

Haemaphysalis
(arachnid: tick)

Overview

Arthropods are coelomate metameric invertebrate animals with a chitinous exoskeleton and jointed limbs. They undergo protostomial embryonic development and grow by cuticular moulting (ecdysis). Three main subphyla are recognized: Chelicerata, Crustacea and Hexapoda. Arachnids have chelicerate mouthparts, two tagmata (cephalothorax and abdomen), four pairs of legs and slit sensilla, but no antennae or wings. All species exhibit incomplete metamorphosis whereby eggs hatch larvae which moult to nymphs and then adults. Acarines comprise the ticks and mites which have sac-like bodies with inconspicuous segmentation and their mouthparts are confined to an anterior capitulum. Four major groups are recognized primarily on the location of their respiratory stigmata: ixodid ticks (Metastigmata), gamesid mites (Mesostigmata), trombidiform mites (Prostigmata) and sarcoptiform mites (Astigmata). Ticks have respiratory stigmata posterior to their legs. They are obligate blood-feeding ectoparasites on vertebrate hosts and their hypostomes are toothed and exposed. Two families are recognized: Argasidae and Ixodidae, known as soft and hard ticks, respectively. Ixodids have hard bodies with a dorsal scutum (shield-shaped plate) and the capitulum is not covered by the body. Larvae, nymphs and adults attach and feed on host blood, their life-cycles involving one, two or three hosts depending on whether moulting occurs on or off the host. Some 650 species of hard ticks infest mammals, birds and reptiles. Infestations by *Haemaphysalis* spp. occur as three-host ticks on a range of domestic and wild animals, causing local skin reactions and transmitting various infectious diseases.

Classification:

Domain: Eukaryota (membrane-bound nucleus)
Supergroup: Amorphea (unikonts with single flagellum, or nonflagellated amoebae)
Kingdom: Metazoa (multicellular eukaryotes, heterotrophs, notably animals)
Group: Protostomia (triploblastic, spiral cleavage)
Subgroup: Ecdysozoa (cuticle moulted = ecdysis)
Phylum: Arthropoda (chitinous exoskeleton, segmented body, jointed limbs, haemocoel)
Subphylum: Chelicerata (chelicerate mouthparts, two tagmata, no antennae)
Class: Arachnida (spiders & allies, four pairs of legs, slit sensilla, incomplete metamorphosis)
Subclass: Acari (Acarina) (ticks and mites, segmentation inconspicuous, sac-like body, mouthparts on capitulum)
Superorder: Parasitiformes (ticks and some mites, with posterior stigmata)
Order: Ixodida (Metastigmata) (ticks, macroscopic, stigmata posterior to legs, hypostome toothed, ectoparasites)
Family: Ixodidae (hard ticks, with dorsal scutum, capitulum projects anteriorly, attach and feed on 1, 2 or 3 hosts)
Genus: *Haemaphysalis* (parasitic on skin of mammals)
Species: various species cause lesions on mammals

Parasite biodiversity and host range: Most Metazoa are multicellular triploblastic animals with differentiated tissues, many being bilaterally symmetrical with a body cavity. Most invertebrate animals are protostomes as their embryonic development involves spiral determinate cleavage. Those that moult their external cuticles during their life-cycles (process known as ecdysis) are grouped together in the unique clade Ecdysozoa, including the nematodes (roundworms), onychophorans (velvet worms), tardigrades (water bears) and arthropods (myriapods, chelicerates, crustaceans and hexapods). Arthropods have small segmented bodies encased in chitinous exoskeletons with articulated limbs. Most species are free-living in terrestrial and aquatic habitats, although a small range are ectoparasitic on other animals, some feeding on the blood or skin of vertebrates. Five subphyla are recognized: Chelicerata, Crustacea, Hexapoda, Myriapoda and Trilobita. The chelicerates typically have appendages (cheliceræ) in the form of pincers or fangs anterior to the mouthparts, 2 body parts (cephalothorax and abdomen), but no antennae or wings. Three classes are recognized: Arachnida (spiders and allies), Merostomata (horseshoe crabs) and Pycnogonida (sea spiders). Arachnids have 8 legs, slit sensilla and life-cycles involving incomplete metamorphosis whereby larvae and nymphs resemble adults. They are classified in 4 orders: Acari (acarines), Araneae (spiders), Opiliones (harvestmen) and Scorpiones (scorpions). The Acari comprises the ticks and mites which have sac-like bodies and mouthparts confined to an anterior capitulum. Four major groups are recognized primarily on the location of their respiratory stigmata (called spiracles in insects): ixodid ticks (posterior Metastigmata), gamesid mites (middle Mesostigmata), trombidiform mites (anterior Prostigmata) and sarcoptiform mites (without stigmata = Astigmata).

Major parasitic families	Biodiversity	Hosts	Parasitic stages	Pathogenesis	Disease transmission
Superorder: Parasitiformes (ticks and some mites, with posterior stigmata)					
Order: Ixodida [Metastigmata] (ticks, macroscopic, stigmata posterior to legs) [3 families]					
Argasidae (soft ticks)	5 genera, 193 species	birds, mammals	larvae, nymphs, adults	blood-sucking	viral, bacterial
Ixodidae (hard ticks)	14 genera, 705 species	birds, mammals	larvae, nymphs, adults	blood-sucking, paralysis	viral, bacterial, protozoal
Order: Mesostigmata [Gamasida] (gamesid mites, stigmata between 2 nd & 4 th legs) [100 families, 662 genera, 5,360 species]					
Macronyssidae (sucking mites)	26 genera, 127 species	birds, reptiles, mammals	nymphs, adults	blood-sucking	bacterial
Dermanyssidae (sucking mites)	5 genera, 37 species	birds, mammals	nymphs, adults	blood-sucking	viral, bacterial
Halarachnidae (lung/ear mites)	7 genera, 10 species	mammals	nymphs, adults	mucosal erosion	-
Raillietidae (ear mites)	1 genus, 7 species	mammals	nymphs, adults	ear wax	-
Rhinonyssidae (nasal mites)	30 genera, 160 species	birds	nymphs, adults	inflammation	-
Varroidae (bee mites)	1 genus, 5 species	bees	nymphs, adults	haemolymph-feeding	viral
Superorder: Acariformes (diverse group of mites, without posterior stigmata) [351 families, 32,000 species]					
Order: Prostigmata [Trombidiformes, Actinedida] (sucking mites, stigmata on capitulum) [34 superfamilies]					
Demodecidae (follicle mites)	7 genera, 65 species	mammals	larvae, nymphs, adults	inflammation	-
Cheyletidae (fur mites)	80 genera, 500 species	mammals (dogs, cats, rabbits), birds	larvae, nymphs, adults	pruritus	-
Myobiidae (fur mites)	46 genera, 185 species	mammals (rodents, bats, marsupials)	larvae, nymphs, adults	mange	-
Psorergatidae (itch mites)	3 genera, 77 species	mammals (rodents, artiodactyls)	larvae, nymphs, adults	mange	-
Trombiculidae (chigger mites)	71 genera, 3,000 species	mammals, birds	larvae	skin-feeding	bacterial
Order: Astigmata [Sarcoptiformes, Acaridida] (fur/feather/itch/dust mites, lacking stigmata) [230 families, 15,000 species]					
Sarcoptidae (itch mites)	3 genera, 42 spp./ssp.	mammals	larvae, nymphs, adults	scabies, mange	-
Psoroptidae (scab mites)	20 genera, species	mammals (carnivores, ungulates)	larvae, nymphs, adults	mange	-
Listrophoridae (fur mites)	20 genera, 170 species	mammals (esp. rodents)	larvae, nymphs, adults	mange	-
Myocoptidae (fur mites)	10 genera, 70 species	mammals (esp. rodents)	larvae, nymphs, adults	myocoptic mange	-
Cytoditidae (airsac/nasal mites)	2 genera, 12 species	birds	larvae, nymphs, adults	respiratory signs	-
Knemidokoptidae (burrowing mites)	7 genera, 16 species	birds	larvae, nymphs, adults	scaly face, scaly leg	-
Laminosioptidae (quill/skin mites)	8 genera, 25 species	birds	larvae, nymphs, adults	flesh/skin lesions	-

The superorder Parasitiformes comprises acarines with posterior respiratory stigmata and includes two major orders: the ixodid ticks (order Metastigmata) with stigmata located posterior to the legs (behind coxae III or IV); and the gamesid mites (order Mesostigmata) where they are located between the legs, sometimes associated with sinuous processes (peritremes). Ticks are further characterized by macroscopic bodies with an exposed ventral hypostome (toothed with backwardly-directed barbs), chelicerae with only 2 joints, long legs with free articulated coxae (not fused to the body wall) and a complex sensory pit (Haller's organ) on tarsus I. They are obligate blood-sucking parasites which feed on terrestrial vertebrates (mammals, birds, reptiles and some amphibians) as larvae, nymphs and adults with 1-, 2- or 3-host life-cycles. Almost 1,000 species have been classified within some 20 genera from numerous wild and domesticated animals around the world. Two main families are recognized: the Argasidae containing ~200 species of 'soft' ticks with flexible leathery cuticles, ventral capitula, short feeding times (< 1 hour) and long life-spans (up to 20 years); and the Ixodidae containing ~800 species of 'hard' ticks with rigid dorsal scutal plates, anterior capitula, long feeding times (hours to days) and shorter life-span (2-6 years). Basic characteristics of representative genera considered in this resource are tabulated below.

Genus	Capitulum				Idiosoma				Usual no. of hosts
	location	basis capitulum	mouth-parts	palps	integument	festoons	eyes	male ventral plates	
Argasidae (soft ticks with leathery cuticle, stigmata between coxae III)									
<i>Argas</i>	ventral	triangular	short	leg-like	stippled with lateral suture	absent	absent	absent	>3
<i>Ornithodoros</i>	ventral	rectangular	short	leg-like	mamillated	absent	usually absent	absent	>3
<i>Otobius</i>	ventral	rectangular	short	leg-like	spinose (nymphs), granulated (adult)	absent	absent	absent	1
Ixodidae (hard ticks with sclerotized dorsal plate (scutum), stigmata behind coxae IV)									
Prostriata (anal groove anterior)									
<i>Ixodes</i>	anterior	triangular	long	long	inornate	absent	absent	present	3
Metastriata (anal groove posterior)									
<i>Amblyomma</i>	anterior	rectangular	long	long	ornate	present	present	indistinct	3
(<i>Aponomma</i>)	anterior	rectangular	long	long	often ornate	present	absent	absent	3
<i>Rhipicephalus</i>	anterior	hexagonal	short	medium	some ornate	present	present	present	3
(<i>Boophilus</i>)	anterior	hexagonal	short	short	inornate	absent	present	present	1
<i>Dermacentor</i>	anterior	rectangular	short	medium	often ornate	present	present	absent	3
<i>Haemaphysalis</i>	anterior	rectangular	short	short	inornate	present	absent	absent	3
<i>Hyalomma</i>	anterior	rectangular	long	long	inornate	present	present	present	2
<i>Bothriocroton</i>	anterior	pentagonal	long	long	ornate	present	absent	absent	3

The family Ixodidae contains 6 subfamilies (Amblyomminae, Bothriocrotoninae, Haemaphysalinae, Hyalomminae, Ixodinae and Rhipicephalinae) which vary in their morphology, biology, host ranges and specificity. [Note that some taxonomic authorities have merged the subfamilies Rhipicephalinae and Hyalomminae, while others have subsequently assigned the subfamilies Amblyomminae and Rhipicephalinae into the new family Amblyommidae, predominantly on the basis of molecular phylogenetic studies]. Hard ticks had previously been divided into 2 groups: the Prostriata (with the anal groove anterior to the anus) and the Metastriata (anal groove absent or posterior to anus). The Prostriata essentially comprises the subfamily Ixodinae with over 230 species assigned to the single extant genus *Ixodes* [plus one fossil genus (*Cornupalpatum*)], while the Metastriata contains members of the remaining subfamilies with over 600 species classified into 18 genera. The subfamily Haemaphysalinae comprises metastriate inornate ticks with festoon but lacking eyes and ventral shields. Nine genera have been recognized (*Amblyocento*, *Anocento*, *Conocento*, *Dermacentor*, *Dermacentorites*, *Dermiomma*, *Haemalasto*, *Haemaphysalis* and *Puncticento*). [Note that all members of the former genus *Aponomma* have now been transferred to the genera *Amblyomma* or *Bothriocroton*]. The genus *Haemaphysalis* contains around 116 species of small ticks with short laterally-projecting palps, most species being classified with 9 subgenera: namely, *H. (Aboimisalis)*, *H. (Aborphysalis)*, *H. (Alloeceraea)*, *H. (Allophysalis)*, *H. (Haemaphysalis)*, *H. (Herpetobia)*, *H. (Kaiseriana)*, *H. (Ornithophysalis)*, and *H. (Rhipistoma)*. The majority are 3-host ticks of mammals, with several species considered to be significant veterinary pests causing skin lesions, anaemia, reduced production and sometimes toxicoses, paralysis and mortality in livestock and companion animals.

<i>Haemaphysalis</i> species	Hosts	Clinical signs	Distribution
<i>H. (Aborphysalis) aborensis</i>	Artiodactyla: bovid (buffalo, yak, zhum), cervid (sambar deer, muntjac), moschid (musk deer), suid (Indian boar); Scandentia: tupaiid (common treeshrew); Rodentia: hystricid (crestless Himalayan porcupine); Carnivora: felid (tiger), mustelid (greater hog-badger); Primates: hominid (human); Galliformes: phasianid (chicken, red junglefowl); Passeriformes: parid (green-backed tit), turdid (pale thrush)		India
<i>H. (Kaiseriana) aciculifer</i>	Artiodactyla: bovid (cattle, buffalo, sheep, goat, oribi, red hartebeest, Roosevelt's hartebeest, common duiker, red forest duiker, tiang, Grant's gazelle, Thomson's gazelle, harnessed bushbuck, Cape bushbuck, southern reedbuck, Bohor reedbuck, waterbuck, kob, Ugandan kob, sitatunga, suni, kongoni), suid (warthog); Eulipotyphla: erinaceid (African hedgehog); Lagomorpha: leporid (Cape hare); Hyracoidea: procaviid (rock hyrax); Rodentia: murid (typical striped grass mouse, Tullberg's soft-furred mouse, soft-furred rat, rusty-bellied brush-furred rat,		Africa

	East African soft-furred mouse), sciurid (ground squirrel); Carnivora: canid (dog, black-backed jackal), felid (wildcat, serval, lion, leopard), herpestid (gray mongoose, banded mongoose, Egyptian mongoose), hyaenid (striped hyena), viverrid (African civet, large spotted genet); Galliformes: phasianid (fowl); Passeriformes: corvid (pied crow)		
<i>H. (Kaiseriana) aculeata</i>	Artiodactyla: bovid (cattle, buffalo), cervid (spotted deer), tragulid (Sri Lankan spotted chevrotain); Rodentia: murid (rat), hystricid (crested porcupine); Carnivora: felid (leopard), herpestid (ruddy mongoose); Primates: cercopithecoid (bonnet macaque, northern plains gray langur), hominid (human); Cuculiformes: cuculid (greater coucal); Galliformes: phasianid (fowl); Passeriformes: muscicapid (Indian robin), pycnonotid (bulbul), sturnid (myna), timaliid (babbler)	(possible vector for Kyasanur Forest disease virus)	India, Sri Lanka
<i>H. adleri</i>	Artiodactyla: bovid (cattle), suid (pig); Carnivora: canid (golden jackal, red fox), felid (jungle cat, African wildcat), mustelid (marbled polecat)		Palaearctic
<i>H. africana</i>	Cuculiformes: cuculid (Burchell's coucal)		Africa
<i>H. ambigua</i>	Artiodactyla: bovid (Japanese serow)		Eurasia
<i>H. angorensis</i>	Perissodactyla: equid (donkey)		Europe
<i>H. (Kaiseriana) anomala</i>	Artiodactyla: bovid (cattle, buffalo, water buffalo, goat), cervid (sambar deer, Indian muntjac); Lagomorpha: leporid (rabbit); Rodentia: murid (black rat, soft-furred rat); Carnivora: canid (wolf), felid (leopard); Primates: hominid (human); Cuculiformes: cuculid (greater coucal); Galliformes: phasianid (chicken); Passeriformes: turdid (thrush) (3-host cycle)	(possible vector for Kyasanur Forest disease virus)	Indo-Asia
<i>H. (Kaiseriana) anomaloceraea</i>	host unknown, collected from vegetation		China
<i>H. (Rhipistoma) anoplus</i>	Rodentia: nesomyid (island mouse, red forest rat)		Madagascar
<i>H. (Alloceraea) aponomoides</i>	Artiodactyla: bovid (cattle, zebu, yak, zhum, buffalo, sheep, goat, serow), cervid (Indian muntjac), suid (wild boar); Perissodactyla: equid (horse); Eulipotyphla: soricid (broad-toothed shrew, Sikkim large-clawed shrew); Rodentia: cricetid (Royle's high mountain vole), murid (house mouse, chestnut rat, little Himalayan rat), sciurid (lesser giant flying squirrel); Carnivora: canid (dog), felid (cat), ursid (Asian black bear); Primates: hominid (human); Galliformes: phasianid (monal pheasant); Sauria (unspecified lizard)		India, Nepal
<i>H. asiatica</i>	Artiodactyla: suid (pig); Scandentia: tupaiid (common treeshrew); Rodentia: murid (rat), sciurid (Bersdmore's ground squirrel); Carnivora: canid (dog), felid (leopard cat, leopard), viverrid (Asian palm civet, Malayan civet, large Indian civet); Sauria: lacertid (multi-ocellated racerunner)		Asia
<i>H. (Aborphysalis) atheruri</i>	Rodentia: hystricid (Asiatic brush-tailed porcupine); Scandentia: tupaiid (treeshrew); Carnivora: canid (dog)		Malaysia
<i>H. (Kaiseriana) bancrofti</i> (syn. <i>H. meraukensis, novaeguineae</i>) (wallaby tick)	Diprotodontia: macropodid (allied rock-wallaby, short-eared rock-wallaby, Godman's rock-wallaby, brush-tailed rock-wallaby, bridled nailtail wallaby, agile wallaby, common wallaroo, black wallaroo, black-striped wallaby, tammar wallaby, western grey kangaroo, eastern grey kangaroo, whiptail wallaby, red-necked wallaby, swamp wallaby, red-necked pademelon, unspecified dorcopsis), potoroid (rufous bettong, long-nosed potoroo, woylie), petaurid (sugar glider), phalangerid (common brushtail possum), phascolarctid (koala), vombatid (common wombat), Dasyuromorphia: dasyurid (northern quoll, spotted-tailed quoll); Peramelemorphia: peramelid (northern brown bandicoot, southern brown bandicoot, long-nosed bandicoot, common spiny bandicoot, long-nosed spiny bandicoot), thylacomyid (greater bilby); Rodentia: murid (black rat, water rat); Artiodactyla: bovid (cattle, zebu, banteng, buffalo, sheep), cervid (red deer, sambar deer), suid (pig, boar); Perissodactyla: equid (horse); Lagomorpha: leporid	trauma, irritation (vector for theileriosis)	Australia, New Guinea

