Lipeurus, Goniocotes, Goniodes, Cuclotogaster, Chelopistes
(insect: louse)

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. Insects are hexapods with three pairs of uniramous legs, three tagmata (head, thorax, abdomen), ectognathous mouthparts with whole-limb mandibles, and one pair of antennae. Lice (Phthiraptera) are small wingless dorsoventrally-flattened hemipterodeans which are permanent obligate ectoparasites on other animals. All lice undergo gradual metamorphosis and there are no free-living stages. Eggs are cemented to host hairs whereas nymphs and adults cling to hairs using enlarged tarsal claws. Lice do not survive long off their hosts so transmission is usually by direct contact. Mallophagan (chewing) lice have blunt rounded heads with mouthparts adapted for feeding on keratin in superficial skin layers. Chewing lice are ectoparasitic on mammals and birds, most species being highly host specific and even site-specific. Ischnoceran lice have prominent filiform antennae but lack maxillary palps. Philopterids have five antennal segments, paired tarsal claws and are found on birds. Infestations by *Lipeurus, Goniodes, Goniocotes, Cuclotogaster* and *Chelopistes* spp. have been associated with restlessness and reduced productivity in poultry and gamebirds.

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:	Hexapoda (three tagmata, three pairs uniramous legs, whole-limb mandibles, Malpighian tubules)
Class:	Insecta (ectognathous mouthparts (bases lie outside head capsule), single pair antennae, many with wings)
Superorder:	Hemipterodea (Exopterygota) (young resemble adults, externally developing wings)
Order:	Phthiraptera (lice, wingless, ectoparasites, dorsoventrally flattened, stout legs, claws, eggs, nymphs, adults)
Suborder:	Mallophaga (= wool-eating) (chewing lice, broad rounded head, feed on keratin, host/site specific)
Superfamily:	Ischnocera (without maxillary palps, prominent filiform antennae, keratin feeders (hairs/feathers))
Family:	Philopteridae (parasitize birds, five-segmented antennae, paired claws on tarsi)
Genus:	*Lipeurus* (parasitic on skin/feathers of birds)
Genus:	*Goniocotes* (parasitic on skin/feathers of birds)
Genus:	*Goniodes* (parasitic on skin/feathers of birds)
Genus:	*Cuclotogaster* (parasitic on skin/feathers of birds)
Genus:	*Chelopistes* (parasitic on skin/feathers of birds)
Species:	various species cause restlessness and reduced productivity in poultry and gamebirds

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. Insects are hexapods with six legs, three distinct body parts, two antennae and mouthparts with whole-limb mandibles. Insects are the most biodiverse group on the planet, with millions of species described in numerous taxa. Notorious ectoparasitic species belong to four orders in two superorders: the Hemipterodea (Exopterygota) containing the orders Hemiptera (bugs) and Phthiraptera (lice); and the Holometabola (Endopterygota) containing the orders Siphonaptera (fleas) and Diptera ('true' flies). Lice are small wingless hemipterodeans that undergo gradual (hemimetabolous) metamorphosis and are permanent obligate ectoparasites on other animals. Four suborders are recognized: the Anoplura containing the haematophagous sucking lice of placental mammals; the Ischnocera and Amblycera (previously classified together as Mallophaga) comprising the chewing or biting lice of birds, marsupials and placental mammals; and the Rhynchophthirina confined to elephants and warthogs in Africa.

Major parasitic phthirapteran families	Biodiversity	Hosts	Parasitic stages	Patho-genesis	Disease transmission
Suborder: Ischnocera [Mallophaga p.p.] (chewing lice of mammals and birds, broad rounded head, without maxillary palps, prominent filiform antennae, keratin feeders) [2 families, 158 genera, 3,371 species]					
Philopteridae(bird lice)	138 genera, 2,958 spp.	birds	nymphs, adults	biting, chewing	-
Trichodectidae (fur lice)	20 genera, 413 spp.	mammals (bovids, equids, carnivores)	nymphs, adults	biting	helminth
Suborder: Amblycera [Mallophaga p.p.] (chewing lice of mammals and birds, large rounded head, with maxillary palps, 4-segmented antennae in antennal grooves, keratin feeders) [6 families, 96 genera, 1,550 species]					
Menoponidae (bird lice)	68 genera, 1,150 spp.	birds	nymphs, adults	biting, chewing	-
Boopiidae (marsupial chewing lice)	8 genera, 57 spp.	mammals (incl. marsupials)	nymphs, adults	biting	helminth
Suborder: Rhynchophthirina (sucking lice of African wildlife) [1 family, 1 genus, 4 species]					
Haematomyzidae (elephant & warthog lice)	1 genus, 4 spp.	mammals (elephants, warthogs)	nymphs, adults	blood-sucking	-
Suborder: Anoplura (sucking lice of placental mammals) (narrow pointed head, pierce skin and feed on fluids (solenophagy)) [16 families, 51 genera, 694 species]					
Haematopinidae (ungulate lice, short-nosed lice)	1 genus, 21 spp.	mammals (equids, bovids, suids)	nymphs, adults	blood-sucking	viral, bacterial
Linognathidae (pale lice, long-nosed lice)	3 genera, 73 spp.	mammals (bovids, canids)	nymphs, adults	blood-sucking	-
Pediculidae (head & body lice)	1 genus, 4 spp.	mammals (hominids, New World primates)	nymphs, adults	blood-sucking	bacterial
Pthiridae (pubic lice)	1 genus, 2 spp.	mammals (hominids)	nymphs, adults	blood-sucking	-

