

## Appendix 1

Data on rodents and their ectoparasites included in analyses. In parentheses – number of individuals captured/collected. In bold – names of ectoparasites for which more than 20 individuals were collected.

Host	Ectoparasite taxon	Ectoparasite species
<i>Apodemus agrarius</i> (458)	Ticks	<i><b>Ixodes persulcatus</b></i> (665), <i>Dermacentor pictus</i> (1)
	Mites	<i>Ameroseius corbiculus</i> (2), <i>Androlaelaps fahrenheiti</i> (56), <i>Eulaelaps stabularis</i> (34), <i>Euryparasitus emarginatus</i> (2), <i>Haemogamasus ambulans</i> (5), <i>Haemogamasus mandschuricus</i> (9), <i>Haemogamasus nidiformes</i> (1), <i>Hirstionyssus apodemi</i> (13), <i>Hirstionyssus isabellinus</i> (110), <i>Hirstionyssus eusoricis</i> (31), <i>Holoparasitus gontcharovae</i> (24), <i>Iphidosoma fimetarium</i> (1), <i>Laelaps clethrionomydis</i> (25), <i>Laelaps hilaris</i> (3), <i>Laelaps muris</i> (4), <i>Laelaps pavlovskyi</i> (420), <i>Macrocheles glaber</i> (9), <i>Myonyssus ingricus</i> (1), <i>Parasitus coleoptratorum</i> (1), <i>Parasitus consanguineus</i> (43), <i>Parasitus convexus</i> (1), <i>Parasitus fimetorum</i> (2), <i>Parasitus magus</i> (2), <i>Parasitus oudemansi</i> (6), <i>Parasitus remberti</i> (1), <i>Pergamasus crassipes</i> (3), <i>Pergamasus septentrionalis</i> (1), <i>Poecilochirus necrophori</i> (218), <i>Poecilochirus subterraneus</i> (31), <i>Proctolaelaps pygmaeus</i> (17)
	Fleas	<i>Amalaraeus penicilliger</i> (37), <i>Amphipsylla sibirica</i> (1), <i>Ceratophyllus indages</i> (1), <i>Ctenophthalmus assimilis</i> (134), <i>Frontopsylla elata</i> (1), <i>Hystrichopsylla talpae</i> (74), <i>Leptopsylla segnis</i> (4), <i>Megabothris rectangulatus</i> (50), <i>Megabothris turbidus</i> (1), <i>Neopsylla acanthina</i> (93), <i>Neopsylla mana</i> (4), <i>Palaeopsylla soricis</i> (80)
<i>Microtus gregalis</i> (871)	Ticks	<i><b>Ixodes persulcatus</b></i> (1005), <i>Ixodes apronophorus</i> (20)
	Mites	<i>Ameroseius corbiculus</i> (9), <i>Ameroseius lanatus</i> (1), <i>Androlaelaps fahrenheiti</i> (3226), <i>Eulaelaps stabularis</i> (108), <i>Euryparasitus emarginatus</i> (6), <i>Euryparasitus medius</i> (3), <i>Haemogamasus ambulans</i> (19), <i>Haemogamasus mandschuricus</i> (104), <i>Haemogamasus nidi</i> (24), <i>Haemogamasus nidiformes</i> (34), <i>Hirci</i> (1), <i>Hirstionyssus isabellinus</i> (371), <i>Hirstionyssus criceti</i> (1), <i>Hirstionyssus eusoricis</i> (25), <i>Hyperlaelaps arvalis</i> (1), <i>Hypoaspis astronomica</i> (3), <i>Hypoaspis austriacus</i> (2), <i>Hypoaspis vacua</i> (2), <i>Iphidosoma fimetarium</i> (1), <i>Laelaps clethrionomydis</i> (1732), <i>Laelaps hilaris</i> (13), <i>Laelaps muris</i> (3), <i>Laelaps pavlovskyi</i> (13), <i>Lasioseius berlesei</i> (1), <i>Macrocheles decoloratus</i> (6), <i>Macrocheles glaber</i> (21), <i>Macrocheles matrius</i> (22), <i>Macrocheles nataliae</i> (11), <i>Macrocheles rotundiscutus</i> (10), <i>Parasitus asiaticus</i> (1), <i>Parasitus coleoptratorum</i> (2), <i>Parasitus consanguineus</i> (333), <i>Parasitus convexus</i> (15), <i>Parasitus copridis</i> (1), <i>Parasitus fimetorum</i> (34), <i>Parasitus mustelarum</i> (1), <i>Parasitus oudemansi</i> (44), <i>Parasitus remberti</i> (10), <i>Pergamasus crassipes</i> (12), <i>Pergamasus lapponicus</i> (1), <i>Pergamasus misellus</i> (1), <i>Pergamasus septentrionalis</i> (1), <i>Poecilochirus necrophori</i> (168), <i>Poecilochirus subterraneus</i> (30), <i>Proctolaelaps pygmaeus</i> (29)
	Fleas	<i>Amalaraeus penicilliger</i> (581), <i>Amphipsylla sibirica</i> (13), <i>Ceratophyllus indages</i> (2), <i>Ctenophthalmus assimilis</i> (871), <i>Frontopsylla elata</i> (3), <i>Hystrichopsylla talpae</i> (64), <i>Leptopsylla segnis</i> (3), <i>Megabothris rectangulatus</i> (357), <i>Megabothris turbidus</i> (1), <i>Neopsylla acanthina</i> (47), <i>Neopsylla mana</i> (21), <i>Palaeopsylla soricis</i> (73), <i>Rhadinopsylla integella</i> (1)