	(rabbit); Carnivora: canid (dog, dingo), felid (cat); Chiroptera: : pteropodid (broad-striped tube-nosed fruit bat), vespertilionid (eastern forest bat); Primates: hominid (human); Cuculiformes: cuculid (pheasant coucal); Gruiformes: rallid (rail); Passeriformes: artamid (Australian magpie) (3-host cycle)		
<i>H. bandicota</i>	Artiodactyla: bovid (cattle); Rodentia: murid (bandicoot rat); Scandentia: tupaiid (treeshrew); Carnivora: herpestid (mongoose)		Asia
<i>H. (Rhipistoma) bartelsi</i>	Rodentia: sciurid (red giant flying squirrel, spotted giant flying squirrel)		Indonesia
<i>H. benedito</i>	Artiodactyla: bovid (goat, mountain goat)		Europe
<i>H. bequaerti</i>	Hyracoidea: procaviid (rock hyrax, yellow-spotted rock hyrax)		Africa
<i>H. (Haemaphysalis) birmaniae</i>	Artiodactyla: bovid (cattle, zebu, yak, zhumi, buffalo, water buffalo, goral, goat, antelope, serow, blackbuck), cervid (Indian muntjac, Reeve's muntjac, Indian sambar deer, chital deer), suid (bushpig); Perissodactyla: equid (horse); Lagomorpha: leporid (Indian hare); Pholidota: manid (pangolin); Rodentia: hystricid (Asiatic brush-tailed porcupine, Himalayan porcupine), murid (mouse); Carnivora: canid (dog), ursid (Asian black bear), viverrid (masked palm civet); Primates: hominid (human)		Asia
<i>H. (Kaiseriana) bispinosa</i> (bush tick)	Artiodactyla: bovid (cattle, zebu, buffalo, water buffalo, sheep, goat, Nilgiri tahr, red forest duiker), cervid (barking deer, water deer, sika deer, chital, muntjac, spotted deer, Sri Lankan axis deer, sambar deer, red deer, elk), suid (pig, Indian boar), tragulid (Sri Lankan spotted chevrotain); Perissodactyla: equid (horse, donkey, mule); Eulipotyphla: erinaceid (Indian hedgehog), soricid (Asian house shrew), talpid (mole); Peramelemorphia: peramelid (northern brown bandicoot); Diprotodontia: macropodid (common wallaroo, black-striped wallaby); Lagomorpha: leporid (European rabbit, mountain hare, black-naped hare, European hare, Indian hare); Rodentia: caviid (guinea pig), hystricid (crested porcupine), murid (house mouse, black rat, brown rat, soft-furred rat, Blanford's rat), sciurid (jungle palm squirrel); Carnivora: canid (dog, raccoon dog, Indian wolf, golden jackal, dhole), felid (cat, jungle cat, Asiatic wildcat, caracal, tiger, lion, leopard), herpestid (mongoose), hyaenid (striped hyena), ursid (sloth bear), mustelid (Japanese badger, stoat, European polecat), viverrid (common genet, masked palm civet, small Indian civet); Primates: cercopithecid (bonnet macaque, toque macaque, northern plains gray langur, black monkey), hominid (human); Accipitriformes: accipitrid (hawk); Anseriformes: anatid (mallard, Indian spot-billed duck); Charadriiformes: charadriid (plover); Coraciiformes: coraciid (Indian roller); Cuculiformes: cuculid (cuckoo); Galliformes: phasianid (chicken, red junglefowl, Sri Lankan junglefowl, turkey, ring-necked pheasant); Passeriformes: alaudid (Eurasian skylark), corvid (crow), leiothrichid (yellow-billed babbler), passerid (house sparrow), pittid (Indian pitta), pomatostomid (white-browed babbler), sturnid (starling), turdid (song thrush), vangid (common woodshrike); Psittaciformes: psittacid (parrot); Strigiformes: strigid (owl) (3-host cycle)	trauma, irritation (vector for babesiosis, theileriosis, and possibly Q fever, Kyasanur forest disease virus)	Australasia
<i>H. (Rhipistoma) bochkovi</i>	Carnivora: herpestid (marsh mongoose), mustelid (spotted-necked otter)		Africa
<i>H. (Kaiseriana) borneata</i>	Artiodactyla: cervid (sambar deer)		Malaysia
<i>H. (Ornithophysalis) bremneri</i>	Artiodactyla: bovid (cattle); Perissodactyla: equid (horse); Diprotodontia: phalangerid (common brush-tailed possum); Aegotheliformes: aegothelid (Australian owlet-nightjar)		Australia
<i>H. (Rhipistoma) burkinae</i>	Lagomorpha: leporid (Cape hare); Carnivora: viverrid (rusty-spotted genet, Hausa genet)		Africa
<i>H. calva</i>	Artiodactyla: bovid (buffalo), cervid (muntjac), suid (boar); Carnivora: ursid (bear), viverrid (civet)		Asia
<i>H. (Rhipistoma)</i>	Eulipotyphla: erinaceid (four-toed hedgehog); Lagomorpha: leporid		Africa

<i>camicasi</i>	(Cape hare); Rodentia: murid (Bellier's striped grass mouse, multimammate mouse, Natal multimammate mouse, gerbil), nesomyid (Gambian pouched rat), sciurid (Gambian sun squirrel, striped ground squirrel); Carnivora: canid (African wild dog, wolf, golden jackal, pale fox), felid (wildcat, leopard), herpestid (common slender mongoose, banded mongoose, white-tailed mongoose, Egyptian mongoose, Gambian mongoose), mustelid (honey badger), viverrid (African civet, common genet, Hausa genet); Primates: galagid (Senegal bushbaby)		
<i>H. (Haemaphysalis) campanulata</i>	Artiodactyla: bovid (cattle), cervid (sambar deer); Perissodactyla: equid (horse); Lagomorpha: leporid (European rabbit); Rodentia: murid (black rat); Carnivora: canid (dog, wolf); Primates: hominid (human); Strigiformes: strigid (little owl)		Eurasia
<i>H. (Rhipistoma) canestrinii</i>	Lagomorpha: leporid (Burmese hare); Rodentia: murid (rat, mouse), sciurid (five-striped palm squirrel); Scandentia: tupaiid (treeshrew); Lagomorpha: leporid (hare); Carnivora: canid (Asiatic jackal, Bengal fox), felid (fishing cat, leopard cat, jungle cat, tiger, leopard), herpestid (small Indian mongoose), mustelid (hog-badger, ferret-badger), viverrid (large Indian civet, palm civet, small Taiwan civet); Primates: hominid (human); Cuculiformes: cuculid (greater coucal); Galliformes: phasianid (chicken, red junglefowl); Testudines: geoemydid (Indian black turtle), testudinid (elongated tortoise)		Eurasia
<i>H. (Aborphysalis) capricornis</i>	Artiodactyla: bovid (Sumatran serow)		Asia
<i>H. caucasica</i>	Artiodactyla: bovid (mouflon); Lagomorpha: leporid (desert hare, tolai hare, European hare); Eulipotyphla: erinaceid (European hedgehog); Rodentia: cricetid (grey dwarf hamster), murid (house mouse, wood mouse, Turkestan rat); Carnivora: canid (red fox, golden jackal), mustelid (beech marten, European badger, least weasel, ferret), ursid (bear); Primates: hominid (human); Bucerotiformes: upupid (Eurasian hoopoe); Galliformes: phasianid (common quail, grey partridge); Passeriformes: corvid (European jay), fringillid (common chaffinch), muscicapid (whinchat), turdid (blue rock thrush); Sauria: lacertid (regel lacertid, sand lizard, felseneidechse), scincid (Berber skink)		Central Asia
<i>H. (Kaiseriana) celebensis</i>	Artiodactyla: bovid (cattle, water buffalo, anoa), cervid (Javan rusa), suid (pig, Celebes warty pig); Perissodactyla: equid (horse); Rodentia: murid (Musschenbroek's Sulawesi maxomys, Pacific rat, Hoffmann's Sulawesi rat); Primates: hominid (human)		Indonesia
<i>H. centropi</i>	Accipitriformes: accipitrid (pied harrier); Cuculiformes: cuculid (lesser coucal, greater coucal); Galliformes: phasianid (red junglefowl); Passeriformes: pycnonotid (red-whiskered bulbul)		Asia
<i>H. (Aboimisalis) chordeilis</i>	Artiodactyla: bovid (cattle, sheep); Perissodactyla: equid (horse); Lagomorpha: leporid (cottontail, hare); Rodentia: geomyid (smooth-toothed pocket gopher), sciurid (American red squirrel, yellow-bellied marmot); Carnivora: felid (cat); Primates: hominid (human); Accipitriformes: accipitrid (marsh hawk); Anseriformes: anatid (wood duck); Caprimulgiformes: caprimulgid (common nighthawk); Charadriiformes: charadriid (killdeer, Wilson's plover); Galliformes: odontophorid (northern bobwhite), phasianid (turkey, quail, chicken, greater prairie chicken, pheasant, ruffed grouse, greater sage-grouse); Passeriformes: corvid (jackdaw), emberizid (bunting), icterid (southern meadowlark), mimid (unspecified), passerellid (seaside sparrow, Florida sparrow, savannah sparrow, eastern towhee, white-eyed towhee), sturnid (Eurasian meadowlark), troglodytid (Florida wren), turdid (red-winged blackbird)		North America
<i>H. (Aboimisalis) cinnabarina</i> (syn. <i>H. sanguinolenta</i>)	Artiodactyla: bovid (cattle, zebu, mouflon, sheep, mouflon, goat), cervid (European fallow deer), suid (pig); Perissodactyla: equid (horse, donkey); Eulipotyphla: erinaceid (European hedgehog); Lagomorpha: leporid (European rabbit, jackrabbit, mountain hare, European hare); Rodentia: dasyproctid (red acouchi), sciurid (red	trauma, irritation (vector for anaplasmosis, babesiosis, Q fever)	Africa, Eurasia, Americas

	<p>squirrel, little ground squirrel); Carnivora: canid (dog, wolf, fox), ursid (bear); Chiroptera: rhinolophid (greater horseshoe bat); Primates: hominid (human); Accipitriformes: accipitrid (golden eagle, marsh hawk, Griffon vulture); Caprimulgiformes: caprimulgid (common nighthawk); Charadriiformes: scolopacid (ruff); Galliformes: odontophorid (northern bobwhite), phasianid (chicken, turkey, ring-necked pheasant, common partridge, rock partridge, red-legged partridge, blue grouse, spruce grouse, willow grouse, ruffed grouse, sharp-tailed grouse, greater sage-grouse, greater prairie chicken); Gruiformes: rallid (corn crane); Passeriformes: alaudid (Eurasian skylark), corvid (jackdaw), motacillid (white wagtail), muscicapid (common redstart), sturnid (Eurasian meadowlark), turdid (common blackbird, red-winged blackbird, song thrush, mistle thrush); Strigiformes: strigid (long-eared owl); Sauria: lacertid (common wall lizard, ocellated lizard, European green lizard); Serpentes: viperid (horned viper) (3-host cycle)</p>		
<i>H. colasbelcourii</i> (syn. <i>H. vietnamensis</i>)	<p>Artiodactyla: bovid (cattle, buffalo), cervid (unspecified deer); Primates: hominid (human)</p>		Asia
<i>H. (Rhipistoma) colesbergensis</i>	<p>Eulipotyphla: erinaceid (hedgehog); Carnivora: canid (dog), felid (cat, wildcat, caracal)</p>		Africa
<i>H. (Haemaphysalis) concinna</i> (bush tick)	<p>Artiodactyla: bovid (cattle, water buffalo, sheep, goat, mouflon, chamois), cervid (red deer, roe deer, Siberian roe deer, European fallow deer, white-tailed deer, sika deer, red deer, elk, reindeer), suid (pig); Perissodactyla: equid (horse, donkey); Eulipotyphla: erinaceid (European hedgehog, northern white-breasted hedgehog), soricid (common shrew, Eurasian pygmy shrew), talpid (European mole); Lagomorpha: leporid (mountain hare, tolai hare, European hare, Manchurian hare, European rabbit), ochotonid (alpine pika); Rodentia: cricetid (common vole, bank vole, tundra vole, reed vole, meadow vole, narrow-headed vole, northern red-backed vole, grey red-backed vole, Maximowicz's vole, European water vole, northern mole vole, giant red-headed hamster, European hamster), murid (Eurasian harvest mouse, striped field mouse, large Japanese field mouse, yellow-necked mouse, wood mouse, brown rat, black rat, great gerbil, Tamarisk jird), sciurid (red squirrel, long-tailed ground squirrel, European ground squirrel, Siberian chipmunk, Korean chipmunk, groundhog), smynthid (long-tailed birch mouse), spalacid (transbaikalian zokor); Carnivora: canid (dog, raccoon dog, wolf, red fox, Arctic fox); felid (cat, caracal, leopard cat, leopard), mustelid (European badger, European pine marten, stoat, ferret, Siberian weasel); Primates: hominid (human); Accipitriformes: accipitrid (lesser spotted eagle, northern black kite, goshawk, Eurasian sparrowhawk, western marsh harrier, Montagu's harrier, common buzzard, European honey buzzard); Anseriformes: anatid (mallard); Bucerotiformes: upudid (Eurasian hoopoe); Caprimulgiformes: caprimulgid (European nightjar); Charadriiformes: charadriid (northern lapwing), scolopacid (common snipe, Swinhoe's snipe, Eurasian woodcock); Cuculiformes: cuculid (common cuckoo); Galliformes: odontophorid (California quail), phasianid (ring-necked pheasant, common quail, rock partridge, chukar partridge, hazel grouse); Gruiformes: rallid (corn crane); Passeriformes: acrocephalid (great reed warbler, thick-billed warbler, Oriental reed warbler, moustached warbler), alaudid (Eurasian skylark), cettid (Cetti's warbler), corvid (carrion crow, hooded crow, Eurasian magpie, Eurasian jay), emberizid (yellowhammer, yellow-breasted bunting, red-headed bunting, corn bunting, meadow bunting, yellow-throated bunting, chestnut-eared bunting, common reed bunting, black-faced bunting, Tristram's bunting), fringillid (European goldfinch, hawfinch, common chaffinch), laniid (red-backed shrike, bull-headed shrike, tiger shrike), locustellid (river warbler,</p>	<p>trauma, irritation (vector for viral encephalitis, rickettsioses, borreliosis, anaplasmosis, Q fever, tularemia and possibly Crimean-Congo haemorrhagic fever, Omsk haemorrhagic fever and Tamdy virus)</p>	Eurasia