Over 4,900 species of biting/chewing lice have been described in 253 genera in 8 families, around 4,400 species associated with birds and 500 species with mammals. Members of the suborder Ischnocera have broad rounded heads with conspicuous filiform antennae but lacking maxillary palps, while members of the suborder Amblycera have large rounded heads with maxillary palps and inconspicuous antennae hidden in grooves. Some 158 ischnoceran genera have been assigned to 2 families (Trichodectidae and Philopteridae), while 96 amblyceran genera have been classified in 6 families (Boopiidae; Gyropidae, Laemobothriidae, Menoponidae, Ricinidae, Trimenoponidae). Species of veterinary importance include members of the ischnoceran families Trichodectidae (bovids, canids, equids) and Philopteridae (poultry), and the amblyceran families Menoponidae (poultry) and Boopiidae (carnivores). Most ischnoceran lice are parasitic on birds, including the philopterids which are found mainly on galliform birds. Members of the family Philopteridae possess antennae with 5 segments and their legs terminate in tarsi with paired claws (in contrast to members of the family Trichodectidae which have 3-segmented antennae and single tarsal claws). Almost 3,000 philopterid species have been described from 138 genera: namely *Acidoproctus*, *Acutifrons*, *Aegypoecus*, *Alcedoecus*, *Alcedoffula*, *Anaticola*, *Anatoecus*, *Aquanirmus*, *Ardeicola*, *Ardeiphagus*, *Auricotes*, *Austrogoniodes*, *Austrophilopterus*, *Bedfordiella*, *Bizarrifrons*, *Bothriometopus*, *Brueelia*, *Bucerocophorus*, *Buceroemersonia*, *Buceronirmus*, *Bucorvellus*, *Buerelius*, *Campanulotes*, *Capraiella*, *Caracaricola*, *Carduiceps*, *Centropodiella*, *Chelopistes*, *Cirrophthirius*, *Colilipeurus*, *Colinicola*, *Coloceras*, *Columbicola*, *Cotingacola*, *Craspedonirmus*, *Craspedorrhynchus*, *Cuclotocephalus*, *Cuclotogaster*, *Cuculicola*, *Cuculoecus*, *Cummingsiella*, *Dahlemhornia*, *Degeeriella*, *Discocorpus*, *Docophoroides*, *Echinophilopterus*, *Emersoniella*, *Episbates*, *Esthiopterum*, *Falcolipeurus*, *Falcolius*, *Forficuloecus*, *Formicaphagus*, *Formicaricola*, *Fulicoffula*, *Furnariphilus*, *Galliphilopterus*, *Goniocotes*, *Goniodes*, *Haffneria*, *Halipeurus*, *Harrisoniella*, *Heptapsogaster*, *Hopkinsiella*, *Ibidoecus*, *Incidifrons*, *Kelloggia*, *Kodocephalon*, *Labicotes*, *Lagopoecus*, *Lamprocorpus*, *Lipeurus*, *Lunaceps*, *Megaginus*, *Megapeostus*, *Megapodiella*, *Meinertzhageniella*, *Meropoecus*, *Mulcticola*, *Nakicola*, *Naubates*, *Neophilopterus*, *Neopsittaconirmus*, *Nesiotinus*, *Nothocotus*, *Nyctibicola*, *Ornicholax*, *Ornithobius*, *Osculotes*, *Otidoecus*, *Oxylipeurus*, *Pachyskelotes*, *Paraclisis*, *Paragoniocotes*, *Paroncophorus*, *Passonomedea*, *Pectenosoma*, *Pectinopygus*, *Pelmatocerandra*, *Penenirmus*, *Perineus*, *Philoceanus*, *Philopterus*, *Physconella*, *Physconelloides*, *Picicola*, *Podargoecus*, *Pseudocophorus*, *Pseudolipeurus*, *Pseudonirmus*, *Pseudophilopterus*, *Psittaconirmus*, *Psittoecus*, *Pterocotes*, *Quadraceps*, *Rallicola*, *Rhopaloceras*, *Rhynonirmus*, *Rotundiceps*, *Saemundssonia*, *Splendoroffula*, *Strigiphilus*, *Strongylocotes*, *Struthiolipeurus*, *Sturnidoecus*, *Syrrhaptoecus*, *Theresiella*, *Tinamotaecola*, *Trabeculus*, *Trichodopeostus*, *Trichophilopterus*, *Trogoniella*, *Trogoninirmus*, *Turnicola*, *Turturicola*, *Upupicola*, *Vernoniella*, and *Wilsoniella*. Several species infest domestic poultry sometimes in association with disease, but most have been described from wild, game or aviary galliform birds. Nearly all species are considered to be host-specific, only a few occurring on closely-related hosts, and many are also thought to site-specific being restricted to specific parts of the body where particular feathers occur. The chewing lice *Lipeurus* (43 species) are frequently found on the skin and feathers of galliform birds, including domestic poultry. *Chelopistes* (34 species) are usually found in quill bases of phasianids in Palearctic and Oriental zoogeographic subregions and cracids in the Neotropical subregion, while *Cuclotogaster* (39 species), *Goniocotes* (46 species) and *Goniodes* (103 species) parasitize the skin and feathers of domestic and wild fowl from most continents.

