
	Meadow vole (<i>Microtus pennsylvanicus</i>)	2 (not reported)	[31]
	muskrat (<i>Ondatra zibethicus</i>)	96% (219)	[33]
muskrat (<i>Ondatra zibethicus</i>)	83% (6)	[35]	
muskrat (<i>Ondatra zibethicus</i>)	82% (189)	[36]	
nutria (<i>Myocastor coypus</i>)	73% (30)	[32]	

Table S2. A selection of worldwide prevalence studies of *Cryptosporidium* spp. in free-living mammalian wildlife. Prevalence data that included molecular analysis are indicated by an asterisk (*)

Country	Host species	% Positive (sample size)	Refs
Australia	grey kangaroo (<i>Macropus giganteus</i>)	51 (not reported)*	[37]
Canada	beaver (<i>Castor canadensis</i>)	2% (27)	[11]
Denmark	roe deer (<i>Capreolus capreolus</i>)	2% (103)	[38]
Egypt	brown rat (<i>Rattus norvegicus</i>)	43% (172)	[12]
Ethiopia	olive babboon (<i>Papio anubis</i>)	12% (59)	[39]
	vervet (<i>Chlorocebus aethiops</i>)	29% (41)	[39]
Finland	bank vole (<i>Clethrionomys glareolus</i>)	5% (41)	[40]
	field vole (<i>Microtus agrestis</i>)	1% (131)	[40]
	tundra vole (<i>Microtus oeconomus</i>)	0% (43)	[40]
Italy	red-squirrel (<i>Sciurus vulgaris</i>)	32% (85)	[41]
Japan	japanese field mouse (<i>Apodemus argenteus</i>)	8% (25)	[42]
	brown rat (<i>Rattus norvegicus</i>)	16% (61)	[43]
	brown rat (<i>Rattus norvegicus</i>)	8% (61)	[43]
	brown rat (<i>Rattus norvegicus</i>)	27% (141)	[44]
	brown rat (<i>Rattus norvegicus</i>)	45% (47)	[44]
	black rat (<i>Rattus rattus</i>)	10% (175)	[45]
	brown rat (<i>Rattus norvegicus</i>)	4% (48)	[45]
Kenya	olive babboon (<i>Papio anubis</i>)	28% (60)	[46]
	olive babboon (<i>Papio anubis</i>)	28% (59)	[47]
	vervet (<i>Chlorocebus aethiops</i>)	71% (58)	[47]
Korea	mice (<i>Mus spp.</i>)	30% (250)	[48]
	brown rat (<i>Rattus norvegicus</i>)	13% (195)	[48]
Norway	moose (<i>Alces alces</i>)	0% (72)	[49]
	beaver (<i>Castor canadensis</i>)	0% (182)	[15]
Poland	common shrew (<i>Sorex araneus</i>)	31% (16)	[50]
	beaver (<i>Castor canadensis</i>)	11% (19)	[51]
	yellow-necked mouse (<i>Apodemus flavicollis</i>)	28% (209)*	[16,52]
	yellow-necked mouse (<i>Apodemus flavicollis</i>)	15% (39)	[50]
	striped field mouse (<i>Apodemus agrarius</i>)	1 (not reported)	[51]
	field mouse (<i>Apodemus spp.</i>)	24% (70)	[51]
	bank vole (<i>Clethrionomys glareolus</i>)	71% (459)*	[16,52]
	bank vole (<i>Clethrionomys glareolus</i>)	23% (102)	[51]
	bank vole (<i>Clethrionomys glareolus</i>)	20% (275)	[50]
	common vole (<i>Microtus arvalis</i>)	73% (274)*	[16,52]
	common vole (<i>Microtus arvalis</i>)	4 (not reported)	[51]
	muskrat (<i>Ondatra zibethicus</i>)	55% (9)	[51]
Spain	white-toothed shrew (<i>Crocidura russula</i>)	15% (88)	[53]
	woodmouse (<i>Apodemus sylvaticus</i>)	49% (302)	[53]
	bank vole (<i>Clethrionomys glareolus</i>)	33% (49)	[53]
	algerian mouse (<i>Mus spretus</i>)	32% (22)	[53]
Tanzania	wildebeests (<i>Connochaetes gnou</i>)	27% (26)	[54]
	african Buffalo (<i>Syncerus caffer</i>)	22% (36)	[54]