	<p>lanceolated warbler, Pallas's grasshopper warbler, Gray's grasshopper warbler), motacillid (white wagtail, western yellow wagtail, forest wagtail, tree pipit, olive-backed pipit, Richardson's pipit, Pechora pipit), muscicapid (European robin, common nightingale, thrush nightingale, Siberian rubythroat, Siberian blue robin, collared flycatcher, spotted flycatcher, common redstart, African stonechat), oriolid (Eurasian golden oriole), parid (great tit, marsh tit, cinereous tit, Eurasian blue tit), passerid (house sparrow, Spanish sparrow, Eurasian tree sparrow), phylloscopid (wood warbler, willow warbler), prunellid (dunnock), sittid (European nuthatch), sittid (Eurasian nuthatch), sturnid (common starling, white-cheeked starling, Daurian starling), sylviid (garden warbler, barred warbler, Eurasian blackcap, common whitethroat), troglodytid (Eurasian wren), turdid (common blackbird, Eurasian blackbird, mistle thrush, grey-backed thrush, song thrush);</p> <p>Piciformes: picid (great spotted woodpecker, middle spotted woodpecker, Eurasian wryneck); Strigiformes: strigid (short-eared owl, tawny owl); Serpentes: colubrid (grass snake); Sauria: lacertid (sand lizard, European green lizard)</p> <p>(3-host cycle)</p>		
<i>H. cooleyi</i>	Hyracoidea: procaviid (rock hyrax); Rodentia: pedetid (South African springhare)		Africa
<i>H. (Kaiseriana) cornigera</i> (syn. <i>H. ias, proxima, taiwana</i>)	Artiodactyla: bovid (cattle, zebu, buffalo, water buffalo, guar), cervid (Indian muntjac, sambar deer, Indian sambar deer, Javan rusa), suid (pig, boar); Rodentia: dasyproctid (agouti), hystricid (porcupine), murid (striped field mouse, long-tailed giant rat), sciurid (Pallas's squirrel); Diprotodontia: phalangerid (cuscus); Scandentia: tupaiid (northern treeshrew); Lagomorpha: leporid (common tapeti, European rabbit); Eulipotyphla: soricid (shrew); Carnivora: canid (dog, wolf), felid (tiger), mustelid (weasel), viverrid (civet); Primates: hominid (human); Galliformes: phasianid (red junglefowl); Passeriformes: corvid (crow), timaliid (scimitar babbler), turdid (blackbird)		Asia
<i>H. (Aboimisalis) cornupunctata</i>	Artiodactyla: bovid (cattle, buffalo, yak, sheep, goat); Perissodactyla: equid (horse); Rodentia: murid (unspecified mouse); Lagomorpha: leporid (hare), ochotonid (pika)		India
<i>H. (Alloceraea) cretacea</i>	fossil (amber)		Myanmar
<i>H. (Kaiseriana) cuspidata</i>	Artiodactyla: bovid (cattle, buffalo, goat), cervid (deer), tragulid (spotted chevrotain); Eulipotyphla: soricid (Asian house shrew); Lagomorpha: leporid (Indian hare, black-naped hare); Rodentia: murid (mouse, black rat, Blanford's rat), hystricid (crested porcupine), sciurid (jungle palm squirrel); Carnivora: canid (dog, jackal), felid (leopard), herpestid (Indian brown mongoose, Indian grey mongoose), viverrid (lesser civet cat, Indian palm civet); Primates: cercopithecoid (bonnet macaque, northern plains gray langur); Bucerotiformes: bucerotid (Malabar gray hornbill); Cuculiformes: cuculid (greater coucal); Galliformes: phasianid (gray junglefowl); Passeriformes: muscicapid (magpie robin), sylviid (warbler)	(possible vector for Kyasanur forest disease virus)	Sri Lanka
<i>H. dangi</i>	Artiodactyla (unspecified); Rodentia: hystricid (porcupine); Carnivora: mustelid (unspecified)		Asia
<i>H. (Allophysalis) danieli</i> (syn. <i>H. xinjiangensis</i>)	Artiodactyla: bovid (goat); Lagomorpha: ochotonid (Royle's pika); Rodentia: cricetid (grey dwarf hamster, Royle's mountain vole), murid (yellow-necked mouse), sciurid (long-tailed marmot)		Central Asia
<i>H. (Haemaphysalis) darjeeling</i>	Artiodactyla: bovid (goral, serow), cervid (Indian muntjac), suid (Indian boar); Carnivora: mustelid (hog-badger); Primates: hominid (human)		Asia
<i>H. (Kaiseriana) davisi</i>	Artiodactyla: bovid (cattle, Indian bison, guar, gyacha, sheep, goat), cervid (sambar deer, Indian muntjac); Perissodactyla: equid (horse, mule); Carnivora: felid (tiger), mustelid (hog-badger)		Asia
<i>H. demidovae</i>	Rodentia: cricetid (vole), sciurid (ground squirrel); Lagomorpha:		Eurasia

	ochotonid (pika)		
<i>H. dentipalpis</i>	Carnivora: canid (golden jackal), felid (jungle cat, leopard, tiger), viverrid (Asian palm civet, Malayan civet, large Indian civet)		Malaysia
<i>H. (Ornithophysalis) doenitzi</i>	Chiroptera (unspecified bat); Rodentia: murid (mouse); Lagomorpha: leporid (Chinese hare); Afrosoricida: tenrecid (lowland streaked tenrec, greater hedgehog tenrec, tailless tenrec); Primates: hominid (human); Accipitriformes: accipitrid (pied harrier); Bucerotiformes: upupid (hoopoe); Coraciiformes: coraciid (roller); Cuculiformes: cuculid (lesser coucal, greater coucal, pheasant coucal); Galliformes: phasianid (red junglefowl, green pheasant, ring-necked pheasant, quail, Chinese bamboo partridge); Gruiformes: rallid (water hen); Passeriformes: alaudid (lark), hirundinid (swallow), muscicapid (flycatcher), paradoxornithid (vinous-throated parrotbill), pittid (pitta), pycnonotid (bulbul), sylviid (whitethroat), timaliid (Taiwan scimitar babbler), sturnid (common mynah), turdid (dusky thrush, pale thrush, scaly thrush); Piciformes: megalaimid (Taiwan barbet); Strigiformes: strigid (owl); Testudines: geoemydid (turtle)		Australasia
<i>H. elliptica</i>	Macroscelidea: macroscelidid (elephant shrew); Rodentia: murid (unspecified); Carnivora: canid (dog), felid (cat, cheetah, lion, leopard); Passeriformes: cisticolid (rattling cisticola, Levaillant's cisticola), ploceid (long-tailed widowbird) (3-host cycle)	(vector for canine babesiosis)	Africa
<i>H. elongata</i>	Chiroptera (unspecified bat); Afrosoricida: tenrecid (lowland streaked tenrec, greater hedgehog tenrec, lesser hedgehog tenrec, tailless tenrec, Talazac's shrew tenrec); Eulipotyphla: erinaceid (hedgehog); Rodentia: murid (unspecified mouse); Carnivora: euplerid (Malagasy mongoose); Primates: hominid (human)		Madagascar
<i>H. (Rhipistoma) erinacei</i> (syn. <i>H. yalvaci</i>) (incl. subsp. <i>erinacei</i> , <i>taurica</i> , <i>turanica</i>)	Artiodactyla: bovid (unspecified); Lagomorpha: leporid (hare), ochotonid (pika); Eulipotyphla: erinaceid (North African hedgehog, European hedgehog, southern white-breasted hedgehog, northern white-breasted hedgehog, long-eared hedgehog, desert hedgehog); Rodentia: calomyscid (mouse-like hamster), cricetid (jird), dipodid (William's jerboa), glirid (garden dormouse), murid (black rat, Cairo spiny mouse, eastern broad-toothed field mouse, Shaw's jird, Tristram's jird, North African gerbil, great gerbil), sciurid (Daurian ground squirrel, Siberian chipmunk); Carnivora: canid (dog, red fox, Anatolian red fox), felid (cat), hyaenid (striped hyena), mustelid (European badger, beech marten, least weasel, marbled polecat, steppe polecat), ursid (bear); Chiroptera: vespertilionid (unspecified); Primates: hominid (human); Apodiformes: apodid (swift); Coraciiformes: meropodid (bee-eater); Falconiformes: falconid (lesser kestrel); Passeriformes: emberizid (bunting), motacillid (pipit), muscicapid (wheatear); Strigiformes: strigid (Eurasian eagle-owl); Testudines: testudinid (tortoise) (3-host cycle)	(possible vector for rickettsiosis)	Africa, Eurasia
<i>H. (Rhipistoma) eupleres</i>	Carnivora: euplerid (falanouc)		Madagascar
<i>H. expositus</i>	Artiodactyla: bovid (cattle); Lagomorpha: leporid (rabbit)		North America
<i>H. filippovae</i>	host unknown, collected from vegetation		Russia
<i>H. flava</i>	Artiodactyla: bovid (cattle, zebu, sheep, goat, Japanese serow), cervid (sambar deer, Formosan sambar deer, sika deer), suid (pig, Indian boar, Japanese boar, Formosan boar); Perissodactyla: equid (horse); Lagomorpha: leporid (rabbit, mountain hare, Indian hare, Japanese hare); Rodentia: cricetid (grey red-backed vole), murid (large Japanese field mouse), sciurid (red squirrel); Carnivora: canid (dog, raccoon dog, jackal, red fox), felid (cat), mustelid (Japanese badger, Siberian weasel), ursid (Asian black bear); Primates: hominid (human); Accipitriformes: accipitrid (besra); Columbiformes: columbid (Oriental turtle dove); Galliformes: phasianid (green pheasant, copper pheasant); Passeriformes: aegithalid (long-tailed tit), corvid (Eurasian jay), emberizid	trauma, irritation (vector for hepatozoonosis)	Japan, India

	(meadow bunting, yellow-throated bunting, rustic bunting, black-faced bunting, yellow-browed bunting, little bunting), motacillid (grey wagtail, olive-backed pipit), parid (coal tit, great tit), turdid (pale thrush, brown-headed thrush, grey-backed thrush, scaly thrush, White's thrush, Izu thrush, Japanese thrush) (3-host cycle)		
<i>H. (Aborphysalis) formosensis</i>	Artiodactyla: cervid (sambar deer, Indian sambar deer), moschid (musk deer), suid (Formosan boar); Lagomorpha: leporid (hare); Scandentia: tupaiid (common treeshrew); Rodentia: hystricid (Malayan porcupine), murid (unspecified); Carnivora: canid (dog), herpestid (mongoose), mustelid (badger), ursid (Asian black bear); Chiroptera: vespertilionid (unspecified); Charadriiformes: scolopacid (Amami woodcock); Galliformes: phasianid (red junglefowl); Passeriformes: corvid (large-billed crow), turdid (eyebrowed thrush, pale thrush, Siberian thrush, White's thrush, gray-backed thrush, scaly thrush)		Asia
<i>H. fossae</i>	Carnivora: euplerid (falanouc, Malagasy civet, fossa)		Madagascar
<i>H. fujisana</i>	Artiodactyla: bovid (cattle)		Japan
<i>H. (Rhipistoma) galidia</i>	Carnivora: euplerid (ring-tailed vontsira)		Madagascar
<i>H. (Allophysalis) garhwalensis</i>	Artiodactyla: bovid (cattle, yak, sheep, goat); Perissodactyla: equid (horse); Rodentia: cricetid (mountain vole), murid (field mouse, rat)		India
<i>H. genevrayi</i>	Artiodactyla: cervid (sambar deer)		Indo-China
<i>H. gestroi</i>	Carnivora: felid (clouded leopard), viverrid (large Indian civet)		Central Asia
<i>H. (Haemaphysalis) goral</i>	Artiodactyla: bovid (goral)		China
<i>H. (Kaiseriana) grochovskajae</i>	Artiodactyla: bovid (cattle)		Asia
<i>H. heinrichi</i>	Artiodactyla: bovid (buffalo); Eulipotyphla: soricid (shrew); Rodentia: murid (unspecified), sciurid (ground squirrel); Carnivora: canid (dog), herpestid (mongoose), mustelid (Burmese ferret-badger, Chinese ferret-badger), viverrid (civet); Primates: hominid (human)		Asia
<i>H. (Herpetobia) himalaya</i>	Artiodactyla: bovid (cattle, buffalo, zhum, goral, sheep, goat, Himalayan tahr, blackbuck), cervid (sambar deer, chital deer, Indian muntjac)		India
<i>H. (Kaiseriana) hirsuta</i>	Artiodactyla: bovid (unspecified), cervid (deer), suid (pig); Rodentia: hystricid (porcupine); Carnivora: canid (dog), mustelid (badger), viverrid (civet)		Indonesia
<i>H. hispanica</i>	Lagomorpha: leporid (European rabbit); Accipitriformes: accipitrid (hawk); Strigiformes: strigid (little owl) (3-host cycle)		Europe
<i>H. (Ornithophysalis) hoodi</i>	Artiodactyla: bovid (harnessed bushbuck); Lagomorpha: leporid (hare); Hyracoidea: procaviid (yellow-spotted rock hyrax); Rodentia: hystricid (African brush-tailed porcupine), murid (gerbil), sciurid (striped ground squirrel); Carnivora: canid (dog), viverrid (genet); Primates: indriid (Verreaux's sifaka); Accipitriformes: accipitrid (Egyptian vulture); Bucerotiformes: bucerotid (African grey hornbill, Abyssinian ground hornbill, red-billed hornbill); Ciconiiformes: ciconiid (Abdim's stork); Coliiformes: coliid (black-naped mouse bird); Columbiformes: columbid (African green pigeon, emerald-spotted wood dove); Coraciiformes: coraciid (blue-bellied roller); Cuculiformes: cuculid (white-browed coucal, western blue-headed coucal, black coucal, Burchell's coucal, Senegal coucal, Malagasy coucal, Madagascar coucal), musophagid (plaintain-eater); Falconiformes: falconid (lanner falcon); Galliformes: numidid (white-breasted guineafowl, helmeted guineafowl), phasianid (chicken, partridge, scaly spurfowl, double-spurred spurfowl, yellow-necked spurfowl, Clapperton's spurfowl, Heuglin's spurfowl, Natal spurfowl, Swainson's spurfowl, Ahanta spurfowl, white-throated francolin, yellow-beaked francolin, double-spurred francolin, Grant's crested francolin, common quail, blue quail); Gruiformes: rallid (African		Africa

	crake); Passeriformes: alaudid (clapper lark, flappet lark), cisticola (rattling cisticola, croaking cisticola, short-winged cisticola, Levaillant's cisticola), corvid (piapiac), leiothrichid (arrow-marked babbler), malaconotid (black-crowned tchagra, tchagra shrike, black-headed gonolek, Abyssinian gonolek, southern boubou), motacillid (striped pipit, buffy pipit, yellow-throated longclaw), muscicapid (white-browed scrub robin, white-throated rock thrush, Arnott's chat, capped wheatear), musophagid (bare-faced go-away bird), ploceid (Holub's golden weaver, white-billed buffalo-weaver), sturnid (lesser blue-eared glossy starling, Meve's starling, red-winged starling, blue-eared starling, long-tailed glossy starling), turdid (olive thrush)		
<i>H. hoogstraali</i>	Carnivora: mephitid (Palawan stink badger)		Philippines
<i>H. (Rhipistoma) horaki</i>	Rodentia: bathyergid (Cape dune mole-rat)		Africa
<i>H. houyi</i> (syn. <i>H. calcarata</i>)	Eulipotyphla: erinaceid (hedgehog), sorcid (shrew); Hyracoidea: procaviid (tree hyrax); Lagomorpha: leporid (scrub hare); Rodentia: murid (mouse), sciurid (striped ground squirrel, unstriped ground squirrel); Carnivora: felid (cat), herpestid (mongoose), mustelid (weasel), viverrid (civet)		Africa
<i>H. (Ornithophysalis) howletti</i>	Perissodactyla: equid (horse); Lagomorpha: leporid (rabbit); Rodentia: murid (black rat, greater bandicoot rat, little Indian field mouse), sciurid (northern palm squirrel); Carnivora: felid (cat), herpestid (mongoose); Cuculiformes: cuculid (greater coucal); Galliformes: phasianid (pheasant)		Central Asia
<i>H. (Ornithophysalis) humerosa</i> (bandicoot tick)	Artiodactyla: bovid (cattle); Perissodactyla: equid (horse); Dasyuromorphia: dasyurid (yellow-footed antechinus, Atherton antechinus, northern quoll); Diprotodontia: macropodid (red-legged pademelon), phalangerid (common brushtail possum, coppery brushtail possum), potoroid (rufous rat kangaroo); Peramelemorphia: peramelid (southern brown bandicoot, northern brown bandicoot, Cape York brown bandicoot, long-nosed bandicoot, western barred bandicoot, common spiny bandicoot); Monotremata: tachyglossid (short-beaked echidna); Rodentia: murid (black rat, bush rat, common rock rat, dusky field rat, pale field rat, giant white-tailed rat, large New Guinea spiny field rat, rakali, fawn-footed mosaic-tailed rat, black-footed tree rat, brush-tailed rabbit rat, Gould's mouse); Primates: hominid (human); Coraciiformes: coraciid (Oriental dollarbird); Cuculiformes: cuculid (pheasant coucal)		Australia
<i>H. hylobatis</i>	Artiodactyla: tragulid (Java mouse deer); Primates: hylobatid (siamang); Rodentia: murid (Rajah spiny rat); Cuculiformes: cuculid (coucal)		Indonesia
<i>H. (Rhipistoma) hyracophila</i>	Hyracoidea: procaviid (rock hyrax); Macroscelidea: macroscelidid (elephant shrew)		Africa
<i>H. (Kaiseriana) hystricis</i>	Artiodactyla: bovid (cattle, buffalo, water buffalo), cervid (sambar deer, Reeve's muntjac), suid (pig, Indian boar, Celebes warty pig); Perissodactyla: equid (horse); Eulipotyphla: erinaceid (hedgehog); Scandentia: tupaiid (common treeshrew); Rodentia: hystricid (Malayan porcupine), murid (black rat, chestnut white-bellied rat, Southeast Asian house rat, Whitehead's spiny rat, northeastern peninsula bunomys, Hellwald's Sulawesi maxomys, Musschenbroek's Sulawesi maxomys), sciurid (Asian red-checked squirrel); Carnivora: canid (dog), felid (leopard, clouded leopard, tiger), mephitid (stink badger), mustelid (yellow-throated marten, European badger, Burmese ferret-badger, greater hog-badger, Sumatran hog-badger), ursid (sun bear, Asian black bear), viverrid (Asian palm civet); Primates: hominid (human); Cuculiformes: cuculid (coucal); Passeriformes: sturnid (common mynah), timaliid (large scimitar babbler), turdid (grey-backed thrush, scaly thrush); Testudines: geoemydid (spiny turtle)		Asia
<i>H. (Rhipistoma) indica</i>	Artiodactyla: cervid (chital deer), suid (boar); Eulipotyphla: erinaceid (hedgehog), sorcid (house shrew); Lagomorpha: leporid		Eurasia, Africa