***Lipeurus* species**	**Hosts**	**Location**	**Clinical signs**	**Distribution**
L. alexandermuelleri	Galliformes: megapodid (scrub fowl)	skin, feathers		Polynesia
L. boonsongi	Galliformes: phasianid (partridge)	skin, feathers		Thailand
L. brunneipictus (syn. *L. intermedius*)	Galliformes: phasianid (crested fireback)	skin, feathers		Asia
L. caponis (syn. *L. antennatus, bakeri, dovei, tesselatus, variabilis*) (wing louse)	Galliformes: phasianid (chicken, quail, jungle-fowl, pheasant, turkey, guineafowl), Pelecaniformes: ardeid (bittern)	skin, feathers (wing, tail)	restlessness, irritation	worldwide
L. charltonii	Galliformes: phasianid (hill partridge, tree partridge)	skin, feathers		Indochina
L. crassus	Galliformes: megapodid (brush turkey)	skin, feathers		Australia
L. crinitus	Galliformes (golden pheasant, Amherst's pheasant)	skin, feathers		Northern Hemisphere
L. deignani	Galliformes: phasianid (fireback pheasant)	skin, feathers		Thailand
L. dekkeri	Galliformes: megapodid (Micronesian scrubfowl)	skin, feathers		Micronesia
L. delta	Galliformes: phasianid (Reeve's pheasant)	skin, feathers		China
L. differens	Galliformes: phasianid (white-breasted guineafowl)	skin, feathers		West Africa
L. epsilon	Galliformes: phasianid (Cape francolin)	skin, feathers		South Africa
L. eurycnemis	Galliformes: phasianid (monal pheasant)	skin, feathers		Himalayas
L. fimbriatus	Galliformes (black partridge)	skin, feathers		South-East Asia
L. fradei	Accipitriformes: accipitrid (long-crested eagle)	skin, feathers		Africa
L. hamatus	Galliformes: phasianid (bobwhite quail)	skin, feathers		Americas
L. introductus (syn. *L. sellatus, subsellatus*)	Galliformes: phasianid (silver pheasant, Kalij pheasant)	skin, feathers		Indochina
L. jonesi	Galliformes: megapodid (brush turkey)	skin, feathers		New Guinea
L. keleri	Galliformes: phasianid (brown-eared pheasant, white-eared pheasant)	skin, feathers		China
L. latifasciatus	Galliformes: megapodid (dusky scrubfowl, Bismarck scrubfowl)	skin, feathers		Indonesia, New Guinea
L. lawrensis	Galliformes: phasianid (helmeted guineafowl)	skin, feathers		South Africa
L. lewisi	Galliformes: phasianid (ferruginous partridge)	skin, feathers		South-East Asia
L. maculosus	Galliformes: phasianid (grey partridge, common pheasant)	skin, feathers		Eurasia
L. meyeri	Galliformes: megapodid (brush turkey)	skin, feathers		New Guinea
L. moluccensis	Galliformes: megapodid (Wallace's scrubfowl)	skin, feathers		Indonesia, New Guinea
L. namalaius	Galliformes: megapodid (Banks Island scrubfowl)	skin, feathers		Vanuatu
L. nodosus	Galliformes: megapodid (collared brush turkey)	skin, feathers		New Guinea
L. numidae (syn. *L. numidianus*)	Galliformes: phasianid (helmeted guineafowl)	skin, feathers		South Africa
L. palauensis	Galliformes: megapodid (Micronesian scrubfowl)	skin, feathers		Micronesia
L. parkeri (syn. *L. sejugatus*)	Galliformes: megapodid (mallee fowl)	skin, feathers		Australia
L. parumsetosus (syn. *L. uncinatus*)	Galliformes: phasianid (crested wood partridge)	skin, feathers		South-East Asia
L. pavo	Galliformes: phasianid (common peafowl, green peafowl)	skin, feathers		South-East Asia
L. phasidus	Galliformes: phasianid (black guineafowl)	skin, feathers		Africa
L. polyplectron	Galliformes: phasianid (Malay peacock-pheasant, grey peacock-pheasant)	skin, feathers		South-East Asia
L. raymondi	Galliformes: phasianid (vulturine guineafowl)	skin, feathers		Africa

L. rheinardia	Galliformes: phasianid (crested argus)	skin, feathers		South-East Asia
L. sarissa	Galliformes: phasianid (long-billed partridge)	skin, feathers		South-East Asia
L. schoutedeni	Galliformes: phasianid (Congo peafowl)	skin, feathers		Africa
L. silvai	Galliformes: phasianid (crested guineafowl)	skin, feathers		South Africa
L. sinuatus	Galliformes: megapodid (dusky scrubfowl, Philippine scrubfowl, orange-footed scrubfowl)	skin, feathers		South-East Asia
L. talautensis	Galliformes: megapodid (Philippine scrubfowl)	skin, feathers		South-East Asia
L. tropicalis	Galliformes: phasianid (chicken)	skin, feathers		?
L. tsade	Galliformes: megapodid (wattled brush turkey, maleo)	skin, feathers		Africa, Indonesia