<i>Microtus oeconomus</i> (491)	Ticks	<i>Ixodes persulcatus</i> (823), <i>Ixodes apronophorus</i> (13)
	Mites	<i>Androlaelaps fabrenholzi</i> (109), <i>Eulaelaps stabularis</i> (26), <i>Euryparasitus emarginatus</i> (6), <i>Haemogamasus ambulans</i> (62), <i>Haemogamasus mandschuricus</i> (6), <i>Haemogamasus nidi</i> (3), <i>Haemogamasus nidiformes</i> (5), <i>Hirstionyssus isabellinus</i> (79), <i>Hirstionyssus eusoricis</i> (60), <i>Laelaps clethrionomydis</i> (39), <i>Laelaps hilaris</i> (130), <i>Laelaps muris</i> (2), <i>Laelaps pavlovskyi</i> (16), <i>Macrocheles glaber</i> (2), <i>Macrocheles nataliae</i> (1), <i>Macrocheles rotundiscutus</i> (1), <i>Myonyssus ingricus</i> (1), <i>Parasitus coleopratorum</i> (4), <i>Parasitus consanguineus</i> (18), <i>Parasitus fimetorum</i> (4), <i>Parasitus oudemansi</i> (30), <i>Parasitus remberti</i> (5), <i>Pergamasus crassipes</i> (1), <i>Pergamasus quisquilarum</i> (3), <i>Pergamasus septentrionalis</i> (3), <i>Poecilochirus necrophori</i> (179), <i>Poecilochirus subterraneus</i> (7), <i>Proctolaelaps pygmaeus</i> (5)
	Fleas	<i>Amalaraeus penicilliger</i> (173), <i>Amphipsylla sibirica</i> (2), <i>Ceratophyllus garei</i> (1), <i>Ceratophyllus indages</i> (1), <i>Ctenophthalmus assimilis</i> (175), <i>Frontopsylla elata</i> (1), <i>Hystrichopsylla talpae</i> (110), <i>Leptopsylla segnis</i> (1), <i>Megabothris rectangulatus</i> (229), <i>Megabothris turbidus</i> (2), <i>Neopsylla acanthina</i> (27), <i>Palaeopsylla soricis</i> (233), <i>Peromyscopsylla bidentata</i> (1), <i>Rhadinopsylla integella</i> (3)
<i>Myodes rutilus</i> (545)	Ticks	<i>Ixodes persulcatus</i> (822), <i>Ixodes apronophorus</i> (4)
	Mites	<i>Ameroseius corbiculus</i> (1), <i>Androlaelaps fabrenholzi</i> (80), <i>Eulaelaps stabularis</i> (32), <i>Haemogamasus ambulans</i> (40), <i>Haemogamasus mandschuricus</i> (1), <i>Haemogamasus nidi</i> (3), <i>Haemogamasus nidiformes</i> (2), <i>Hirstionyssus isabellinus</i> (270), <i>Hirstionyssus eusoricis</i> (20), <i>Holoparasitus gontcharovae</i> (1), <i>Iphidosoma fimetarium</i> (5), <i>Laelaps clethrionomydis</i> (3), <i>Laelaps hilaris</i> (12), <i>Laelaps muris</i> (1), <i>Lasioseius youcefi</i> (1), <i>Macrocheles decoloratus</i> (1), <i>Macrocheles glaber</i> (10), <i>Macrocheles nataliae</i> (1), <i>Parasitus