	(Indian hare); Rodentia: murid (mouse); Chiroptera (unspecified bat); Carnivora: canid (dog, Asiatic jackal, Bengal fox), felid (jungle-cat, leopard), herpestid (Indian gray mongoose, Indian small mongoose), hyaenid (hyena), mustelid (honey badger), viverrid (African palm civet, large Indian civet); Cuculiformes: cuculid (coucal); Galliformes: phasianid (fowl); Passeriformes: laniid (shrike), motacillid (forest wagtail), muscicapid (flycatcher), timaliid (babbler), turdid (thrush); Pelecaniformes: threskiornithid (black ibis)		
<i>H. (Haemaphysalis) indoflava</i>	Artiodactyla: bovid (cattle, sheep), suid (wild boar); Carnivora: canid (dog, jackal, fox); Primates: hominid (human)		India
<i>H. (Alloceraea) inermis</i> (syn. <i>H. ibrikliensis</i>) (winter tick)	Artiodactyla: bovid (cattle, zebu, Himalayan zebu, water buffalo, sheep, mouflon, goat, Japanese serow), cervid (red deer, fallow deer, roe deer, sambar deer, sika deer), suid (pig); Perissodactyla: equid (horse, donkey); Eulipotyphla: erinaceid (northern white-breasted hedgehog), soricid (common shrew), talpid (European mole); Lagomorpha: leporid (European hare); Rodentia: cricetid (bank vole, common vole, European pine vole, European water vole), glirid (European edible dormouse, hazel dormouse), murid (house mouse, yellow-necked mouse, wood mouse, Black Sea field mouse); Carnivora: canid (dog, red fox), felid (wildcat); Primates: hominid (human); Charadriiformes: scolopacid (Eurasian woodcock); Galliformes: phasianid (grey partridge, common quail); Passeriformes: corvid (Eurasian jay), muscicapid (spotted flycatcher), phylloscopid (willow warbler), sylviid (unspecified babbler); Sauria: lacertid (sand lizard, common wall lizard, Caucasus emerald lizard, European green lizard); Serpentes: viperid (meadow viper); Testudines: testudinid (Greek tortoise) (3-host cycle)	(vector for tick-borne encephalitis virus, babesiosis and possibly rickettsioses)	Eurasia
<i>H. (Kaiseriana) intermedia</i>	Artiodactyla: bovid (cattle, buffalo, water buffalo, sheep, goat), cervid (sambar deer, Indian muntjac, Sri Lankan axis deer), suid (wild boar), tragulid (Sri Lankan spotted chevrotain); Perissodactyla: equid (horse); Lagomorpha: leporid (Indian hare, black-naped hare); Rodentia: sciurid (jungle palm squirrel); Carnivora: canid (dog, golden jackal), felid (cat, jungle cat, leopard cat, leopard); Primates: cercopithecoid (bonnet macaque); Columbiformes: columbid (dove); Cuculiformes: cuculid (plaintive cuckoo, coucal); Galliformes: phasianid (chicken, gray francolin, painted spurfowl, Sri Lankan junglefowl); Passeriformes: acrocephalid (Blyth's reed warbler), alaudid (Bengal bush lark), cisticolid (common tailorbird), dicrurid (ashy drongo, gray drongo), laniid (brown shrike), leiothrichid (white-headed babbler), motacillid (forest wagtail), muscicapid (Indian robin, Oriental magpie-robin), pittid (Indian pitta), pycnotid (red-vented bulbul), sturnid (common mynah, Brahminy starling), turdid (yellow-billed babbler), vangid (common woodshrike); Piciformes: picid (unspecified)		Asia
<i>H. japonica</i> (syn. <i>H. jezoensis</i>)	Artiodactyla: bovid (cattle, goat, Japanese serow), cervid (chital deer, sika deer, Chinese roe deer, Siberian roe deer, red deer, elk), suid (pig); Perissodactyla: equid (horse); Eulipotyphla: erinaceid (hedgehog); Lagomorpha: leporid (Manchurian hare); Rodentia: cricetid (grey red-backed vole), murid (striped field mouse, large Japanese field mouse, wood mouse), sciurid (red squirrel, Siberian chipmunk); Carnivora: canid (dog), felid (Eurasian lynx), mustelid (yellow-throated marten, European badger), ursid (bear); Primates: hominid (human); Charadriiformes: scolopacid (common snipe); Galliformes: phasianid (hazel grouse); Passeriformes: corvid (Eurasian jay, Eurasian magpie), emberizid (meadow bunting, yellow-throated bunting, black-faced bunting), fringillid (hawfinch), laniid (red-backed shrike), motacillid (olive-backed pipit, forest wagtail, western yellow wagtail), muscicapid (Siberian blue robin, Siberian rubythroat), passerid (Eurasian tree sparrow), sittid (Eurasian nuthatch), sturnid (Daurina starling), turdid (green-		Asia

	backed thrush); Strigiformes: strigid (owl)		
<i>H. juxtakochi</i> (syn. <i>H. kochi</i>)	Artiodactyla: bovid (cattle, sheep, goat), camelid (alpaca, vicugna), cervid (white-tailed deer, Panama white-tailed deer, chital, pampas deer, red brocket, small red brocket, Central American red brocket, brown brocket, Amazonian brown brocket, grey brocket, pygmy brocket, guazucho, cuagu pita), suid (pig), tayassuid (white-lipped peccary, collared peccary); Perissodactyla : equid (horse, mule), tapirid (Baird's tapir, South American tapir); Cingulata: chlamyphorid (southern three-banded armadillo); Didelphimorphia: didelphid (common opossum, big-eared opossum, brown four-eyed opossum, unspecified mouse opossum); Pilosa: myrmecophagid (northern tamandua); Lagomorpha: leporid (common tapeti, eastern cottontail); Rodentia: cricetid (Azara's grass mouse, red hocicudo), dasyproctid (black agouti, red-rumped agouti, Central American agouti, Azara's agouti), echimyid (armoured rat, Tome's spiny rat), erethizontid (Andean porcupine), sciurid (Brazilian squirrel, North Amazon red squirrel); Carnivora: canid (dog, maned wolf, coyote, crab-eating fox), felid (cougar), procyonid (white-nosed coati, South American coati); Primates: cebid (wedge-capped capuchin, Kaapori capuchin), hominid (human); Accipitriformes: accipitrid (harpy eagle, roadside hawk); Galliformes: cracid (dusky-legged guan); Passeriformes: corvid (plush-crested jay), passerellid (saffron-billed sparrow), thamnophilid (spot-backed antbird, common scale-backed antbird), thraupid (chestnut-headed tanager), turdid (white-necked thrush, pale-breasted thrush, rufous-bellied thrush), tyrannid (brownish twistwing)		Americas
<i>H. (Ornithophysalis) katarsani</i>	Rodentia: murid (Sulawesi giant rat, central Sulawesi echiothrix)		Indonesia
<i>H. (Herpetobia) kashmirensis</i>	Artiodactyla: bovid (sheep, goat); Rodentia: murid (house mouse), sciurid (white-bellied giant flying squirrel); Sauria: agamid (tuberculated agama)		India
<i>H. (Kaiseriana) kinneari</i>	Artiodactyla: bovid (cattle, buffalo), suid (boar), tragulid (chevrotain); Lagomorpha: leporid (hare); Eulipotyphla: soricid (shrew); Rodentia: hystricid (crested porcupine), murid (rat, Asiatic long-tailed mouse), sciurid (squirrel); Carnivora: canid (dog, Asiatic jackal); felid (tiger, leopard), herpestid (Indian gray mongoose), ursid (black bear); Primates: cercopithecid (bonnet macaque, langur monkey); Bucerotiformes: bucerotid (hornbill); Cuculiformes: cuculid (coucal); Galliformes: phasianid (fowl); Passeriformes: sylviid (warbler), timaliid (babbler); Piciformes: capitonid (barbet)		Asia
<i>H. (Alloceraea) kitaokai</i>	Artiodactyla: bovid (cattle, sika deer, Japanese serow), cervid (sika deer); Perissodactyla: equid (horse); Galliformes: phasianid (fowl)		Asia
<i>H. knobigera</i>	Artiodactyla: bovid (cattle, goat)		India
<i>H. (Alloceraea) kolonini</i>	host unknown, collected from vegetation		China
<i>H. konigsbergeri</i>	Rodentia: murid (black rat), sciurid (red giant flying squirrel, Hose's pygmy flying squirrel); Scandentia: ptilocercid (pen-tailed treeshrew); Carnivora: felid (cat, marbled cat, leopard cat, leopard, clouded leopard, tiger), mephitid (Sunda stink badger), mustelid (yellow-throated marten, Malayan weasel, Malayan glutton), viverrid (binturong, masked palm civet, banded palm civet, small-toothed palm civet, Asian palm civet, Malayan civet); Primates: hominid (human)		Asia
<i>H. kopetdaghica</i>	Artiodactyla: bovid (goat); Perissodactyla: equid (horse); Carnivora: felid (leopard)		Eurasia
<i>H. krijgsmani</i>	Artiodactyla: suid (wild boar)		New Guinea
<i>H. (Herpetobia) kumaonensis</i>	hosts unknown		India
<i>H. kutchensis</i>	Artiodactyla: bovid (cattle, sheep); Lagomorpha: leporid (black-naped hare); Rodentia: murid (rat); Carnivora: canid (dog, Indian wolf, golden jackal), felid (cat, jungle cat, caracal, lynx), herpestid (mongoose), hyaenid (striped hyena); Cuculiformes: cuculid		Central Asia

	(greater coucal); Galliformes: phasianid (grey francolin, painted francolin, Indian peafowl, ring-necked pheasant); Passeriformes: alaudid (Indian bush lark, red-winged lark), leiothrichid (common babbler), muscicapid (Indian robin), passerid (house sparrow), sturnid (rosy starling), sylviid (common whitethroat); Strigiformes: strigid (owl)		
<i>H. (Aborphysalis) kyanurensis</i>	Artiodactyla: bovid (cattle, buffalo), suid (boar), tragulid (chevrotain); Eulipotyphla: soricid (Asian house shrew); Lagomorpha: leporid (rabbit, Indian hare); Rodentia: hystricid (Indian crested porcupine), murid (black rat, Blanford's rat, Asiatic long-tailed climbing mouse), sciurid (jungle palm squirrel, red giant flying squirrel); Carnivora: canid (dog, dhole), felid (leopard cat); Primates: cercopithecoid (bonnet macaque, northern plains gray langur); Galliformes: phasianid (chicken)		Central Asia
<i>H. (Ornithophysalis) lagostrophii</i>	Diprotodontia: macropodid (banded hare-wallaby, rufous hare-wallaby, black-flanked rock-wallaby); Peramelemorphia: peramelid (western barred bandicoot)		Australia
<i>H. (Kaiseriana) lagrangei</i>	Artiodactyla: bovid (cattle, gaur), cervid (Indian muntjac, Indian sambar deer), suid (Indian boar), tragulid (Java mouse-deer); Scandentia: tupaiid (lesser tree shrew); Rodentia: murid (unspecified rat), sciurid (black giant squirrel, ground squirrel, Asian red-cheeked squirrel); Carnivora: canid (red dog), herpestid (small Indian mongoose, small Asian mongoose, Javan mongoose), mustelid (Burmese ferret-badger), Ursid (Asian black bear), viverrid (Asian palm civet, small Indian civet, small-toothed palm civet); Primates: hominid (human); Falconiformes: falconid (common kestrel); Galliformes: phasianid (red junglefowl); Passeriformes: laniid (shrike), muscicapid (flycatcher); Sauria: varanid (monitor)		Asia
<i>H. laocayensis</i>	Artiodactyla: cervid (deer); Carnivora: mustelid (weasel)		Asia
<i>H. (Rhipistoma) latitudinis</i>	Artiodactyla: bovid (cattle); Rodentia: murid (multimammate mouse, gerbil); Carnivora: canid (wolf), felid (cat), herpestid (marsh mongoose, white-tailed mongoose, banded mongoose, Gambian mongoose, common kusimanse), mustelid (African striped weasel), viverrid (African civet, rusty-spotted genet, Cape genet, Hausa genet); Chiroptera: molossid (Sierra Leone free-tailed bat)		Africa
<i>H. leachii</i> (syn. <i>Ixodes, H. elliptica, muhsami</i>) (yellow dog tick)	Artiodactyla: bovid (cattle, zebu, sheep, goat, steenbok, southern reedbeek, harnessed bushbuck, Coke's hartebeest, Lelwel hartebeest, Gunther's dikdik, Kirk's dikdik, common duiker, bay duiker, black duiker, Maxwell's duiker, tiang, oribi), suid (pig, red river hog, desert warthog); Perissodactyla: equid (horse), rhinocerotid (rhinoceros); Proboscidea: elephantid (African elephant); Eulipotyphla: erinaceid (four-toed hedgehog, European hedgehog, South African hedgehog, Sudanese hedgehog, African pygmy hedgehog), soricid (greater red musk shrew, African musk shrew, African giant shrew, Etruscan shrew, Asian house shrew); Pholidota: manid (pangolin); Lagomorpha: leporid (bush hare, scrub hare, Cape hare, Somalian hare, Natal red rock hare); Hyracoidea: procaviid (rock hyrax, yellow-spotted rock hyrax); Macroscelidea: macroscelid (western rock elephant shrew); Tubulidentata: orycteropid (aardvark); Rodentia: bathyergid (Cape dune mole-rat), dipodid (jerboa), heterocephalid (mole-rat), hystricid (crested porcupine, Cape porcupine), murid (house mouse, fat mouse, flat-haired mouse, little Indian field mouse, typical striped grass mouse, four-striped grass mouse, Griselda's striped grass mouse, Peter's striped mouse, Guinean grass mouse, eastern spiny mouse, southern multimammate mouse, Natal multimammate mouse, Guinea multimammate mouse, Hubert's multimammate mouse, Tullberg's soft-furred mouse, sub-Saharan pygmy mouse, black rat, acacia rat, red veld rat, Namaqua rock rat, Tanezumi rat, South African vlei rat, African grass rat, Abyssinian grass rat, gray brush-furred rat, rusty-bellied brush-furred rat, gracile tateril,	trauma, irritation (vector for babesiosis, rickettsiosis, Q fever)	Africa, Asia, Australia

	<p>savannah gerbil, bushveld gerbil, Cape gerbil, Guinea gerbil, Cape short-eared gerbil, Kemp's gerbil, common dasymys, nesomyid (Gambian pouched rat, South African pouched mouse), pedetid (South African springhare, West African springhare), sciurid (striped ground squirrel, unstriped ground squirrel, red bush squirrel, Smith's bush squirrel, Cape ground squirrel, Thomas's rope squirrel, Lord Derby's scaly-tailed squirrel, Indian giant flying squirrel), spalacid (Aberdare Mountains African mole-rat), thryonomyid (greater cane rat); Carnivora: canid (dog, hunting dog, African wild dog, wolf, African wolf, golden jackal, silver jackal, black-backed jackal, side-striped jackal, Indian jackal, Senegalese jackal, red fox, pale fox, Cape fox, bat-eared fox), felid (cat, black-footed cat, bushcat, wildcat, junglecat, serval, caracal, lion, leopard cat, leopard, clouded leopard, cheetah, panther, tiger), herpestid (common kusimanse, meerkat, common dwarf mongoose, Somalian dwarf mongoose, common slender mongoose, Somalian slender mongoose, marsh mongoose, water mongoose, yellow mongoose, white-tailed mongoose, short-tailed mongoose, black-legged mongoose, banded mongoose, Indian gray mongoose, Cape gray mongoose, Egyptian mongoose, Gambian mongoose), hyaenid (spotted hyena, striped hyena, brown hyena, aardwolf), mustelid (ferret, honey badger, African clawless otter, spotted-necked otter, Malayan glutton, stoat, striped polecat, Cape polecat, yellow-throated marten, African striped weasel), ursid (sun bear), viverrid (African civet, large Indian civet, small Indian civet, African palm civet, Asian palm civet, common genet, small spotted genet, rusty spotted genet, pardine genet, servaline genet, king genet, Cape genet, Angolan genet, Hausa genet); Primates: cercopithecid (grivet), hominid (human), lorid (Sunda slow loris); Anseriformes: anatid (knob-billed duck); Cuculiformes: cuculid (white-browed coucal, Senegal coucal, African emerald cuckoo); Galliformes: phasianid (red junglefowl, double-spurred spurfowl); Passeriformes: callaeid (huia), malaconotid (bush shrike, brown-crowned tchagra, black-crowned tchagra), motacillid (forest wagtail), muscicapid (bearded scrub robin, Miombo scrub robin, thrush nightingale, northern anteater chat), ploceid (red-collared widowbird), turdid (arrow-marked babbler); Strigiformes: strigid (Verreaux's eagle-owl); Testudines: geoemydid (Indian black turtle), testudines (elongated tortoise, leopard tortoise) (3-host cycle)</p>		
<i>H. lemuris</i>	Primates: cheirogaleid (mouse lemur), indriid (Verreaux's sifaka), lemurid (ring-tailed lemur, black-and-white ruffed lemur), lepilemurid (red-tailed sportive lemur)		Madagascar
<i>H. leporispalustris</i> (syn. <i>Ixodes leporis</i> , <i>leporisproxima</i> , <i>proxima</i>) (rabbit tick)	Artiodactyla: bovid (cattle, goat, blackbuck), cervid (white-tailed deer), tayassuid (collared peccary); Perissodactyla: equid (horse); Lagomorpha: leporid (European hare, marsh hare, snowshoe hare, rabbit, swamp rabbit, black-tailed jackrabbit, white-tailed jackrabbit, brush rabbit, marsh rabbit, pygmy rabbit, common tapeti, eastern cottontail, desert cottontail, mountain cottontail, Mearn's cottontail, South America cottontail, New England cottontail, common tapeti, Central American tapeti); Didelphimorphia: didelphid (brown four-eyed opossum, Virginia opossum); Rodentia: cricetid (deer mouse, pinyon mouse, cotton mouse, northern grasshopper mouse, pack rat, hispid cotton rat, bushy-tailed woodrat, eastern woodrat, desert woodrat, Southern Plains woodrat), dasyproctid (Azara's agouti, Central American agouti), dipodid (Merriam's rat kangaroo, chisel-toothed rat kangaroo, Ord's rat kangaroo), echimyid (Guyenne spiny rat), geomyid (southern pocket gopher), heteromyid (Great Basin pocket mouse), murid (house mouse, northern golden mouse, white-footed mouse, black rat, brown rat, Florida wood rat), sciurid (least chipmunk, woodchuck, groundhog, pine squirrel, rock squirrel, fox squirrel, gray squirrel, striped ground squirrel, California ground	trauma, irritation (vector for tularemia, Lyme disease, Rocky Mountain spotted fever)	Americas