***Goniocotes* species**	**Hosts**	**Location**	**Clinical signs**	**Distribution**
G. afer	Galliformes: phasianid (red-necked francolin)	feathers		Africa
G. afropavo	Galliformes: phasianid (Congo peafowl)	feathers		Africa
G. albidus (syn. *G. homocerus, phasiani*)	Galliformes: phasianid (silver pheasant)	feathers		South-East Asia
G. castaneicollis	Galliformes: phasianid (chestnut-naped francolin)	feathers		Africa
G. chapini	Galliformes: phasianid (Congo peafowl)	feathers		Africa
G. chrysocephalus	Galliformes: phasianid (ruffed grouse, common pheasant)	feathers		North America
G. clayae	Galliformes: phasianid (double-spurred francolin)	feathers		Africa
G. congolensis	Galliformes: phasianid (helmeted guineafowl)	feathers		Africa
G. coxatus	Tinamiformes: tinamid (solitary tinamou)	feathers		South America
G. crassicauda	Galliformes: phasianid (vulturine guineafowl)	feathers		Africa
G. creber	Galliformes: phasianid (silver pheasant)	feathers		South-East Asia
G. crossoptiloni	Galliformes: phasianid (white-eared pheasant)	feathers		Himalayas
G. diasi	Galliformes: phasianid (crested guineafowl)	feathers		Africa
G. diplogonus	Galliformes: phasianid (satyr tragopan)	feathers		Himalayas
G. eurygaster	Galliformes: phasianid (white-throated hill partridge)	feathers		Taiwan
G. gallinae (syn. *G. hologaster*) (fluff louse)	Galliformes: phasianid (chicken, turkey, ferruginous wood partridge)	feathers (back, rump)	restlessness, damaged plumage, anaemia	worldwide
G. gregarius	Galliformes: phasianid (grey-winged francolin)	feathers		South Africa
G. haplogonus	Galliformes: phasianid (monal pheasant)	feathers		Himalayas
G. ictiorhynchi	Galliformes: phasianid (yellow-billed francolin)	feathers		Africa
G. ignitus	Galliformes: phasianid (crested-fireback pheasant)	feathers		Indonesia
G. jirufti	Galliformes: phasianid (black francolin)	feathers		India
G. keleri	Galliformes: phasianid (red-necked francolin)	feathers		Africa
G. keniensis	Galliformes: phasianid (grey-winged francolin)	feathers		Africa
G. kivuensis	Galliformes: phasianid (handsome francolin)	feathers		Africa
G. maculatus (syn. *G. meleagris, nigromaculatus, numidae, valdezi*)	Galliformes: phasianid (chicken, helmeted guineafowl)	feathers		Africa
G. mayuri	Galliformes: phasianid (common peafowl)	feathers		South Asia
G. megalocephalus (syn. *G. macrocephalus*)	Galliformes: phasianid (hazel grouse)	feathers		Japan
G. microcephalus	Galliformes: phasianid (white-throated hill partridge)	feathers		Taiwan
G. microthorax (syn. *G. alatus, simillimus*)	Galliformes: phasianid (chukar partridge, grey partridge)	feathers		Europe

G. nahanii	Galliformes: phasianid (forest partridge)	feathers		Africa
G. obscurus	Galliformes: phasianid (red-legged partridge)	feathers		Europe
G. pallidiflavus	Galliformes: megapodid (mallee fowl)	feathers		Indonesia
G. pallidomaculatus	Galliformes: phasianid (bar-backed partridge, chestnut-headed partridge, chestnut-bellied partridge, grey-breasted partridge, rufous-throated partridge)	feathers		Indonesia
G. parviceps (syn. *G. yngarejsuf*)	Galliformes: phasianid (common peafowl, green peafowl)	feathers		South Asia
G. plumiferae	Galliformes: phasianid (plumed guineafowl)	feathers		Africa
G. pternistis	Galliformes: phasianid (yellow-necked francolin)	feathers		Africa
G. pucherani	Galliformes: phasianid (crested guineafowl)	feathers		Africa
G. punctatus	Apodiformes: trochilid (green-throated carib)	feathers		Central America
G. pusillus	Galliformes: phasianid (chukar partridge, Barbary partridge)	feathers		North Africa
G. rectangulatus (syn. *G. rectangulus*)	Galliformes: phasianid (common peafowl)	feathers		South Asia
G. reticulatus	Galliformes: phasianid (Kalij pheasant, green pheasant)	feathers		Indochina
G. rotundiceps	Galliformes: phasianid (Reeve's pheasant)	feathers		China
G. schraderi	Galliformes: phasianid (Erckel's francolin)	feathers		Africa
G. shelleyii	Galliformes: phasianid (Shelley's francolin)	feathers		Africa
G. tetraophasis	Galliformes: phasianid (monal partridge)	feathers		China
G. vulturini	Galliformes: phasianid (vulturine guineafowl)	feathers		Africa

***Goniodes* species**	**Hosts**	**Location**	**Clinical signs**	**Distribution**
G. aepypodius	Galliformes: megapodid (Bruijn's brush turkey)			Indonesia
G. agelastes (syn. *G. latifasciatus*)	Galliformes: phasianid (white-breasted guineafowl, crested fireback pheasant)			Africa, South-East Asia
G. ammoperdix	Galliformes: phasianid (sand partridge, see see partridge)			Arabia
G. antennatus	Galliformes: phasianid (yellow-necked spurfowl)			Africa
G. arfakianus	Galliformes: megapodid (wattled brush turkey)			Indonesia
G. argus	Galliformes: phasianid (great argus pheasant)			Southeast Asia
G. assimilis (syn. *G. pternistis*)	Galliformes: phasianid (red-necked francolin, Ahanta spurfowl, double-spurred spurfowl, Cape spurfowl, chestnut-naped spurfowl, Clapperton's spurfowl, Coqui francolin, Erckel's spurfowl, Hildebrandt's spurfowl, yellow-necked spurfowl, red-winged francolin, Orange River francolin, Natal spurfowl, crested francolin, scaly spurfowl, Swainson's spurfowl, stone partridge)			Africa
G. astrocephalus (syn. *G. gracilis*)	Galliformes: phasianid (common quail, harlequin quail, rain quail)			Europe, Africa, Indochina
G. australis (syn. *G. maorianus*)	Galliformes: megapodid (mallee fowl)			Australia
G. bambusicolus	Galliformes: phasianid (mountain bamboo partridge)			Indo-Asia
G. bifurcus	Galliformes: phasianid (crested guineafowl)			Africa
G. biordinatus	Galliformes: megapodid (scrub fowl)			New Guinea, Micronesia
G. bituberculatus	Galliformes: phasianid (western capercaillie)			Europe, Russia
G. bonasus	Galliformes: phasianid (ruffed grouse)			North America
G. capitatus	Galliformes: phasianid (common pheasant)			Asia
G. centrocerci	Galliformes: phasianid (sage grouse)			North America
G. cervinicornis	Galliformes: phasianid (silver pheasant, Kalij			Indo-Asia