coleopratorum</i> (3), <i>Parasitus consanguineus</i> (38), <i>Parasitus convexus</i> (1), <i>Parasitus fimetorum</i> (3), <i>Parasitus magus</i> (1), <i>Parasitus oudemansi</i> (12), <i>Parasitus remberti</i> (11), <i>Pergamasus crassipes</i> (4), <i>Pergamasus lapponicus</i> (1), <i>Pergamasus misellus</i> (1), <i>Pergamasus septentrionalis</i> (3), <i>Poecilochirus necrophori</i> (347), <i>Poecilochirus subterraneus</i> (55), <i>Proctolaelaps pygmaeus</i> (6)
	Fleas	<i>Amalaraeus penicilliger</i> (165), <i>Amphipsylla sibirica</i> (2), <i>Ceratophyllus indages</i> (4), <i>Ctenophthalmus assimilis</i> (106), <i>Frontopsylla elata</i> (1), <i>Hystrichopsylla talpae</i> (162), <i>Megabothris rectangulatus</i> (199), <i>Megabothris turbidus</i> (1), <i>Neopsylla acanthina</i> (33), <i>Neopsylla mana</i> (5), <i>Palaeopsylla soricis</i> (166), <i>Rhadinopsylla integella</i> (1)
<i>Oxymycterus rufus</i> (139)	Ticks	<i>Ixodes loricatus</i> (11)
	Mites	<i>Androlaelaps fabrenholzi</i> (301), <i>Androlaelaps rotundus</i> (3), <i>Laelaps manguinhosi</i> (8), <i>Laelaps paulistanensis</i> (1), <i>Ornithonyssus bacoti</i> (587)
	Chiggers	<i>Eutrombicula alfreddugesi</i> (2051)
	Fleas	<i>Polygenis atopus</i> (28), <i>Polygenis axius</i> (17), <i>Polygenis frustratus</i> (4), <i>Polygenis massoi</i> (46), <i>Polygenis pradoi</i> (3), <i>Polygenis puelche</i> (1), <i>Polygenis tripus</i> (3)
	Lice	<i>Hoplopleura fonsecai</i> (1)
	Staphylinid beetles	<i>Amblyopinodes gabani</i> (271)
<i>Rhabdomys pumilio</i> (367)	Ticks	<i>Amblyomma</i> sp. (1), <i>Haemaphysalis aciculifer</i> (292), <i>Haemaphysalis elliptica</i> (1567), <i>Hyalomma truncatum</i> (549), <i>Ixodes alluaudi</i> (11), <i>Ixodes bakeri</i> (1372), <i>Ixodes rhabdomysae</i> (1132), <i>Rhipicephalus gertrudae</i> (11593), <i>Rhipicephalus lounsburyi</i> (44)
	Mites	<i>Androlaelaps dasymys</i> (67), <i>Androlaelaps fabrenholzi</i> (733), <i>Laelaps giganteus</i> (567), <i>Laelaps horaki</i> (104), <i>Laelaps paraspinoza</i> (1), <i>Laelaps radovskyi</i> (22), <i>Macrocheles</i> sp. (1)
	Fleas	<i>Chiastopsylla rossi</i> (173), <i>Dinopsyllus ellobius</i> (19), <i>Dinopsylla hypus</i> (5), <i>Dinopsyllus tenax</i> (30), <i>Hypsophthalmus temporis</i> (119), <i>Listropsylla agrippinae</i> (106), <i>Xenopsylla hirsuta</i> (2)
	Lice	<i>Polyplax arvicanthis</i> (2939)