	<p>squirrel, Mexican ground squirrel, Richardson's ground squirrel, thirteen-lined ground squirrel, yellow-bellied marmot); Carnivora: canid (dog, red fox, gray fox), felid (cat, bobcat), mephitid (striped skunk), procyonid (raccoon), viverrid (palm civet); Primates: hominid (human); Accipitriformes: accipitrid (eagle, red-tailed hawk); Apodiformes: trochilid (broad-tailed hummingbird); Caprimulgiformes: caprimulgid (common nighthawk); Charadriiformes: larid (gull), scolopacid (sandpiper), sternid (tern); Columbiformes: columbid (mourning dove); Cuculiformes: cuculid (greater roadrunner, black-billed cuckoo, groove-billed ani); Galliformes: cracid (dusky-legged guan), odontophorid (northern bobwhite quail, California desert quail), phasianid (chicken, prairie chicken, sage hen, turkey, greater sage-grouse, ruffed grouse, spruce grouse, sharp-tailed grouse, Gambel's quail, Mexican scaled quail, ring-necked pheasant); Gruiformes: rallid (American coot, sora rail); Passeriformes: alaudid (horned lark, prairie horned lark), cardinalid (rose-breasted grosbeak, painted bunting, indigo bunting, western tanager, northern cardinal, dickcissel), corvid (jackdaw, Eurasian magpie, blue jay, plush-crested jay, California scrub jay, American crow, raven), emberizid (saffron-billed sparrow, half-collared sparrow, black-striped sparrow), fringillid (American goldfinch), icterid (brown-headed cowbird, red-winged blackbird, bronze grackle, purple grackle, eastern meadowlark, western meadowlark, yellow-breasted chat), laniid (loggerhead shrike), mimid (brown thrasher, sage thrasher, crissal thrasher, curve-billed thrasher, grey catbird, mockingbird, northern mockingbird), muscicapid (common redstart), parid (tufted titmouse, black-capped chickadee), parulid (ovenbird, Louisiana water thrush, hooded warbler, two-banded warbler, black-throated blue warbler, black-throated grey warbler, prairie warbler, palm warbler, Audubon's warbler, common yellowthroat), passerid (house sparrow, English sparrow), passerellid (chipping sparrow, field sparrow, song sparrow, vesper sparrow, swamp sparrow, savannah sparrow, fox sparrow, grasshopper sparrow, golden-crowned sparrow, white-crowned sparrow, white-throated sparrow, black-throated sparrow, black-striped sparrow, half-collared sparrow, American tree sparrow, Bachman's sparrow, Bell's sparrow, Brewer's sparrow, Gambel's sparrow, Lincoln's sparrow, eastern towhee, canyon towhee, green-tailed towhee, red-eyed towhee, white-eyed towhee, Alabama towhee, Arctic towhee, dark-eyed junco), polioptilid (blue-grey gnatcatcher), regulid (ruby-crowned kinglet), sturnid (common starling), thamnophilid (chestnut-backed antbird, variable antshrike), thraupid (black-goggled tanager, blue-black grassquit, green-winged saltator), troglodytid (house wren, moustached wren, bay wren, rock wren, tropical wren, canyon wren, Carolina wren, Bewick's wren), turdid (yellow-throated nightingale-thrush, hermit thrush, gray-cheeked thrush, olive-backed thrush, wood thrush, Swainson's thrush, rufous-bellied thrush, mountain bluebird, eastern bluebird, red-winged blackbird, Brewer's blackbird, Townsend's solitaire, American robin), tyrannid (eastern kingbird, southern antpipit, masked water tyrant, olive-sided flycatcher, brown-crested flycatcher, ash-throated flycatcher, American grey flycatcher), vireonid (blue-headed vireo); Tinamiformes: tinamid (Tataupa tinamou); Piciformes: picid (golden-fronted woodpecker, ladder-backed woodpecker, hairy woodpecker, northern flicker, red-shafted flicker); Strigiformes: strigid (buffy prairie owl, screech owl, barred owl) (3-host cycle)</p>		
<i>H. lobachovi</i>	Rodentia: hystricid (crested porcupine)		Africa
<i>H. (Kaiseriana) longicornis</i> (bush tick, Asian longhorned tick)	Artiodactyla: bovid (cattle, sheep, goat), cervid (elk, white-tailed deer, sambar deer, fallow deer, Javan rusa), suid (pig); Perissodactyla: equid (horse, donkey); Diprotodontia: macropodid (eastern grey kangaroo, common wallaroo, pademelon, black-	trauma, irritation, reduced production, damaged hides	Eurasia, Americas, Australasia

	<p>striped wallaby), phalangerid (common brushtail possum), pseudocheirid (common ringtail possum); Peramelemorphia: peramelid (northern brown bandicoot); Didelphimorphia: didelphid (Virginia opossum); Eulipotyphla: erinaceid (European hedgehog); Lagomorpha: leporid (European rabbit, European hare); Rodentia: murid (house mouse, black rat, brown rat); Carnivora: canid (dog), felid (cat), mustelid (stoat, ferret, least weasel, Japanese badger), procyonid (raccoon); Primates: hominid (human); Accipitriformes: accipitrid (swamp harrier); Anseriformes: anatid (mallard); Apterygiformes: apterygid (North Island brown kiwi); Charadriiformes: larid (gull); Galliformes: phasianid (chicken, turkey, ring-necked pheasant); Gruiformes: rallid (buff-banded rail, weka); Passeriformes: alaudid (Eurasian skylark), artamid (Australian magpie), emberizid (yellowhammer), passerid (house sparrow), sturnid (common myna), turdid (song thrush, dusky thrush, pale thrush); Psittaciformes: psittaculid (budgerigar) (3-host cycle)</p>	(vector for babesiosis, theileriosis, rickettsioses, hepatozoonosis)	
<i>H. longipalpis</i>	Artiodactyla: tragulid (Indian spotted chevrotain)		Sri Lanka
<i>H. (Kaiseriana) luzonensis</i>	Artiodactyla: cervid (Philippine deer), suid (Philippine warty pig)		Philippines
<i>H. (Ornithophysalis) madagascariensis</i>	Cuculiformes: cuculid (Malagasy coucal); Passeriformes: vangid (vanga)		Madagascar
<i>H. (Kaiseriana) mageshimaensis</i>	Artiodactyla: bovid (cattle, buffalo, goat), cervid (muntjac, Reeve's muntjac, sika deer), suid (pig); Rodentia: murid (rat); Carnivora: canid (dog), felid (leopard cat, tiger), viverrid (masked palm civet); Primates: hominid (human); Passeriformes: pycnonotid (brown-eared bulbul), zosteropid (warbling white-eye)		Eurasia
<i>H. megalaimae</i>	Piciformes: megalaimid (small green barbet, white-cheeked barbet)		Asia
<i>H. megaspinosa</i>	Artiodactyla: bovid (cattle, buffalo), cervid (deer), suid (pig); Perissodactyla: equid (horse); Carnivora: canid (dog), felid (cat), ursid (giant panda); Primates: hominid (human)		Eurasia
<i>H. megaventralis</i>	Passeriformes: hirundinid (cave swallow)		North America
<i>H. (Kaiseriana) menglaensis</i>	Artiodactyla: cervid (deer)		China
<i>H. menui</i>	Artiodactyla: cervid (Indian sambar deer)		Indo-China
<i>H. mesnardi</i>	Carnivora: ursid (Asian black bear)		Vietnam
<i>H. (Ornithophysalis) minuta</i>	Artiodactyla: bovid (buffalo, sheep, goat); Rodentia: hystricid (crested porcupine); Rodentia: murid (rat); Carnivora: herpestid (mongoose), viverrid (small Indian civet); Primates: cercopithecid (northern plains gray langur); Cuculiformes: cuculid (coucal); Galliformes: phasianid (chicken, Sri Lankan junglefowl); Passeriformes: timaliid (babler)		Asia
<i>H. mjoebergi</i>	Artiodactyla: bovid (cattle), cervid (sambar deer)		Malaysia
<i>H. monospinosa</i>	Artiodactyla: tragulid (lesser mouse-deer)		Indonesia
<i>H. montgomeryi</i>	Artiodactyla: bovid (cattle, zebu, buffalo, sheep, goat, Sumatran serow), camelid (camel), cervid (deer); Perissodactyla: equid (horse, mule); Eulipotyphla: erinaceid (hedgehog), soricid (shrew); Rodentia: cricetid (mountain vole), murid (rat, mouse), sciurid (long-tailed marmot, squirrel); Carnivora: canid (dog), felid (leopard), herpestid (mongoose); Primates: hominid (human); Galliformes: phasianid (partridge); Passeriformes: corvid (spotted nutcracker)		China, Nepal
<i>H. (Rhipistoma) moreli</i>	Rodentia: murid (grass rat, Defua rat, Tullberg's soft-furred mouse); Eulipotyphla: erinaceid (four-toed hedgehog, African hedgehog); Lagomorpha: leporid (Cape hare, African savanna hare); Carnivora: canid (dog, side-striped jackal, pale fox), felid (cat, African wildcat, leopard, lion, serval), herpestid (marsh mongoose), hyaenid (striped hyena), nandiniid (African palm civet), viverrid (African civet, common genet, forest genet, large-spotted genet, Villier's genet, Cape genet, Pardine genet, Senegal genet, false genet); Primates: galagid (Senegal bushbaby)		Africa
<i>H. (Haemaphysalis)</i>	Artiodactyla: bovid (yak), moschid (dwarf musk deer);		China

<i>moschisuga</i>	Lagomorpha: leporid (hare); Galliformes: phasianid (fowl)		
<i>H. muhsami</i>	Eulipotyphla: erinaceid (four-toed hedgehog); Tubulidentata: orycteropodid (aardvark); Rodentia: murid (typical striped grass mouse, fat mouse), nesomyid (Gambian pouched rat); Carnivora: herpestid (common dwarf mongoose, marsh mongoose, banded mongoose, water mongoose, Egyptian mongoose), hyaenid (spotted hyena), viverrid (common genet, Cape genet, African civet); Passeriformes: muscicapid (Miombo scrub-robin); Strigiformes: strigid (Verreaux's eagle-owl)		Africa
<i>H. murinus</i>	Eulipotyphla: soricid (Asian house shrew); Rodentia: murid (Indian black rat, Blanford's rat, bandicoot rat), sciurid (jungle palm squirrel)		India
<i>H. nadchatrami</i>	Artiodactyla: bovid (cattle, buffalo), cervid (unspecified), suid (pig, bearded pig), tragulid (chevrotain); Perissodactyla: equid (horse), tapirid (tapir); Rodentia: murid (unspecified), sciurid (ground squirrel); Carnivora: canid (dog), felid (tiger), mustelid (weasel); viverrid (civet); Primates: hominid (human)		Asia
<i>H. (Herpetobia) nepalensis</i>	Artiodactyla: bovid (cattle, yak, buffalo, sheep, goat, Sumatran serow); Rodentia: murid (white-bellied rat); Carnivora: felid (wildcat), ursid (Asian black bear); Primates: hominid (human)		China, Nepal
<i>H. (Dermaphysalis) nesomys</i>	Rodentia: nesomyid (Island mouse, red forest rat)		Madagascar
<i>H. neumanni</i>	Artiodactyla: bovid (cattle, guar, sheep, goat), cervid (sika deer, chital deer, red deer); Perissodactyla: equid (horse, mule); Rodentia: murid (striped field mouse); Carnivora: canid (dog, golden jackal), mustelid (European badger)		Japan
<i>H. nishiyamai</i>	Artiodactyla: cervid (sambar deer, Reeve's muntjac), suid (Taiwan pig); Carnivora: canid (dog); Primates: hominid (human)		Taiwan
<i>H. norvali</i>	Eulipotyphla: erinaceid (South African hedgehog)		Africa
<i>H. (Haemaphysalis) numidiana</i>	Artiodactyla: bovid (cattle, sheep); Eulipotyphla: erinaceid (long-eared hedgehog, northern white-breasted hedgehog, European hedgehog, Brandt's hedgehog), soricid (lesser white-toothed shrew); Lagomorpha: leporid (tolai hare, desert hare, European hare), ochotonid (Pallas's pika); Rodentia: cricetid (flat-headed vole, European snow vole, grey dwarf hamster), dipodid (thick-tailed three-toed jerboa, dwarf fat-tailed jerboa, small five-toed jerboa, northern three-toed jerboa, great jerboa), murid (house mouse, yellow-necked mouse, eastern broad-toothed field mouse, wood mouse, short-tailed bandicoot rat, Turkestan rat, midday jird, Libyan jird, Tamarisk jird), pedetid (springhare), sciurid (yellow ground squirrel, little ground squirrel, long-clawed ground squirrel, European ground squirrel); Carnivora: canid (red fox, corsac fox), felid (sand cat, African wildcat), mustelid (beech marten, stoat, steppe polecat, marbled polecat, European polecat, least weasel, ferret), ursid (brown bear); Primates: hominid (human); Falconiformes: falconid (Eurasian hobby); Passeriformes: emberizid (red-headed bunting), muscicapid (isabelline wheatear); Testudines: testudinid (Russian tortoise)		Central Asia
<i>H. obesa</i>	Artiodactyla: bovid (cattle), cervid (Tibetan black deer, muntjac), suid (Indian boar); Perissodactyla: tapirid (Malayan tapir); Carnivora: canid (dog), mustelid (badger), ursid (bear); Primates: cercopithecoid (capped langur), hominid (human)		Vietnam, India
<i>H. obtusa</i>	Afrosoricida: tenrecid (tenrec); Rodentia: murid (mouse), nesomyid (pouched rat); Carnivora: canid (dog), euplerid (fossa, ring-tailed vontsira), viverrid (small Indian civet)		Madagascar
<i>H. (Rhipistoma) oliveri</i>	Artiodactyla: bovid (unspecified antelope); Rodentia: murid (African grass rat, Cairo spiny mouse); Carnivora: canid (side-striped jackal), felid (wild cat, serval), herpestid (white-tailed mongoose), viverrid (small spotted genet)		Africa
<i>H. orientalis</i>	Artiodactyla: bovid (klipspringer); Hyracoidea: procaviid (yellow-spotted rock hyrax)		Africa
<i>H. (Ornithophysalis) ornithophila</i>	Artiodactyla: bovid (klipspringer, bharal); Lagomorpha: leporid (hare); Carnivora: mustelid (Siberian weasel); Galliformes:		Eurasia

	phasianid (red junglefowl, Swinhoe's pheasant, Taiwan partridge); Passeriformes: chloropseid (leafbird), pittid (rusty-naped pitta), turdid (pale thrush, scaly thrush, Amami ground thrush)		
<i>H. palawanensis</i>	Artiodactyla: cervid (Javan rusa), suid (Philippine warty pig); Rodentia: hystricid (Philippine porcupine), murid (Palawan pencil-tailed tree mouse), sciurid (Palawan flying squirrel); Carnivora: felid (small cave cat), herpestid (short-tailed mongoose), mephitid (Palawan stink badger), viverrid (Malayan civet); Primates: hominid (human)		Philippines
<i>H. (Kaiseriana) papuana</i>	Artiodactyla: bovid (cattle, banteng, buffalo, water buffalo), cervid (Indian sambar deer), tragulid (Javan mouse-deer), suid (pig, babirusa, banded pig, Philippine warty pig, Indian boar, Bornean bearded pig); Perissodactyla: equid (horse), tapirid (Malayan tapir); Eulipotyphla: soricid (Asian house shrew); Rodentia: hystricid (porcupine), murid (mouse, Asiatic long-tailed climbing mouse, black rat, Indian black rat, rice field rat, Blanford's rat, Bower's white-toothed rat, Malayan field rat, long-tailed giant rat, Muller's giant Sunda rat, red spiny rat, Musschenbroek's spiny rat, Rajah spiny rat), sciurid (jungle palm squirrel, shrew-faced squirrel); Carnivora: canid (dog, pariah dog, dhole), felid (cat, leopard, tiger), mustelid (greater hog-badger), ursid (sun bear), viverrid (masked palm civet); Primates: cercopithecoid (bonnet macaque, northern plains gray langur), hominid (human); Galliformes: phasianid (unspecified); Passeriformes: muscicapid (unspecified)	(vector for Kyasanur forest disease virus)	Asia, New Guinea
<i>H. (Rhipistoma) paraleachi</i>	Artiodactyla: bovid (cattle, buffalo, water buffalo, bushbuck), moschid (musk deer); Rodentia: cricetid (gerbil), hystricid (porcupine), murid (unspecified); Carnivora: canid (dog, African hunting dog, side-striped jackal, black-backed jackal, golden jackal, red fox), felid (cat, African wild cat, serval, lion, leopard), herpestid (grey mongoose, white-tailed mongoose), hyaenid (hyena), viverrid (African civet, genet, bush genet); Primates: cercopithecoid (black-and-white colobus), hominid (human); Galliformes: phasianid (junglefowl)		Africa
<i>H. paraturturis</i>	Artiodactyla: bovid (cattle, goat), suid (Indian boar); Eulipotyphla: soricid (shrew); Rodentia: murid (rat), sciurid (squirrel); Carnivora: canid (Indian wolf, Ussuri dhole), felid (jungle cat), herpestid (mongoose), ursid (bear); Cuculiformes: cuculid (greater coucal); Passeriformes: timaliid (babbler)		India
<i>H. (Kaiseriana) parmata</i>	Artiodactyla: bovid (cattle, zebu, buffalo, forest buffalo, sheep, goat, hartebeest, Lichtenstein's hartebeest, harnessed bushbuck, Cape bushbuck, harnessed antelope, royal antelope, common duiker, black duiker, bay duiker, zebra duiker, blue duiker, red forest duiker, black-fronted duiker, red-flanked duiker, Maxwell's duiker, Harvey's duiker, Peter's duiker, Bate's pygmy antelope, impala, kob, puku, bongo, oribi), giraffid (okapi), suid (pig, bushpig, red river hog, warthog), tragulid (water chevrotain); Macroscelidea: macroscelidid (black-and-rufous elephant shrew); Lagomorpha: leporid (hare); Pholidotes: manid (pangolin); Rodentia: hystricid (African brush-tailed porcupine), murid (black rat, gerbil), nesomyid (Gambian pouched rat), sciurid (forest giant squirrel), thryonomyid (greater cane rat); Carnivora: canid (dog), felid (cat, leopard), herpestid (marsh mongoose, white-tailed mongoose), viverrid (African civet, African palm civet, common genet, rusty-spotted genet, king genet, servaline genet); Primates: cercopithecoid (moustached guenon), hominid (human); Bucerotiformes: bucerotid (eastern piping hornbill); Galliformes: numidid (helmeted guineafowl, forest guineafowl, plumed guineafowl, black guineafowl, southern crested guineafowl), phasianid (double-spurred spurfowl, Ahanta spurfowl, Latham's francolin, grey-necked rock fowl); Passeriformes: estrildid (unspecified finch), viduid (pin-tailed whydah); Serpentes: atractaspidid (mole viper), lamprophiid (burrowing asp)		Africa
<i>H. (Haemaphysalis)</i>	Artiodactyla: bovid (cattle, zebu, water buffalo, sheep, goat, wild	(vector for	Europe