	pheasant)			
G. chloropus	Galliformes: phasianid (green-legged hill partridge)			Thailand
G. chrysolophi	Galliformes: phasianid (golden pheasant, Lady Amherst's pheasant)			Eurasia, Americas
G. colchici	Galliformes: phasianid (common pheasant)			Asia
G. columbianus (syn. *G. latiorfasciatus*)	Galliformes: phasianid (crested bobwhite)			South America
G. confusio	Galliformes: megapodid (Nicobar scrub fowl)			India
G. coronatus (syn. *G. laevis, obscrurus*)	Galliformes: phasianid (crested wood partridge)			Southeast Asia
G. corpulentus	Galliformes: phasianid (spruce grouse)			North America
G. costatus (syn. *G. tetraogallae*)	Galliformes: phasianid (Tibetan snowcock, Himalayan snowcock, Altai snowcock)			Himalayas
G. crassipes	Galliformes: megapodid (red-billed brush turkey)			Indonesia
G. crossoptilon	Galliformes: phasianid (blue-eared pheasant, black-billed brush turkey)			Asia, New Guinea
G. cupido	Galliformes: phasianid (prairie chickens)			North America
G. curtiprothorax	Galliformes: megapodid (collared brush turkey)			New Guinea
G. curvicornis	Galliformes: phasianid (great argus pheasant)			Southeast Asia
G. diardi	Galliformes: phasianid (Siamese fireback pheasant)			Asia
G. discogaster	Galliformes: megapodid (dusky scrub fowl)			Indonesia
G. dispar (syn. *G. breviantennatus, cypricus, flaviceps, truncatus*)	Galliformes: phasianid (chukar partridge, rock partridge, red-legged partridge, grey partridge)			Europe
G. dissimilis (brown chicken louse)	Galliformes: phasianid (chicken, grey junglefowl, Sri Lankan jungle-fowl)	feathers (body)	restlessness, damaged plumage, reduced productivity	worldwide
G. dolani	Galliformes: phasianid (white-eared pheasant)			Indo-China
G. emersoni	Galliformes: phasianid (montane francolin)			Africa
G. eurygaster	Galliformes: phasianid (monal pheasant)			Himalayas
G. fissus	Galliformes: megapodid (wattled brush turkey, Waigeo brush turkey, Australian brush turkey)			Indonesia, New Guinea
G. gigas (syn. *G. abdominalis, hologaster*) (large chicken louse)	Galliformes: phasianid (chicken, plumed guineafowl, crested guineafowl, helmeted guineafowl)	skin, feathers (body)	restlessness, damaged plumage, reduced productivity	worldwide, esp. tropics
G. graecus	Galliformes: phasianid (rock partridge)			Europe
G. gutterae	Galliformes: phasianid (plumed guineafowl)			Africa
G. hopkinsi	Galliformes: phasianid (crested guineafowl)			Africa
G. humiae	Galliformes: phasianid (Hume's pheasant, Elliot's pheasant)			Indochina
G. inaequalis	Galliformes: phasianid (crested guineafowl)			Africa
G. indicus	Galliformes: phasianid (rufous-throated partridge, hill partridge)			Indo-Asia
G. intermedius	Galliformes: phasianid (koklass)			Indochina
G. isogenos	Galliformes: phasianid (greyling francolin)			Africa
G. ithaginis	Galliformes: phasianid (blood pheasant)			Indochina
G. keleri	Galliformes: phasianid (brush turkey, Madagascar partridge)			Australia
G. klockenhoffi	Galliformes: phasianid (helmeted guineafowl)			Africa
G. lagopi	Galliformes: phasianid (rock ptarmigan, red			Eurasia, North

(syn. *G. chelicornis, lagopodis*)	grouse, western capercaillie)			America
G. leipoae	Galliformes: megapodid (Mallee fowl)			Australia
G. leucurus	Galliformes: phasianid (snow quail)			North America
G. longus (syn. *G. pallidus*)	Galliformes: phasianid (king quail, crested fireback pheasant, crestless fireback pheasant)			Asia
G. lootensi	Galliformes: phasianid (king quail)			Asia
G. lophurus	Galliformes: phasianid (Kalij pheasant)			Himalayas
G. macrocephalus	Galliformes: megapodid (brush turkey)			Australia
G. major (syn. *G. meyeri*)	Galliformes: megapodid (blue-eared pheasant, New Guinea scrubfowl, dusky megapode, Philippine megapode, Melanesian megapode, Micronesian megapode, Nicobar megapode, black-billed brush turkey)			Asia
G. megaceros	Galliformes: phasianid (Himalayan monal, Slater's monal)			India
G. meinertzhageni	Galliformes: phasianid (common peafowl)			South Asia
G. merriamanus (syn. *G. simoni*)	Galliformes: phasianid (dusky grouse)			North America
G. meyi	Galliformes: phasianid (helmeted guineafowl)			Africa
G. minimus	Galliformes: megapodid (orange-footed scrubfowl)			New Guinea
G. minor	Galliformes: megapodid (Philippine scrubfowl, Sula scrubfowl, orange-footed scrubfowl)			Philippines, Indonesia, Australasia
G. montschadskyi	Galliformes: phasianid (black-billed capercaillie)			Russia, China
G. moucheti	Galliformes: phasianid (handsome francolin)			Africa
G. nebraskensis	Galliformes: phasianid (sharp-tailed grouse)			North America
G. neokeleri	Galliformes: megapodid (brush turkey)			Australia
G. numidae (syn. *G. fimbriatus, perlatus*) (guinea feather louse)	Galliformes: phasianid (helmeted guineafowl)			Africa
G. ocellatus (syn. *G. dentatus*)	Galliformes: phasianid (Kalij pheasant, koklass)			Himalayas
G. ocrea	Galliformes: megapodid (Moluccas scrub fowl)			Indonesia
G. oreophilus	Galliformes: phasianid (Jackson' spurfowl, Shelley's francolin)			Africa
G. ortygis	Galliformes: phasianid (bobwhite)			North America
G. ovoidalis	Galliformes: phasianid (California quail)			North America
G. pavonis (syn. *G. falcicornis, tetragonocephalus*)	Galliformes: phasianid (green peafowl, common peafowl)			South Asia
G. phasidus	Galliformes: phasianid (black guineafowl)			Africa
G. pictus	Galliformes: phasianid (mountain quail)			North America
G. plumiferae	Galliformes: phasianid (plumed guineafowl)			Africa
G. processus	Galliformes: phasianid (bar-backed partridge, white-cheeked partridge, white-necklaced partridge, rufous-throated partridge, hill partridge)			Indo-Asia
G. reichenowii	Galliformes: phasianid (helmeted guineafowl)			Africa
G. retractus	Galliformes: phasianid (brown quail)			Australia
G. rhynchortyx	Galliformes: phasianid (tawny-faced quail)			Central and South America
G. schoutedenii	Galliformes: phasianid (crested guineafowl)			Africa
G. scleroptilus	Galliformes: phasianid (Orange River francolin)			Africa
G. sectus	Galliformes: phasianid (cheer pheasant)			India
G. securiger	Galliformes: phasianid (Barbary partridge)			North Africa
G. sinensis	Galliformes: phasianid (Mikado pheasant)			Taiwan