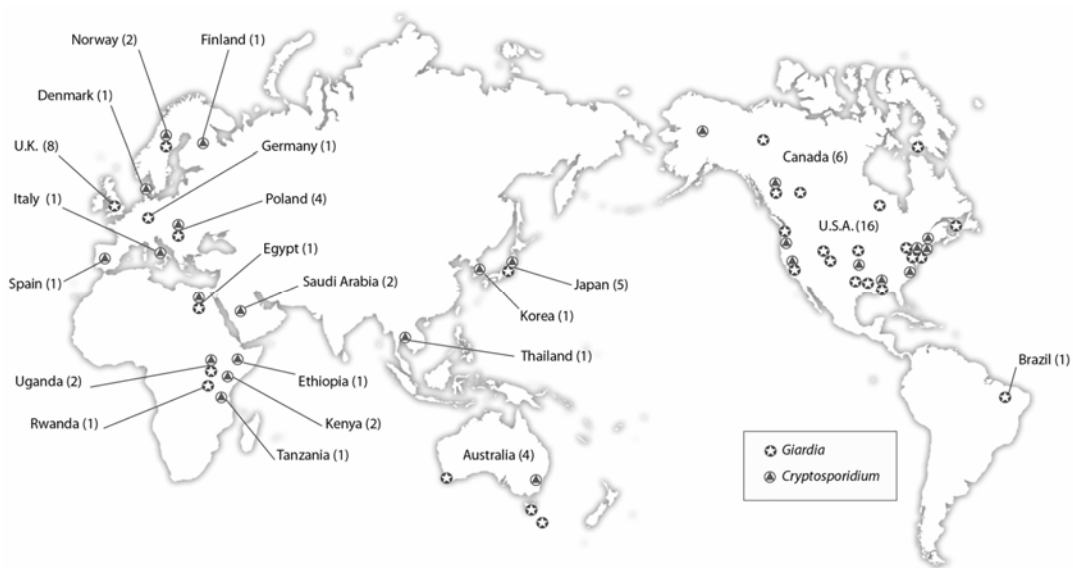
Uganda	zebra (<i>Equus zebra</i>)	28% (25)	[54]
	olive babboon (<i>Papio anubis</i>)	32% (140)*	[21]
	mountain gorilla (<i>Gorilla gorilla beringei</i>)	11% (100)*	[23]
UK	fallow deer and muntjac deer (<i>Dama dama</i> and <i>Muntiacus reevesi</i>)	9% (58)	[55]
	fox (<i>Vulpes vulpes</i>)	9% (23)	[55]
	badger (<i>Meles meles</i>)	15% (26)	[55]
	hedehog (<i>Erinaceus europaeus</i>)	25% (4)	[55]
	common and pygmy shrew (<i>Sorex araneus</i> and <i>S. minutus</i>)	7% (30)	[55]
	rabbit (<i>Oryctolagus cuniculus</i>)	7% (28)	[55]
	woodmouse (<i>Apodemus sylvaticus</i>)	16% (230)	[56]
	bank vole (<i>Clethrionomys glareolus</i>)	51% (114)	[57]
	bank vole (<i>Clethrionomys glareolus</i>)	10% (123)	[56]
	house mouse (<i>Mus musculus</i>)	50% (58)	[58]
	house mouse (<i>Mus musculus</i>)	13% (242)	[56]
	wild rodents (<i>Mus spp.</i>)	30% (nr)	[59]
	brown rat (<i>Rattus norvegicus</i>)	24% (438)	[60]
	brown rat (<i>Rattus norvegicus</i>)	63% (73)	[61,62]
	USA	caribou (<i>Rangifer tarandus</i>)	6% (49)*
tule elk (<i>Cervus elaphus nannodes</i>)		20% (40)*	[24]
mule deer (<i>Odocoileus hemionus</i>)		13% (38)*	[24]
white-tailed deer (<i>Odocoileus virginianus</i>)		11% (91)*	[64]
white-tailed deer (<i>Odocoileus virginianus</i>)		5% (360)	[26]
white-tailed deer (<i>Odocoileus virginianus</i>)		9% (34)	[26]
deer (<i>spp.</i> not reported)		3 (not reported)*	[65]
fox (<i>spp.</i> not reported)		8% (76)*	[66]
striped skunk (<i>Mephitis mephitis</i>)		50% (2)*	[64]
california sea lion (<i>Zalophus californianus</i>)		50% (6)*	[29]
raccoon (<i>Procyon lotor</i>)		13% (100)	[67]
raccoon (<i>Procyon lotor</i>)		20% (5)*	[64]
raccoon (<i>Procyon lotor</i>)		4% (51)*	[66]
beaver (<i>Castor canadensis</i>)		0% (87)	[66]
house mouse (<i>Mus musculus</i>)		30% (115)	[68]
muskrat (<i>Ondatra zibethicus</i>)		100% (6)*	[64]
muskrat (<i>Ondatra zibethicus</i>)		8% (237)*	[66]
otter (<i>spp.</i> not reported)		0% (20)	[66]
white-foot mouse (<i>Peromyscus leucopus</i>)		60% (2)*	[64]
cotton rat (<i>Sigmodon hispidus</i>)		11% (9)	[69]
ground squirrel (<i>Spermophilus beecheyi</i>)		16% (309)*	[70]
eastern chipmunk (<i>Tamias striatus</i>)		60% (5)*	[64]

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Supplementary Figure 1. A selection of *Giardia* and *Cryptosporidium* prevalence studies undertaken on free-living mammalian wildlife during the past 20 years. The number of surveys conducted in each country is listed in brackets beside the country name. Of the 68 studies represented, only ten of the *Giardia* studies and 18 of the *Cryptosporidium* surveys were undertaken at the molecular level. Future studies of wildlife that incorporate molecular analysis are paramount for refining the host range, transmission dynamics and zoonotic potential of known and novel *Giardia* and *Cryptosporidium* species and genotypes. Therefore, future studies must be undertaken in defined locations in which host assemblages and their interactions are well understood so that the results of genotyping studies can be put into an ecological context.