<i>parva</i> (syn. <i>H. otophila</i>)	goat, camelid (camel), cervid (roe deer, red deer), suid (pig); Perissodactyla: equid (horse, donkey); Eulipotyphla: erinaceid (long-eared hedgehog, northern white-breasted hedgehog, European hedgehog); Lagomorpha: leporid (mountain hare, European hare), ochotonid (African pika); Rodentia: calomyscid (Hotson's mouse-like hamster); cricetid (social vole, Gunther's vole, grey dwarf hamster, Ciscaucasian hamster), dipodid (William's jerboa), glirid (forest dormouse), murid (house mouse, wood mouse, gerbil, Tristram's jird, Persian jird, Libyan jird), sciurid (speckled ground squirrel), spalacid (lesser blind mole-rat); Carnivora: canid (dog, wolf, golden jackal, red fox), felid (cat, fishing cat, panther), mustelid (European badger, least weasel, ferret), viverrid (small Indian civet); Primates: hominid (human); Accipitriformes: accipitrid (tawny eagle, Bonelli's eagle, Montagu's harrier); Charadriiformes: burhinid (Eurasian stone curlew), charadriid (sociable lapwing), scolopacid (common snipe, Eurasian woodcock); Columbiformes: columbid (dove, European turtle dove); Coraciiformes: coraciid (European roller), meropid (European bee-eater); Falconiformes: falconid (lesser kestrel); Galliformes: phasianid (common quail, common partridge, grey partridge, ring-necked pheasant); Otidiformes: otidid (little bustard); Passeriformes: alaudid (crested lark, Calandra lark, Eurasian skylark), corvid (raven, rook, carrion crow, Eurasian magpie), emberizid (yellowhammer, corn bunting, rock bunting, black-headed bunting, Ortolan bunting), motacillid (tree pipit), muscicapid (common redstart, common rock thrush, blue rock thrush, western black-eared wheatear, isabelline wheatear, northern wheatear), passerid (house sparrow), passerellid (Eurasian tree sparrow), sturnid (common starling), sylviid (garden warbler), turdid (song thrush, common blackbird); Piciformes: picid (woodpecker); Strigiformes: strigid (short-eared owl, little owl); Sauria: agamid (Caucasian agama), anguid (sheltopusik), lacertid (snake-eyed lizard, sand lizard, common wall lizard, felseneidechse, Caspian green lizard, European green lizard, Crimean wall lizard, rapid racerunner); Serpentes: colubrid (grass snake, Balkan whip snake), psammophiid (eastern Montpellier snake); Serpentes: viperid (meadow viper); Testudines: testudinid (Greek tortoise) (3-host cycle)	babesiosis and possibly Q fever, tularemia and rickettsioses)	
<i>H. pavlovskyi</i>	Eulipotyphla: erinaceid (long-eared hedgehog); Lagomorpha: leporid (desert hare, tolai hare); Galliformes: phasianid (common quail, white-winged pheasant); Passeriformes: phylloscopid (willow warbler), sylviid (unspecified warbler)		Eurasia
<i>H. (Rhipistoma) pedetes</i>	Rodentia: pedetid (South African springhare); Carnivora: felid (unspecified cat), herpestid (unspecified mongoose), mustelid (unspecified polecat)		Africa
<i>H. pentalagi</i>	Lagomorpha: leporid (Amami rabbit)		Japan
<i>H. peregrinus</i>	Pterocliiformes: pteroclid (Pallas's sandgrouse)		Europe
<i>H. (Ornithophysalis) petrogalis</i>	Diprotodontia: macropodid (unadorned rock-wallaby)		Australia
<i>H. (Ornithophysalis) phasiana</i>	Artiodactyla: cervid (sika deer, Chinese muntjac); Lagomorpha: leporid (rabbit); Charadriiformes: turnicid (barred buttonquail); Galliformes: phasianid (green pheasant, ring-necked pheasant, hazel grouse); Passeriformes: emberizid (chestnut bunting, Siberian grey-headed bunting), locustellid (Middendorf's grasshopper warbler), muscicapid (blue rock thrush)		Asia
<i>H. (Allophysalis) pospelovashtromae</i> (syn. <i>H. aksarensis</i>)	Artiodactyla: bovid (cattle, yak, sheep, goat), suid (pig); Lagomorpha: leporid (hare), ochotonid (pika), Rodentia: sciurid (ground squirrel); Passeriformes: sittid (nuthatch)		Central Asia
<i>H. (Alloceraea) primitiva</i>	host unknown, collected from vegetation		China
<i>H. (Rhipistoma) princeps</i>	Artiodactyla: bovid (unspecified antelope); Lagomorpha: leporid (Cape hare); Eulipotyphla: erinaceid (four-toed hedgehog), sorcidid		Africa

	(African giant shrew); Rodentia: murid (Cairo spiny mouse, Natal multimammate mouse, African grass rat, unspecified gerbil, Kemp's gerbil) Carnivora: canid (wolf, side-striped jackal, golden jackal, pale fox), felid (cat, wildcat, serval, lion), herpestid (marsh mongoose, banded mongoose, white-tailed mongoose, Egyptian mongoose, Gambian mongoose, Pousargues's mongoose), mustelid (striped polecat), viverrid (African civet, common genet, rusty-spotted genet, Hausa genet)		
<i>H. (Kaiseriana) psalistos</i>	Artiodactyla: bovid (cattle, anoa), cervid (Javan rusa, Philippine deer), suid (pig, Philippine warty pig, Celebes warty pig); Rodentia: murid (common bunomys, Pacific rat, Hoffmann's Sulawesi rat, marmoset xanthurus rat)		Philippines
<i>H. (Rhipistoma) punctaleachi</i>	Artiodactyla: bovid (royal antelope); Rodentia: hystricid (porcupine); Carnivora: canid (dog), felid (leopard), nandiniid (African palm civet), viverrid (African civet, Cape genet, Senegal genet, Johnston's genet)		Africa
<i>H. (Aboimisalis) punctata</i>	Artiodactyla: bovid (cattle, water buffalo, sheep, mouflon, goat, wild goat), camelid (camel, dromedary), cervid (European fallow deer, red deer, roe deer), suid (pig); Perissodactyla: equid (horse, donkey); Eulipotyphla: erinaceid (northern white-breasted hedgehog, long-eared hedgehog, eastern hedgehog, European hedgehog), soricid (common shrew, garden shrew), talpid (European mole); Lagomorpha: leporid (desert hare, mountain hare, tolai hare, European hare, European rabbit); Rodentia: cricetid (bank vole, common vole, European water vole, northern mole vole, grey dwarf hamster), glirid (garden dormouse, forest dormouse), murid (house mouse, yellow-necked mouse, wood mouse, striped field mouse, Turkestan rat, Tamarisk jird), sciurid (red squirrel, little ground squirrel, relict ground squirrel, European ground squirrel); Carnivora: canid (dog, wolf, red fox), felid (cat), mustelid (European polecat, steppe polecat, least weasel, European badger), ursid (bear); Chiroptera (unspecified bat); Primates: hominid (human); Accipitriformes: accipitrid (common buzzard, hen harrier, Montagu's harrier, marsh hawk); Bucerotiformes: bucerotid (Eurasian hoopoe); Caprimulgiformes: caprimulgid (European nightjar); Charadriiformes: burhinid (Eurasian stone curlew), charadriid (northern lapwing, sociable lapwing), haematopodid (Eurasian oystercatcher), larid (herring gull, black-headed gull, common tern), scolopacid (Eurasian curlew, Eurasian woodcock, common sandpiper); Columbiformes: columbid (pigeon, hill pigeon, Oriental turtle dove, European turtle dove); Coraciiformes: coraciid (European roller), meropid (European bee-eater); Cuculiformes: cuculid (common cuckoo); Falconiformes: falconid (common kestrel, lesser kestrel, Eurasian hobby); Galliformes: phasianid (chicken, red junglefowl, snow cock, turkey, common partridge, Daurian partridge, grey partridge, rock partridge, chukar partridge, see-see partridge, red-legged partridge, common pheasant, ring-necked pheasant, ruffed grouse, black grouse, Pallas's sandgrouse, common quail, black francolin); Gruiformes: rallid (corncrake, common moorhen); Otidiformes: otidid (great bustard, little bustard); Passeriformes: acrocephalid (great reed warbler, Blyth's reed warbler, sedge warbler, melodius warbler), alaudid (woodlark, crested lark, horned lark, red-capped lark, bimaculated lark, Calandra lark, Eurasian skylark), corvid (raven, rook, hooded crow, carrion crow, chough, western jackdaw, Eurasian magpie, Eurasian jay), emberizid (yellowhammer, reed bunting, rock bunting, corn bunting, pine bunting, red-headed bunting, Ortolan bunting), fringillid (hawfinch, common chaffinch, common linnet, white-winged grosbeak), hirundinid (barn swallow), laniid (red-backed shrike, red-tailed shrike, brown shrike, lesser grey shrike), motacillid (meadow pipit, tawny pipit, water pipit, tree pipit, white wagtail, grey wagtail, western yellow wagtail, pied wagtail), muscicapid (African stonechat, whinchat,	trauma, irritation, toxicosis, paralysis (vector for babesiosis, theileriosis, anaplasmosis, rickettsioses, viral encephalitis, Congo-Crimean haemorrhagic fever, Bhanja, Palma, Tribec and louping-ill viruses)	Eurasia, Africa

	wheatear, robin, spotted flycatcher, thrush nightingale, common nightingale, bluethroat, common redstart, Guldenstadt's redstart, common rock thrush, blue rock thrush, European robin, isabelline wheatear, northern wheatear, variable wheatear, pied wheatear), parid (great tit, azure tit, cinereous tit), passerid (house sparrow, Spanish sparrow, Eurasian tree sparrow), passerellid (rock sparrow), phylloscopid (willow warbler, Siberian chiffchaff), prunellid (dunnock), sittid (western rock nuthatch), sturnid (common starling, rosy starling), sylviid (common whitethroat, lesser whitethroat, barred warbler), turdid (common blackbird, song thrush, fieldfare, mistle thrush, red-throated thrush); Pelecaniformes: ardeid (squacco heron); Piciformes: picid (great spotted woodpecker, white-winged woodpecker, Nuttall's woodpecker); Pteroclitiformes: pteroclid (black-bellied sandgrouse); Strigiformes: strigid (Eurasian eagle-owl, long-eared owl); Struthioniformes: struthionid (ostrich); Sauria: agama (Caucasian agama), anguid (European glass lizard), lacertid (snake-eyed lizard, sand lizard, common wall lizard, ocellated lizard, Maderian wall lizard, felseneidechse, European green lizard, Caspian green lizard, spiny-footed lizard, steppe runner, rapid racerunner); Serpentes: viperid (aspic viper); Testudines: testudinid (Russian tortoise) (3-host cycle)		
<i>H. quadriaculeata</i>	Rodentia: spalacid (mole-rat); Carnivora: canid (dog, gray wolf), mustelid (unspecified)		Vietnam
<i>H. (Haemaphysalis) qinghaiensis</i>	Artiodactyla: bovid (cattle, yak, sheep, goat); Perissodactyla: equid (horse, donkey, mule); Lagomorpha: leporid (rabbit); Primates: hominid (human) (3-host cycle)		Asia
<i>H. (Kaiseriana) ramachandrai</i>	Artiodactyla: bovid (cattle, buffalo, goat), cervid (sambar deer, chital deer, Indian muntjac); Carnivora: felid (leopard, tiger); Primates: hominid (human)		India
<i>H. (Ornithophysalis) ratti</i>	Dasyuromorphia: dasyurid (fawn antechinus, kowari); Peramelemorphia: peramelid (western barred bandicoot); Diprotodontia: phalangerid (common brushtail possum); Rodentia: murid (bush rat, long-haired rat, eastern rat, dusky field rat, fawn-footed mosaic-tailed rat, brush-tailed rabbit-rat, canefield rat)		Australia, New Guinea
<i>H. (Kaiseriana) renschi</i>	Artiodactyla: bovid (cattle, banteng, buffalo, water buffalo, goat), cervid (Javan rusa deer), suid (Celebes warty pig); Perissodactyla: equid (horse); Rodentia: murid (Pacific rat, mouse); Carnivora: canid (dog); Charadriiformes: larid (greater crested tern); Anura: ranid (unspecified frog)		Australasia
<i>H. rhinilophi</i>	Chiroptera: rhinolophid (greater horseshoe bat, Geoffroy's horseshoe bat)		Europe
<i>H. roubaudi</i>	Artiodactyla: cervid (Indian sambar deer); Primates: hominid (human)		Vietnam
<i>H. (Kaiseriana) rugosa</i>	Artiodactyla: bovid (cattle, waterbuck, tsessebe, Bohor reedbuck, harnessed bushbuck, tiang, oribi); Lagomorpha: leporid (Crawshay's hare); Rodentia: murid (pygmy gerbil); Carnivora: felid (serval), herpestid (Egyptian mongoose, white-tailed mongoose), viverrid (African civet, forest genet, Villier's genet)		Africa
<i>H. rusae</i>	Artiodactyla: cervid (rusa deer, Philippine deer), suid (Philippine warty pig), Diprotodontia: macropodid (unspecified wallaby)		Philippines, New Guinea
<i>H. (Haemaphysalis) sambar</i>	Artiodactyla: cervid (sambar deer)		India
<i>H. (Ornithophysalis) sciuri</i>	Rodentia: sciurid (Mindanao squirrel)		Philippines
<i>H. (Kaiseriana) semermis</i>	Artiodactyla: cervid (muntjac, sambar deer), suid (bushpig, Indian boar, Bornean bearded pig); Artiodactyla: tragulid (Javan mouse-deer); Perissodactyla: tapirid (Malayan tapir); Scandentia: tupaiid (common treeshrew); Rodentia: murid (long-tailed giant rat, Bower's white-toothed rat, Muller's giant Sunda rat, Malaysian house rat, Rajah spiny rat, red spiny rat), sciurid (plainsquirrel, slender squirrel); Carnivora: canid (dog, dhole); felid (leopard,		Asia

	clouded leopard, tiger), ursid (sun bear), viverrid (Malayan civet); Primates: hominid (human)		
<i>H. (Rhipistoma) setosa</i>	Hyracoidea: procaviid (hyrax); Lagomorpha: leporid (Cape hare), Rodentia: murid (Angoni vlei rat, Southern African vlei rat, maned rat); Carnivora: felid (cat), herpestid (white-tailed mongoose, Egyptian mongoose), viverrid (African civet, common genet, Cape genet); Primates: hominid (human)		Africa
<i>H. sewelli</i>	Artiodactyla: bovid (goat)		India
<i>H. (Kaiseriana) shimoga</i>	Artiodactyla: bovid (cattle, bison, sheep, goat, gaur), cervid (sambar deer), suid (boar); Rodentia: murid (rat), sciurid (squirrel); Primates: hominid (human)		Asia
<i>H. silacea</i>	Artiodactyla: bovid (cattle, gaur, sheep, goat, eland, kudu, Cape bushbuck, Nyala bushbuck, common duiker, blue duiker); Perissodactyla: rhinocerotid (rhinoceros); Lagomorpha: leporid (hare); Macroscelidea: macroscelidid (elephant shrew); Rodentia: murid (Namaqua rock mouse); Carnivora: canid (dog, black-backed jackal), felid (caracal, lynx), herpestid (white-tailed mongoose, yellow mongoose), hyaenid (hyena); Primates: hominid (human); Galliformes: numidid (helmeted guineafowl); Passeriformes: alaudid (rufous-naped lark), corvid (Cape raven), pycnonotid (black-eyed bulbul), sturnid (Cape glossy starling); Pelecaniformes: threskiornithid (Hadada ibis)		Africa
<i>H. silvafelis</i>	Lagomorpha: leporid (hare); Rodentia: sciurid (squirrel); Carnivora: felid (jungle cat); Cuculiformes: cuculid (coucal)		India
<i>H. (Ornithophysalis) simplex</i>	Afrosoricida: tenrecid (greater hedgehog tenrec, lesser hedgehog tenrec, tailless tenrec, lowland streaked tenrec, Talazac's shrew tenrec); Eulipotyphla: erinacid (hedgehog); Rodentia: murid (rat); Primates: cheirogaleid (mouse lemur), indriid (sifaka); Pelecaniformes: threskiornithid (Madagascar ibis)		Madagascar
<i>H. simplicima</i>	Afrosoricida: tenrecid (tenrec)		Madagascar
<i>H. sinensis</i>	Artiodactyla: bovid (cattle, goat)		Asia
<i>H. (Kaiseriana) spinigera</i>	Artiodactyla: bovid (cattle, zebu, buffalo, Indian bison, water buffalo, sheep), cervid (sambar deer, Indian sambar deer), tragulid (chevrotain); Peramelemorphia: peramelid (northern brown bandicoot, southern brown bandicoot); Diprotodontia: macropodid (unspecified); Eulipotyphla: soricid (Asian house shrew); Lagomorpha: leporid (black-naped hare); Rodentia: hystricid (Indian crested porcupine), murid (black rat, Indian black rat, brown rat, rakali, bandicoot rat, dusky field rat, Blanford's rat), sciurid (jungle palm squirrel, Malabar giant squirrel); Carnivora: canid (dog, Asiatic jackal), felid (leopard, tiger, panther), herpestid (gray mongoose), ursid (sloth bear, Indian bear), viverrid (small Indian civet); Primates: cercopithecoid (bonnet macaque, northern plains gray langur), hominid (human); Cuculiformes: cuculid (greater coucal); Galliformes: phasianid (grey junglefowl, peacock); Passeriformes: leiothrichid (jungle babbler), motacillid (forest wagtail), muscicapid (Indian robin, white-throated ground thrush), pycnonotid (red-vented bulbul), sturnid (jungle myna), turdid (orange-headed thrush) (3-host cycle)	trauma, irritation (vector for Kysanur forest disease)	India, Sri Lanka, Australia
<i>H. spinulosa</i> (syn. <i>H. ethiopica</i>)	Artiodactyla: bovid (common eland); Lagomorpha: leporid (scrub hare); Carnivora: canid (dog, bat-eared fox), felid (cat, caracal, leopard), herpestid (marsh mongoose, common dwarf mongoose, white-tailed mongoose, banded mongoose), mustelid (African striped weasel), nesomyid (Gambian pouched rat), viverrid (common genet, Cape genet); Primates: galagid (brown greater galago, Senegal bushbaby)		Africa
<i>H. subelongata</i>	Afrosoricida: tenrecid (tailless tenrec, lowland streaked tenrec); Rodentia: murid (unspecified rodents)		Madagascar
<i>H. (Kaiseriana) subphilippensis</i>	Artiodactyla: cervid (Philippine deer), suid (Philippine warty pig)		Philippines
<i>H. subterra</i>	Rodentia: murid (red veld rat, Natal multimammate mouse), spalacid (East African mole-rat); Carnivora: herpestid (common		Africa