G. soueefi (syn. *G. elongatus*)	Galliformes: phasianid (quail, fireback pheasant)			Eurasia
G. spinicornis (syn. *G. bicuspidatus*)	Galliformes: phasianid (Blyth's tragopan, Temminck's tragopan, satyr tragopan)			Indochina
G. squamatus	Galliformes: phasianid (scaled quail)			North America
G. stefani (syn. *G. mamillatus*)	Galliformes: phasianid (California quail)			North America
G. submamillatus	Galliformes: phasianid (Gambel's quail)			North America
G. talegallae	Galliformes: megapodid (black-billed brush turkey)			New Guinea
G. temporalis (syn. *G. extraneus*)	Galliformes: phasianid (swamp partridge)			India
G. tetraonis (syn. *G. heterocerus*)	Galliformes: phasianid (black grouse)			Eurasia
G. tetraophasis	Galliformes: phasianid (monal partridge)			China
G. tibetanus	Galliformes: phasianid (Tibetan snowcock)			Himalayas
G. tragopan	Galliformes: phasianid (western tragopan)			Himalayas
G. wilsoni	Galliformes: phasianid (Congo peafowl)			Africa
G. zairensis	Galliformes: phasianid (plumed guineafowl)			Africa

***Chelopistes* species**	**Hosts**	**Location**	**Clinical signs**	**Distribution**
C. bicolor	Galliformes: cracid (Marail guan)	feathers		South America
C. calvus	Galliformes: phasianid (marbled wood quail)	feathers		South America
C.chamaepetes	Galliformes: cracid (sickle-winged guan)	feathers		South America
C.costaricensis	Galliformes: cracid (black guan)	feathers		Central America
C. craxae	Galliformes: cracid (blue-billed curassow)	feathers		South America
C.dendrortyx	Galliformes: phasianid (singing quail, buffy-crowned wood partridge, long-tailed wood partridge)	feathers		South America
C. elongatus	Galliformes: phasianid (rufous-fronted wood quail)	feathers		South America
C. erythrops	Galliformes: phasianid (rufous-fronted wood quail)	feathers		South America
C. eximius	Galliformes: cracid (horned guan)	feathers		Central America
C. guttatus	Galliformes: phasianid (spot-winged wood quail)	feathers		South America
C. heterurus	Galliformes: phasianid (rufous-fronted wood quail)	feathers		South America
C.hyperythra	Galliformes: phasianid (chestnut wood quail)	feathers		South America
C. jacquacu	Galliformes: cracid (Spix's guan)	feathers		South America
C. karachiensis	Galliformes: phasianid (turkey)	feathers		India
C. latafrons	Galliformes: cracid (grey-headed chachalaca, chestnut-winged chachalaca, little chachalaca, West Mexican chachalaca, rufous-vented chachalaca)	feathers		Americas
C. lervicola	Galliformes: phasianid (snow partridge)	feathers		Indochina
C. leucolaema	Galliformes: phasianid (white-throated wood quail)	feathers		South America
C. longicephalus	Galliformes: phasianid (marbled wood quail)	feathers		South America
C. longipes	Galliformes: cracid (helmeted curassow)	feathers		South America
C. longisetosus	Galliformes: phasianid (wood quail)	feathers		South America
C. macropoda	Galliformes: phasianid (marbled wood quail)	feathers		South America
C. melanonotus	Galliformes: phasianid (black-backed wood quail)	feathers		South America
C. meleagridis (syn. *C. stylifer*) (large turkey louse)	Galliformes: phasianid (turkey, ocellated turkey)	skin, feathers (body)	restlessness, damaged plumage, reduced productivity	worldwide, esp. tropics
C. mexicanus	Galliformes: phasianid (spotted wood quail)	feathers		North America

C. minutus	Galliformes: phasianid (black-fronted wood quail)	feathers		South America
C. oculari	Galliformes: cracid (crested guan, dusky-legged guan, Andean guan)	feathers		Central and South America
C. peruviana	Galliformes: phasianid (rufous-breasted wood quail)	feathers		South America
C. phasiani	Galliformes: cracid (little chachalaca)	feathers		South America
C. pilosus	Galliformes: cracid (Andean guan)	feathers		South America
C. quadratus	Galliformes: phasianid (stripe-faced wood quail)	feathers		South America
C. rotundus (syn. *C. diversus*)	Galliformes: cracid (highland guan)	feathers		Central America
C. setosus	Galliformes: phasianid (marbled wood quail, rufous-fronted wood quail)	feathers		South America
C. stigmatus	Galliformes: cracid (band-tailed guan)	feathers		South America
C. subquadratus	Galliformes: cracid (sickle-winged guan)	feathers		South America
C. texanus	Galliformes: cracid (plain chachalaca)	feathers		North America