<i>Scapteromus aquaticus</i> (213)	Ticks	<i>Ixodes loricatus</i> (1)
	Mites	<i>Androlaelaps fahrenheiti</i> (72), <i>Gigantolaelaps wolffsohni</i> (1), <i>Laelaps manguihosi</i> (780), <i>Ornithonyssus bacoti</i> (15)
	Chiggers	<i>Eutrombicula alfreddugesi</i> (305)
	Fleas	<i>Polygenis atopus</i> (33), <i>Polygenis axisus</i> (1), <i>Polygenis bohlsi</i> (1), <i>Craneopsylla minerva</i> (18)
	Lice	<i>Hoplopleura scapteromydis</i> (673)
	Staphylinid beetles	<i>Amblyopinodes gabani</i> (6)

## Appendix 2

Summary of null model analyses of co-occurrence of parasite species or higher taxa for seven host species using V-ratio. Uninfested hosts were excluded from input matrices. O = E – number of samples for which the observed value of V-ratio did not differ significantly than that expected by chance ( $p > 0.05$ ); O < E – number of samples for which the observed value of V-ratio was significantly less than that expected by chance ( $p < 0.05$ ); O > E – number of samples for which the observed value of V-ratio was significantly greater than that expected by chance ( $p < 0.05$ ).

Host	Parasite	O = E	O < E	O > E
<i>A. agrarius</i>	mites	8	–	6
	fleas	4	–	10
	higher taxa	7	–	7
<i>M. gregalis</i>	mites	8	–	10
	fleas	3	–	15
	higher taxa	5	–	13
<i>M. oeconomus</i>	mites	7	–	9
	fleas	1	–	15
	higher taxa	3	–	13
<i>M. rutilus</i>	mites	13	–	4
	fleas	3	–	16
	higher taxa	9	–	10
<i>O. rufus</i>	mites	13	1	2
	fleas	2	–	5
	higher taxa	14	–	4
<i>R. pumilio</i>	ticks	3	–	5
	mites	4	–	4
	fleas	1	–	7
	higher taxa	2	–	6
<i>S. aquaticus</i>	mites	18	–	6
	higher taxa	14	–	10

## Appendix 3

Summary of meta-analyses of rate of detection of non-randomness in organization of ectoparasite communities in seven host species using random effects model. A – within ectoparasite taxon among hosts, B – among ectoparasite taxa within host. \* –  $p < 0.05$ , ns – non-significant. Z – combined Z-scores,  $I^2$  – heterogeneity statistics.

	Index	Parasite	Host	Event rate	95% limits	Z	$I^2$
A	C-score	mites		0.38	0.22–0.57	-2.14*	69.90
		fleas		0.83	0.73–0.89	5.28*	0.00
		higher taxa		0.59	0.44–0.72	1.13 <sup>ns</sup>	55.48
	V-ratio	mites		0.40	0.27–0.54	-1.95*	53.85
		fleas		0.84	0.75–0.91	5.44*	0.00
		higher taxa		0.55	0.39–0.70	0.66 <sup>ns</sup>	61.29
B	C-score		<i>A. agrarius</i>	0.52	0.21–0.82	0.14 <sup>ns</sup>	75.37
			<i>M. gregalis</i>	0.80	0.67–0.89	3.97*	0.00
			<i>M. oeconomicus</i>	0.74	0.56–0.91	1.98*	66.2
			<i>M. rutilus</i>	0.54	0.21–0.84	0.24 <sup>ns</sup>	82.24
			<i>O. rufus</i>	0.41	0.14–0.75	-0.48 <sup>ns</sup>	72.8
			<i>R. pumilio</i>	0.68	0.50–0.82	2.00*	0.00
			<i>S. aquaticus</i>	0.31	0.14–0.54	-1.99*	7.00
	V-ratio		<i>A. agrarius</i>	0.57	0.35–0.76	0.60 <sup>ns</sup>	47.35
			<i>M. gregalis</i>	0.71	0.57–0.84	2.84*	6.00
			<i>M. oeconomicus</i>	0.75	0.52–0.90	2.10*	53.49
			<i>M. rutilus</i>	0.54	0.21–0.84	0.24 <sup>ns</sup>	82.24
			<i>O. rufus</i>	0.39	0.10–0.77	-0.58 <sup>ns</sup>	71.94
			<i>R. pumilio</i>	0.69	0.5–0.83	1.97*	0.00
			<i>S. aquaticus</i>	0.33	0.19–0.51	-1.90*	32.23