	slender mongoose, marsh mongoose, white-tailed mongoose, banded mongoose, Egyptian mongoose), viverrid (rusty-spotted genet)		
<i>H. (Herpetobia) sulcata</i> (syn. <i>H. angorensis</i> , <i>cretica</i> , <i>cholodkovskiyi</i>)	Artiodactyla: bovid (cattle, water buffalo, sheep, mouflon, Asiatic mouflon, argali, goat, wild goat, goitered gazelle), camelid (camel), cervid (red deer, European fallow deer), suid (pig); Perissodactyla: equid (horse, donkey); Eulipotyphla: erinacid (long-eared hedgehog, European hedgehog); Lagomorpha: leporid (tolai hare, European hare), ochotonid (pika); Rodentia: calomyscid (Hotson's mouse-like hamster), cricetid (narrow-headed vole, grey dwarf hamster), dipodid (William's jerboa), murid (wood mouse, Turkestan rat), sciurid (red squirrel, little ground squirrel, yellow ground squirrel, European ground squirrel); Carnivora: canid (dog, red fox), felid (cat), mustelid (badger); Chiroptera: vespertilionid (pipistrelle); Primates: hominid (human), lemurid (common brown lemur); Accipitriformes: accipitrid (golden eagle, Griffon vulture); Bucerotiiformes: bucerotid (Eurasian hoopoe); Charadriiformes: burhinid (Eurasian stone curlew), scolopacid (European woodcock); Columbiformes: columbid (pigeon); Coraciiformes: coraciid (European roller), meropid (European bee-eater); Falconiformes: falconid (lesser kestrel); Galliformes: phasianid (chicken, rock partridge, Daurian partridge, common quail, ring-necked pheasant); Gruiformes: rallid (corncrake); Otidiformes: otid (little bustard); Passeriformes: alaudid (crested lark, desert lark, lesser short-toed lark, Calandra lark, Eurasian skylark), corvid (Eurasian magpie), emberizid (red-headed bunting, corn bunting, rock bunting, black-headed bunting, white-capped bunting), fringillid (common linnet), laniid (brown shrike), motacillid (tawny pipit, tree pipit, Richardson's pipit, western yellow wagtail), muscicapid (thrush nightingale, common rock thrush, blue rock thrush, European robin, isabelline wheatear, northern wheatear, variable wheatear, pied wheatear), passerid (house sparrow, Eurasian tree sparrow), sittid (western rock nuthatch), sturnid (common starling, rosy starling), sylviid (common whitethroat), turdid (common blackbird, song thrush); Strigiformes: strigid (little owl); Sauria: agamid (sunwatcher toadhead agama, steppe agama, starred agama, Caucasian agama, small-scaled rock agama, Anderson's rock agama, Turkestan rock agama, Olivier's horny-scaled agama), anguid (slow worm, slender glass lizard, Pallas's glass lizard, European glass lizard), gekkonid (comb-toed gecko, Turkestan thin-toed gecko), lacertid (snake-eyed lizard, sand lizard, common wall lizard, Caspian green lizard, European green lizard, Crimean wall lizard, Fraa's lizard, felseneidechse, greenish eidechse, Anatolian lizard, European green lizard, Bosc's fringe-toed lizard, small-toed lizard, steppe runner, Pleske's racerunner, rapid racerunner, regel racerunner, multi-ocellated racerunner, Kirghiz racerunner, Strauch's racerunner), scincid (desert lidless skink, gold skink), varanid (desert monitor); Serpentes: colubrid (grass snake, steppe rat snake, slender whip snake, spotted whip snake, dotted dwarf racer, smooth snake, Balkan whip snake, green whip snake), psammophiid (eastern Montpellier snake), viperid (horned viper, meadow viper, saw-scaled viper, Halys pit viper); Testudines: testudinid (Russian tortoise) (3-host cycle)	(vector for brucellosis, anaplasmosis, Q fever and rickettsiosis)	Europe
<i>H. sumatraensis</i>	Artiodactyla: cervid (sambar deer), suid (banded pig); Carnivora: canid (dog), felid (Sumatran tiger), viverrid (civet)		Indonesia
<i>H. (Herpetobia) sundrai</i>	Artiodactyla: bovid (sheep, goat), cervid (muntjac)		India
<i>H. (Aborphysalis) suntzovi</i>	Artiodactyla: suid (pig); Rodentia: hystricid (Malayan porcupine)		Vietnam
<i>H. (Kaiseriana) susphilippensis</i>	Artiodactyla: cervid (Philippine deer), suid (Celebes warty pig)		Philippines
<i>H. tauffliebi</i>	Rodentia: hystricid (African brush-tailed porcupine, tufted-tailed		Africa

	porcupine), murid (typical striped grass mouse, Indian gerbil); Carnivora: felid (caracal); Passeriformes: motacillid (plain-backed pipit)		
<i>H. taurica</i>	Eulipotyphla: erinaceid (northern white-breasted hedgehog)		Israel
<i>H. theilerae</i>	Afrosoricida: tenrecid (tailless tenrec, greater hedgehog tenrec)		Madagascar
<i>H. (Allophysalis) tibetensis</i>	Artiodactyla: bovid (cattle, buffalo, sheep); Carnivora: canid (dog)		China
<i>H. tiptoni</i>	Afrosoricida: tenrecid (tailless tenrec, highland streaked tenrec, lowland streaked tenrec)		Madagascar
<i>H. toxopei</i>	Carnivora: canid (dog); Chiroptera: pteropodid (Sulawesi rousette, lesser short-nosed fruit bat)		Indonesia
<i>H. traguli</i>	Artiodactyla: tragulid (Java mouse-deer, lesser mouse-deer), suid (boar); Scandentia: tupaiid (common treeshrew); Rodentia: murid (Rajah spiny rat)		Malaysia
<i>H. (Haemaphysalis) traubi</i>	Artiodactyla: cervid (Indian muntjac, sambar deer), suid (boar)		Malaysia
<i>H. (Kaiseriana) turturis</i>	Artiodactyla: bovid (cattle, buffalo, goat, Nilgiri tahr), cervid (muntjac, sambar deer, Indian sambar deer, chital deer, spotted deer), suid (pig, boar), tragulid (chevrotain); Eulipotyphla: soricid (Asian house shrew); Lagomorpha: leporid (hare, black-naped hare); Rodentia: hystricid (Indian crested porcupine), murid (black rat, bandicoot rat, Blanford's rat), sciurid (jungle palm squirrel, white-bellied giant flying squirrel); Carnivora: canid (dog, Asiatic jackal), felid (jungle cat, leopard), viverrid (small Indian civet); Primates: cercopithecoid (bonnet macaque, northern plains gray langur), hominid (human); Columbiformes: columbid (spotted dove); Cuculiformes: cuculid (coucal); Galliformes: phasianid (fowl); Passeriformes: corvid (large-billed crow), turdid (thrush); Piciformes: picid (unspecified); Psittaciformes: psittacid (unspecified); Sauria: varanid (monitor); Serpentes: pythonid (python); Testudines: testudinid (tortoise)		Central Asia
<i>H. verticalis</i>	Artiodactyla: bovid (cattle, Przewalski's gazelle); Rodentia: murid (long-clawed jird), sciurid (Daurian ground squirrel); Carnivora: canid (dog); Passeriformes: passerid (sparrow)		China
<i>H. vidua</i>	Carnivora: viverrid (palm civet, Malayan civet)		Malaysia
<i>H. (Rhipistoma) walkerae</i>	Carnivora: canid (bat-eared fox), hyaenid (aardwolf), mustelid (striped polecat); Rodentia: pedetid (East African springhare)		Africa
<i>H. (Allophysalis) warburtoni</i>	Artiodactyla: bovid (cattle, buffalo, yak, zhumi, sheep, argali, goat, wild goat, Himalayan tahr, goral, Siberian ibex, mainland serow, Japanese serow, Sumatran serow), camelid (camel), suid (pig); Perissodactyla: equid (horse); Lagomorpha: leporid (rabbit, tolai hare), ochotonid (large-eared pika, Pallas's pika, steppe pika); Rodentia: cricetid (flat-headed vole, narrow-headed vole, silver mountain vole, Gobi Altai mountain vole, Tien Shan red-backed vole, European snow vole, grey dwarf hamster, golden hamster), murid (wood mouse), sciurid (long-tailed ground squirrel, gray marmot, long-tailed marmot), smynthid (birch mouse); Carnivora: canid (dog, red fox), felid (cat); Primates: hominid (human); Galliformes: phasianid (chicken, monal pheasant); Passeriformes: sittid (western rock nuthatch)		China
<i>H. (Kaiseriana) wellingtoni</i>	Artiodactyla: bovid (cattle, zebu, buffalo, water buffalo), cervid (barking deer), tragulid (chevrotain); Eulipotyphla: soricid (Asian house shrew); Rodentia: hystricid (crested porcupine), murid (black rat, rajah spiny rat, dark-tailed tree rat, Hellwald's Sulawesi maxomys); Carnivora: canid (dog), viverrid (Asian palm civet); Primates: cercopithecoid (bonnet macaque, northern plains gray langur), hominid (human); Accipitriformes: accipitrid (hawk); Anseriformes: anatid (ducks, goose); Charadriiformes: charadriid (plover); Bucerotiformes: bucerotid (hornbill); Cuculiformes: cuculid (greater coucal); Galliformes: phasianid (chicken, turkey, red junglefowl, red spurfowl); Gruiformes: rallid (rail); Passeriformes: turdid (Japanese thrush)		Australasia
<i>H. yeni</i>	Artiodactyla: bovid (sheep, goat), cervid (sambar deer);		Vietnam

	Lagomorpha: leporid (hare); Carnivora: canid (dog, dhole), felid (jungle cat), viverrid (civet); Cuculiformes: cuculid (lesser coucal)		
<i>H. zambeziae</i>	Artiodactyla: bovid (klipspringer); Hyracoidea: procaviid (southern tree hyrax)		Africa
<i>H. (Rhipistoma) zumpti</i>	Carnivora: felid (cat, black-footed cat, caracal, Southern African wildcat), herpestid (yellow mongoose, common slender mongoose, meerkat), hyaenid (aardwolf), mustelid (striped polecat), viverrid (common genet, Cape genet); Rodentia: sciurid (Cape ground squirrel, Smith's bush squirrel)		Africa

Parasite morphology: *Haemaphysalis* spp. form 4 different types of morphological stages during their developmental cycles: namely, eggs, larvae, nymphs and adults. The eggs are shiny brown spherical stages measuring around 0.5 mm in diameter. Larvae (sometimes known as seed ticks) are somewhat dorsoventrally flattened and oval-pyriform in dorsal profile measuring 0.5-0.6 mm long. They are usually yellow to brown, but become darker in colour after feeding. They have a conspicuous capitulum (head) with anterior mouthparts, and a larger posterior idiosoma (body) with 3 pairs of long pale legs arising ventrally. Larvae lack respiratory openings (stigmata) and tracheae (respiration and fluid regulation occurs through the cuticle). Nymphs have discoid-ovoid bodies that are flattened ventrally and slightly convex dorsally. They are larger and darker than larvae, and may swell up to 1-2 mm in length after feeding. Nymphs have 4 pairs of long pale legs attached to the ventral idiosoma and possess a pair of lateral respiratory stigmata surrounded by round plates. Adult ticks are small in size compared to other ixodid genera, ranging in length from 2.5-3.5 mm (although engorged females may grow up to 8-9 mm long). Unfed adults are usually yellow-brown to red-brown in colour, but engorged individuals often develop blue-black bodies with dark brown legs. Adults have 2 major tagma: a small anterior capitulum (head) and a larger robust idiosoma (body). The capitulum projects forwards and is visible from above (whereas that of argasids is ventral and not visible from above). It comprises the basis capitulum (integumental ring encircling mouthparts) and the gnathosoma bearing palps and the feeding mouthparts (chelicerae and hypostome) but lacks antennae (as do all ticks). The basis capitulum is rectangular with straight lateral margins, and not triangular (like *Ixodes*), nor hexagonal (like *Rhipicephalus/Boophilus*) nor pentagonal (like *Bothriocroton*). The gnathosoma is retractable and has 2 short lateral palps with pronounced lateral spur-like projections at the bases of their second segments. The palps are sensory and do not enter the skin when feeding but move laterally out of the way. The mouthparts are short (around same length as basis capitulum) and are well adapted for piercing skin and sucking blood. The 2 chelicerae have tubular shafts with dentate tips and are used to cut host skin creating pools of blood in the dermis. The barbed hypostome is inserted into the pooled blood to facilitate feeding as well as to aid attachment to the host. A buccal feeding canal is formed dorsally by the chelicerae and ventrally by the hypostome and used to suck blood and inject saliva from long paired salivary glands. Blood is taken up by a muscular pharynx (with pharyngeal valve) and delivered via a short oesophagus to the large saccular midgut (ventriculus) with several pairs of blind-ending lateral diverticula (caeca). Waste from the gut and excretory Malpighian tubules is collected in a rectal sac that opens to the subterminal ventral anus. The anus is partially encircled by a posterior (metastrate) anal groove (unlike *Ixodes* which has an anterior (prostrate) anal groove). The dorsal idiosoma possesses a hard sclerotized dorsal plate (scutum) which almost completely covers males (= conscutum) but is limited to a smaller anterior shield in females. The rest of the cuticle has tiny surface patterns, sometimes with larger indentations, and a number of sensory setae and pores (openings of dermal glands and sensillae). In *Haemaphysalis* spp., the scutum (and conscutum) are plain and inornate, whereas those of *Amblyomma/Aponomma*, *Bothriocroton*, and some *Rhipicephalus* and *Dermacentor* spp. are ornate (with coloured patterns). The posterior body margin has a series of invaginated grooves (called festoons) which may be unclear in engorged females, but dorsal 'eyes' are not present. The ventral idiosoma gives rise to 4 pairs of well-developed pale-brown legs (without pale rings) which remain tightly folded against the body when the tick is stationary. Each leg contains 6 segments (coxae, trochanter, femur, patella (genu), tibia, and tarsus) and all end in pair of claws with pad-like pulvilli (adult argasids lack pulvilli). *Haemaphysalids* have a large tapering internal spur on coxae I, and short blunt internal spurs on coxae II-IV. A unique sensory structure (Haller's organ) is located on tarsus I and used to detect odours, heat and vibrations. Adults have a pair of lateral respiratory stigmata surrounded by round-comma-shaped plates located ventrally behind coxae IV (while argasids have smaller stigmata between coxae III). Adult ticks exhibit considerable sexual dimorphism in that males are smaller than females, their dorsal scutum is much larger, and females have porose areas (clusters of pores) on the dorsal aspects of their basis capituli. Males also lack ventral shields which are present in *Ixodes*, *Rhipicephalus/Boophilus* and *Hyalomma* spp. The male reproductive tract comprises 2 tubular testes with vas efferentia fusing to form a common vas deferens (with a large multilobed accessory gland) leading to the ejaculatory duct and genital opening (gonopore) located ventrally between coxae IV. Males lack external copulatory structures and they produce packets of spermatids (spermatophores) that they transfer to females. The female reproductive system comprises a single saccular ovary with paired tubular oviducts that join to form a common uterus leading to a bipartite vagina (with a cervical region acting as a receptaculum seminis to store spermatophores, and a vestibular region that prolapses during oviposition). The gonopore is U- or V-shaped with marginal folds and situated near the ventral midbody. During oviposition, eggs are coated with waxy waterproof secretions by the porose areas and by a special tubular accessory gland (Gene's organ) located near the female gonopore.

Site of infection: Larvae, nymphs and adults are obligate ectoparasites that attach to the skin of vertebrate hosts to feed on host blood. Infestations have been found on mammals belonging to 82 families in 22 orders (including ungulates, insectivores, shrews, lagomorphs, carnivores, rodents, marsupials, bats, primates), birds belonging to 49 passerine families and 40 non-passerine families

in 24 orders (including shorebirds, waterfowl, landfowl, nightjars, doves, woodpeckers and birds of prey), reptiles belonging to 6 lizard families, 6 snake families and 2 tortoise families, as well as one amphibian family. Most *Haemaphysalis* spp. have broad host ranges, although many seem to exhibit preferences for particular hosts. Larvae and nymphs are found mostly on small mammals, birds and reptiles, whereas adult ticks infest larger mammals, including livestock. Ticks may be found anywhere on the host body, but are commonly found on the head, ears, muzzle, lower legs, axilla, escutcheon and udders.