***Cuclotogaster* species (syn. *Cuclutogaster*)**	**Hosts**	**Location**	**Clinical signs**	**Distribution**
C. acuminatus	Galliformes: phasianid (king quail)	skin, feathers		South-East Asia
C. aethiopicus	Galliformes: phasianid (chestnut-naped francolin)	skin, feathers		North Africa
C. arabicus	Galliformes: phasianid (Arabian chukar)	skin, feathers		Arabia
C. barbara	Galliformes: phasianid (Barbary partridge)	skin, feathers		North Africa
C. bicalcaratus	Galliformes: phasianid (double-spurred francolin)	skin, feathers		Africa
C. cameratus	Galliformes: phasianid (black grouse)	skin, feathers		Eurasia
C. cinereus	Galliformes: phasianid (common quail, Japanese quail)	skin, feathers		Europe, North Africa, Asia
C. erckelii	Galliformes: phasianid (Erckel's francolin)	skin, feathers		Africa
C. gedgii	Galliformes: phasianid (Clapperton's francolin)	skin, feathers		Africa
C. haydocki	Galliformes: phasianid (coqui francolin)	skin, feathers		Africa
C. heterogrammicus	Galliformes: phasianid (grey partridge)	skin, feathers		Eurasia
C. heterographus (syn. *C. burnetti, eynsfordii, laticorpus, pallidus*) (chicken head louse)	Galliformes: phasianid (chicken, Chukar partridge, green peafowl, pheasant), Tinamiformes (tinamou)	skin, feathers (head, neck)	scales, scabs, feather loss, weakness	worldwide
C. heyi	Galliformes: phasianid (sand partridge)	skin, feathers		Arabia
C. hopkinsi	Galliformes: phasianid (greyling francolin)	skin, feathers		Africa
C. hungerfordi	Galliformes: phasianid (Jackson's francolin)	skin, feathers		Africa
C. insolitus	Galliformes: phasianid (rufous-throated partridge)	skin, feathers		Indochina
C. maculipes	Galliformes: phasianid (bobwhite quail)	skin, feathers		North America
C. madagascariensis	Galliformes: phasianid (Madagascar partridge)	skin, feathers		Madagascar
C. maranensis	Galliformes: phasianid (scaly francolin)	skin, feathers		Africa
C. meinertzhageni	Galliformes: phasianid (yellow-necked francolin)	skin, feathers		Africa
C. moucheti	Galliformes: phasianid (Clapperton's francolin)	skin, feathers		Africa
C. nigromarginatus	Galliformes: phasianid (Kalij pheasant)	skin, feathers		Indo-Asia
C. notatus	Galliformes: phasianid (stone partridge)	skin, feathers		Africa
C. obscurior (syn. *C. obscurus*)	Galliformes: phasianid (red-legged partridge, rock partridge)	skin, feathers		Europe
C. occidentalis	Falconiformes: phasianid (palm-nut vulture)	skin, feathers		Africa
C. phayrei	Galliformes: phasianid (Chinese francolin)	skin, feathers		Asia
C. placentella	Galliformes: phasianid (grey-striped francolin)	skin, feathers		Africa

C. pternistis	Galliformes: phasianid (red-necked spurfowl, Swainson's francolin)	skin, feathers		Africa
C. rosalindae	Galliformes: phasianid (Shelley's francolin)	skin, feathers		Africa
C. sephaenae	Galliformes: phasianid (crested francolin)	skin, feathers		Africa
C. spinicaudatus	Galliformes: phasianid (jungle bush quail)	skin, feathers		Asia
C. subinsolitus	Galliformes: phasianid (bar-backed partridge)	skin, feathers		Thailand
C. synoicus	Galliformes: phasianid (brown quail)	skin, feathers		Australasia
C. tetraogallus	Galliformes: phasianid (Tibetan snowcock, Caucasian snowcock, Altai snowcock)	skin, feathers		Indochina
C. theresae	Galliformes: phasianid (black francolin)	skin, feathers		India
C. ugandanus	Galliformes: phasianid (Clapperton's francolin)	skin, feathers		Africa
C. zumpti	Galliformes: phasianid (coqui francolin)	skin, feathers		Africa