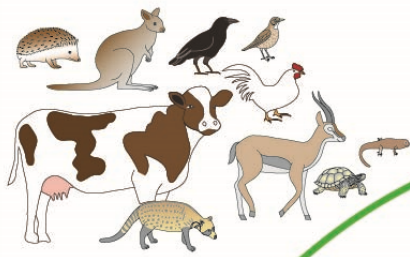
Pathogenesis: All motile developmental stages are haematophagous ectoparasites that feed only once but for extended periods over days (in contrast, argasid ticks feed transiently for short periods over minutes). Light infestations by a few larvae, nymphs or adults may go unnoticed by the host, but heavier infestations cause irritation and discomfort with skin lesions, blood loss and poor health. Feeding stages use their chelicerae to cut skin creating dermal blood pools, and then insert their hypostomes into the pools to suck blood (feeding process known as telmophagy). During feeding, ticks inject saliva (with various vaso-active compounds, including cytolytic, analgesic, anticoagulant, vasodilatory and vascular permeability activities) as well as produce proteinaceous cement (for attachment). Tick bites cause traumatic damage to skin with irritation, inflammation, erythema, oedema, pruritus, focal necrosis, haemorrhage and granuloma formation. Infestations by as few as 30 ticks may cause enough blood loss to manifest as anaemia, which may persist for several weeks. Infested animals suffer considerable tick worry, becoming listless, restless, anorexic and sometimes feverish. Heavy infestations in livestock may affect productivity due to poor growth, reduced weight gains, decreased milk yields, damaged hides due to tick punctures and host reactions, and occasional mortalities. Some animals may develop hypersensitivity reactions to bites and attempt to lick, bite, scratch or rub affected areas, sometimes causing open wounds which are prone to secondary bacterial infections. Some tick species (e.g. *H. punctata*, *H. inermis*) may also cause tick paralysis as their saliva contains neurotoxins which produce progressive ascending motor paralysis with hindlimb incoordination, weakness, respiratory abnormalities and death. *Haemaphysalis* spp. may also act as vectors (biological or mechanical) for the transmission of various infectious diseases. Microbes may amplify in tick tissues; most survive tick metamorphic changes (trans-stadial transmission) and some even undergo vertical transfer to tick eggs (trans-ovarian transmission). They may be transmitted during feeding (via saliva), during fluid regulation (via regurgitation) or during waste elimination (via defaecation). Various tick species have been found to transmit haemoprotozoan parasites causing babesiosis (tick fever) and theileriosis; rickettsial bacteria causing Mediterranean and Japanese spotted fevers, Boutonneuse fever, and anaplasmosis; spirochaetes causing borreliosis (relapsing fever, Lyme disease); coccobacilli causing brucellosis and tularaemia; gammaproteobacteria causing coxiellosis (Q fever); and viruses causing Russian spring-summer encephalitis, Kyasanur Forest disease, Powassan encephalitis, Crimean-Congo haemorrhagic fever, and human haemorrhagic fever (thrombocytopenia syndrome).

Developmental cycle and mode of transmission: *Haemaphysalis* spp. exhibit incomplete (hemimetabolous) metamorphosis where eggs hatch larvae which moult to nymphs and then adults. Each stage feeds on blood once and then drops off the host, so they have 3-host life-cycles as larvae, nymphs and adults parasitize 3 separate hosts (often different host species). Gravid females lay eggs in clusters in the external environment (shaded cryptic sites in vegetation or soil) where they hatch in 60-90 days depending on the temperature and humidity (longer in colder drier conditions). The emergent larvae climb vegetation where they wait for hosts (ambush strategy). When triggered by sensory cues associated with passing hosts (odours, heat, vibrations), they actively quest by waving their forelegs in the air. They may wait for hosts for several days to weeks, depending on environmental conditions (longer in colder conditions). Upon contact with a host, they crawl onto the skin and migrate to preferred attachment sites. Most species have preferred hosts and they may reject a host as unsuitable and drop off after taking a small sample meal. On suitable hosts, the larvae attach and feed to repletion on host blood for 4-6 days. They then drop to the ground and shelter in dark moist places to digest their bloodmeals over 14-30 days depending on environmental conditions (longer in cold conditions). The larvae then moult to nymphs which climb vegetation and quest for hosts over several days to months depending on prevailing climatic conditions. Like other ixodids, haemaphysalids only form one nymphal instar (whereas argasids form 2-7 nymphal instars). While all unfed stages may overwinter, nymphs commonly do so as they appear to be better able to survive cold conditions and frosts. When nymphs find a suitable host, they attach and feed on blood for around a week. When replete, they drop off the host and shelter in vegetation for up to 40 days before moulting to adult ticks. Adults climb vegetation and may quest for hosts for several day to months. Having found a suitable host, they attach and feed on blood for a week or longer, growing new cuticle to accommodate larger bloodmeals. Reproductive cycles in adult ticks are complicated as some species (or races/strains/populations) are obligate parthenogenetic triploid (females may produce fertile eggs without mating), others are bisexual diploid (females produce fertile eggs after mating), and some may be aneuploid (capable of both bisexual and parthenogenetic reproduction). Male ticks are rarely seen, as they take small meals and remain unattached while moving about searching for mates. Female ticks remain attached and engorge with host blood swelling to many times their original size before dropping off after 1-2 weeks. Gravid females lay large batches of several thousand eggs over several days, although oviposition may be delayed for several weeks in adverse cold conditions. Adult ticks do not have long life-spans and males die soon after mating while females die soon after oviposition. The duration of the whole life-cycle depends largely on prevailing environmental conditions influencing the survival and longevity of off-host stages (longer in colder climates, sometimes with diapause). Most species have annual cycles (one generation per year) in temperate regions with alternating seasons. Larvae usually develop over late summer, nymphs may develop in autumn but generally overwinter and engorge in spring, while adults develop and engorge in late spring and early summer. In more tropical warm moist regions with mild summers, some tick species may complete 2 generations each year with larvae being found in early spring as well as in summer and autumn. In temperate or polar regions with cold winters, some tick species only have one generation every 2-3 years as the successive developmental stages must overwinter each year.

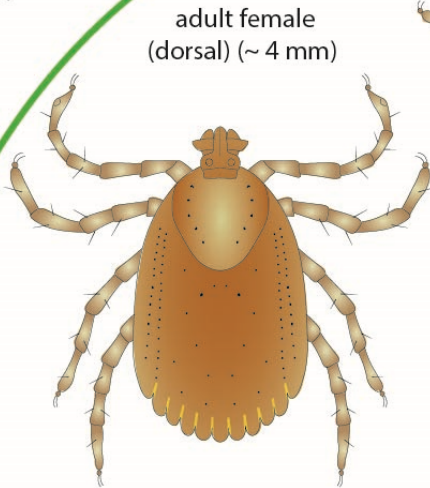
Differential diagnosis: Infestations are difficult to diagnose on clinical grounds as any symptoms and signs (skin lesions, granulomas, anaemia, anorexia) may be caused by a range of other infectious or non-infectious disease conditions. Diagnosis is generally afforded by the direct detection of attached ticks feeding on hosts. Specimens may be carefully removed and examined microscopically for unique morphological characteristics (especially rectangular basis capituli, coxal and palpal spurs). Samples may be frozen or fixed for subsequent molecular analyses (proteins or DNA). Ticks can also be collected from the environment (pastures and bushland) by dragging blankets or using dry ice (carbon dioxide) traps. Molecular biological techniques have been used to help identify stages, strains (races) and species following polymerase chain reaction (PCR) amplification of nuclear (18S and 28S ribosomal RNA, internal transcribed spacers 1 and 2) and mitochondrial (12S and 16S ribosomal RNA, cytochrome c oxidase subunit I, nicotinamide adenine dinucleotide dehydrogenase subunit 5) gene sequences.

Treatment and control: Infestations on humans usually only involve a few ticks which may be carefully removed and the bite sites treated with disinfectants, analgesics, antipruritics and antihistamines to provide symptomatic relief and even antibiotics to prevent secondary bacterial infections. Tick removal may be accomplished using fine forceps or tweezers or special tick removal devices (ticks keys, loops, lassos, twists or V-shaped tools) but taking care not to squeeze them or break off their mouthparts (tick fluids and fragments are pro-inflammatory). Some success has been reported in removing attached ticks by applying freezing sprays or pyrethroid acaricides directly onto their backs. People at risk may discourage tick bites by using insect repellents on their skin or clothing, including diethyl-meta-toluamide (DEET), picaridin, oil of lemon eucalyptus, para-methane-diol, undecanone and permethrin. Infestations on companion animals and livestock are treated using topical or systemic acaricidal chemicals which are available in a wide range of sprays/showers, baths/dips, emulsions, dusts, pour-ons, spot-ons, injections, drenches, tablets, chewables, and impregnated collars, ear tags and tail tags. Animals have been successfully treated using arsenical preparations, organochlorines (dichloro-diphenyl-trichloroethane (DDT), lindane), organophosphates (dioxathion, fenchlorphos), organophosphonates (chlorfenvinphos, dichlorvos, tetrachlorvinphos, trichlorfon), monothiophosphates (chlorpyrifos, coumaphos, cythioate, diazinon, fenthion, propetamphos), dithiophosphates (malathion, phosmet), carbamates (carbaryl), pyrethroids (permethrin, flumethrin, deltamethrin, decamethrin, cypermethrin, cyprothrin, alphamethrin), formamidines (amitraz), macrocyclic lactones (ivermectin, selamectin), phenylpyrazoles (fipronil), chloronicotinyls (imidacloprid), isoxazolines (afoxolaner, fluralaner), some natural products (rotenone) and some insect growth regulators (methoprene, pyriproxyfen). Multiple treatments are often required as animals rapidly become re-infested, although slow-release formulations and compounds with long-lasting residual activity may help reduce treatment frequency. Unfortunately, the incorrect or over-usage of many chemicals has led to the development of acaricide resistance in many tick populations, particularly against arsenical compounds and organochlorines, as well as some organophosphates, pyrethroids and formamidines. Recommendations to combat resistance include cyclic rotation between major classes of acaricides, using co-formulations (cocktails), avoiding under-dosing and regularly screening for resistance (using *in situ* or *in vitro* egg hatch or larval/adult survival tests). Due to the time-consuming nature of these tests, studies are currently underway to develop more rapid molecular tests (such as immunoassays or DNA analyses). Pastoralists are encouraged to adopt integrated tick control programmes as haemophysalids are difficult to eradicate because they may survive on pastures for many months and may infest a wide range of reservoir hosts. Programmes should include animal health interventions (surveillance, strategic treatment, culling, cohort separation, quarantine, sensible stocking), grazing management (pasture rotation, pasture spelling/cultivation, stabling, clearing vegetation (cut, slash, burn, plough)), environmental decontamination (cleaning animal holding facilities (water, steam, disinfectants), sealing crevices in housing, applying residual acaricides (pyrethroids) to confined spaces) and wildlife control (excluding reservoir hosts (fencing, hunting, trapping), diverting migration routes, giving access to medicated supplementary feed or self-treatment devices (rubbing posts, rollers) and encouraging grooming birds such as oxpeckers). Several mathematical prediction models have also become available for producers to schedule interventions based on climatic factors (temperature, rainfall, humidity, photoperiod), location (latitude, longitude, elevation), land-use, vegetation structure, and animal husbandry. Other preventive strategies include selective breeding programmes for tick-resistant livestock, particularly involving indigenous *Bos indicus* breeds which have an innate resistance to tick infestations. A range of experimental immunological studies have also been conducted on *H. longicornis* infestations in rabbits, with variable protection being afforded following vaccination with many tick extracts, including subolesin, paramyosin, lipocalin, hexokinase, serpin, metalloprotease, cystatin and a salivary-gland associated protein (p29). Preliminary studies on biological control have investigated several predators, pests and pathogens of ticks, with indications that tick populations may be moderated by entomopathogenic fungi (*Beauveria* and *Metarhizium*), predatory antlions (*Euroleon*), and possibly by endosymbiotic bacteria (*Wolbachia*).

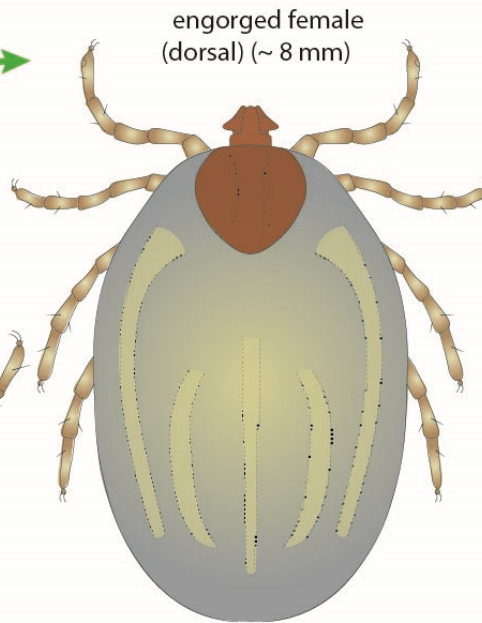
Haemaphysalis



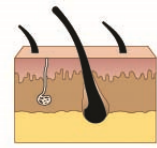
Hosts
(mammals,
birds,
reptiles)



adult female
(dorsal) (~ 4 mm)



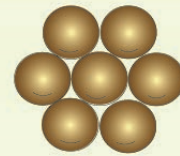
engorged female
(dorsal) (~ 8 mm)



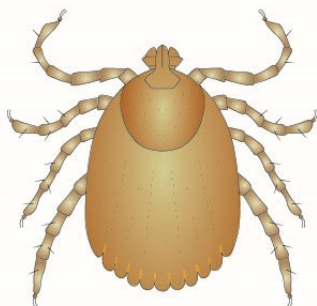
skin
(blood loss,
irritation,
lesions,
toxicosis)
(vectors for
infectious
microbial
diseases)

some females are pathenogenetic
(produce eggs without mating)

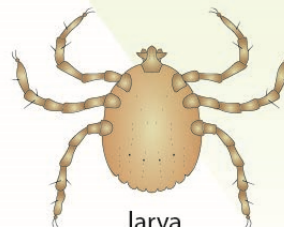
eggs laid in
shaded soil/litter



eggs
(~ 0.5 mm)



nymph
(dorsal)
(~ 2 mm)



larva
(ventral)
(~ 0.6 mm)

hatch

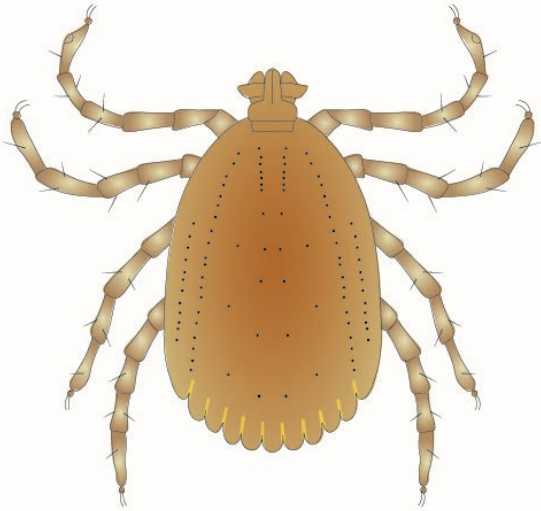
questing
(host-seeking)

motile stages (L, N, A)
are transient ectoparasites
on vertebrate hosts
(feed on blood)

Haemaphysalis spp. have 3-host cycles,
where larvae (L), nymphs (N) and adults (A)
occur on different hosts

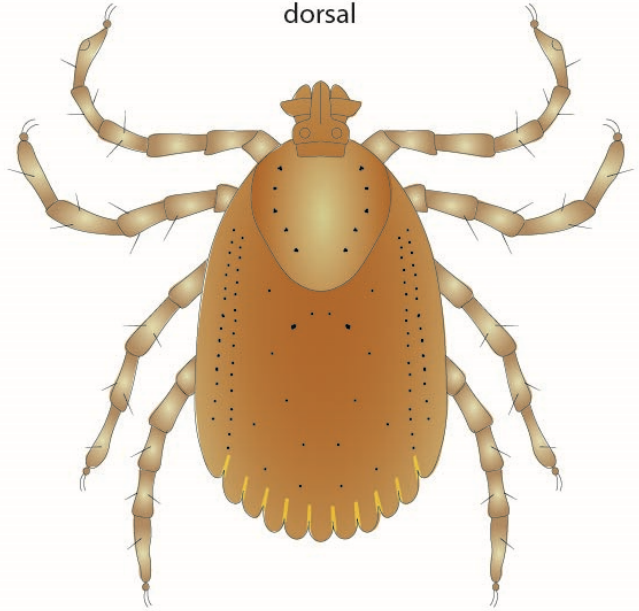
Haemaphysalis

dorsal



male (~ 3 mm)

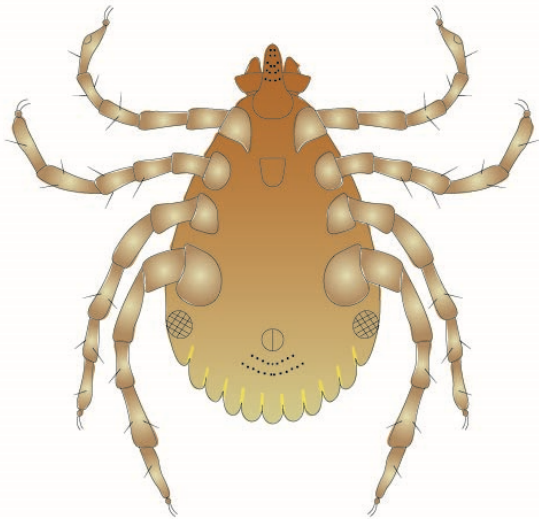
dorsal



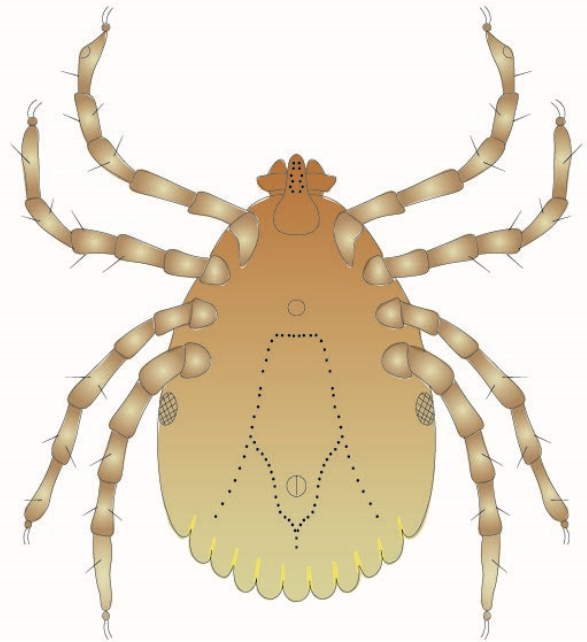
female (~ 5 mm)

adult ticks

ventral



ventral





PHIL-22873

Haemaphysalis adult



Haemaphysalis adult



Haemaphysalis larva