Parasite morphology: Philopterid chewing lice form 3 different types of developmental stages: eggs (often called nits, although some restrict this term to empty egg-cases); nymphs (3 consecutive instars); and adult lice (males and females). The eggs are pale-coloured (tan to grey) and elongate oval-ellipsoidal in shape measuring around 0.7-1.0 mm in length. They are attached by their bases to feathers but appear to lay longitudinally along quills. The eggs are embryonated and eventually hatch to release first-stage nymphs which moult twice before forming adult lice. All 3 nymphal instars are similar in morphology to adults, but are smaller, less sclerotized, possess fewer body setae, and lack genitalia. Adult lice are generally small in size (1-5 mm long), range from pale-tan to grey to reddish-brown in colour, and have dorso- ventrally flattened bodies comprising 3 distinct parts (head, thorax and abdomen). The family Philopteridae is extremely biodiverse and contains almost 140 genera which are unified by several defining characteristics (notably the presence of 5-segmented antennae and paired tarsal claws) but otherwise display considerable pleomorphic variation. Adult lice belonging to the genera *Goniocotes, Goniodes* and *Chelopistes* have stout squat bodies, those of the genus *Cuclotogaster* have barrel-shaped bodies, and those of the genus *Lipeurus* have distinctive narrow elongate bodies. They all have prominent heads, rounded anteriorly (often described as circum-fasciate (rounded in an unbroken arc)), nearly as wide as the abdomen, and sometime helmet-like in appearance. Most heads bear setae, either several short anterior hairs (*Lipeurus*), both anterior and posterior hairs (*Cuclotogaster*), or 2-3 long posterolateral bristles (*Goniocotes, Goniodes, Chelopistes*). Philopterid lice lack maxillary palps (present in amblyceran lice) and all species have 2 lateral filiform antennae which are conspicuous (not confined to antennal grooves like amblyceran lice), each antenna composed of 5 segments (not 3 like trichodectid lice). The first antennal segment on male *Lipeurus, Chelopistes, Cuclotogaster* and *Goniodes* is enlarged, those of male *Goniodes* bears thumb-like prongs (absent on male *Gonicotes*) and the third antennal segment of male *Cuclotogaster* has spur-like extensions. These chewing lice have small ventral mouthparts with 2 opposing sclerotized mandibles closing over a posterior plate-like labrum (often with an anterior hyaline pad-like pulvinus), 2 lateral maxillae and an anterior labium. Food particles are maneuvered into the preoral cavity and salivary secretions are added through a central hypopharynx. The mandibles of ischnoceran lice are inserted at right angles to the head (so the condyles are posterior and the ginglymus is anterior), the maxillae are reduced to single lobes, and the labium is small and tripartite. The mouth opens to the alimentary tract which comprises a foregut (with hypopharynx, salivary glands, oesophagus and fusiform crop), a large midgut (with ventriculus and anterior caeca) and a hindgut (with pylorus, papillae and rectum). The midgut contains a rudimentary organ known as the mycetome (or bacteriome or stomach disc) harbouring bacterial/fungal symbionts (mycetome more developed in anopluran sucking lice, but absent in amblyceran lice). The thorax is small and narrow and composed of fused segments with indistinct boundaries, often with dorsal sternal plates bearing long lateral or posteriorly directed bristles. The ventral thorax gives rise to 3 pairs of legs, each composed of 5 segments (coxa, trochanter, femur, tibia, tarsus) and all bearing paired tarsal claws (in contrast to the single tarsal claws found on trichodectid lice). The legs are generally similar in size, although those of some genera differ in length (the hind-legs of *Lipeurus* are longer than the mid- and fore-legs, while the fore-legs of *Cuclotogaster* are shorter than the mid- and hind-legs). The abdomen is oval to elliptical in shape and has 8 conspicuous segments with well-developed sclerotized paratergal plates (except *Lipeurus*) with lateral spiracles (openings to the tracheal (breathing) system). The abdominal segments of the different genera differ in their chaetotaxy (arrangement of setae), ranging from sparse numbers (*Lipeurus*) to several rows of short dorsal and ventral setae (*Cuclotogaster*) or more frequently rows of short dorsal setae and tufts of long ventrolateral bristles (*Goniocotes, Goniodes, Chelopistes*). Adult lice exhibit sexual size dimorphism, with female lice being larger than males. The size differences between sexes of different philopterid species has been shown to generally conform to Rensch's rule (allometric increase in male body size relative to female size, i.e. larger lice produce proportionately larger males although they remain smaller than females). Male lice have 2 pairs of lobular testes (3 pairs in amblyceran lice) joined to tubular vas deferens which coalesce into a seminal vesicle connected to the genital sac equipped with a tubular copulatory/intromittent organ (aedeagus with dorsal gonopore and terminal endophallus (pseudopenis)) supported by a basal apodeme (plate-like sclerite) and 2 lateral parameres (rod-like sclerites). Female lice have saccular ovaries with polytrophic ovarioles and tubular oviducts connected to a globular uterus with spermatheca (sperm storage vesicle) and accessory glands (produce adhesive glue/cement used in oviposition). The uterus opens into a vaginal receptacle with a genital plate that is located between well-developed bifurcated gonopods often with elongate terminal setae.

Site of infection: Philopterid lice are ectoparasitic on the skin and/or feathers of their avian hosts. Eggs are attached to barbs near the bases of feather quills, while nymph and adult stages are mostly found amongst fluff and down at the bases of feathers. Most species are oioxenous (specific for individual host species) or stenoxenous (specific for a small number of closely-related host species). These ischnoceran chewing lice are relatively more sedentary than amblyceran chewing lice, and exhibit greater site specificity (tissue tropism) for particular regions of the head, neck, back, belly, wings, tail and vent (although they may be more widespread in heavy infestations). *Cuclotogaster* spp. seem to prefer the skin and feathers of the head (many known as head lice), *Lipeurus* spp. are usually found on the undersides of the wings and tail (many known as wing lice), *Chelopistes* spp. inhabit the bases of quills on the back, belly and wings, *Goniocotes* spp. mainly infest the back and vent (many known as fluff lice), and *Goniodes* spp. are more widespread over the body.

Pathogenesis: Light infestations by these bird lice are often asymptomatic and remain subclinical, but heavy infestations may cause mild-severe disease characterized by irritation, inflammation, self-trauma, damaged plumage and weight loss. These ischnoceran chewing lice feed on skin and/or feathers using a biting or scraping action of their mandibles. Some species have occasionally been observed to feed on blood either by scraping the integument until it bleeds or by chewing on blood clots associated with skin lesions. Lice foraging and feeding on skin and feathers can be extremely irritating to birds and may cause damage to underlying tissues, with local inflammation, pruritus and hyperkeratosis (possibly exacerbated by allergic responses to louse antigens). Birds become restless and endeavor to relieve the annoyance by repetitive grooming (scratching the skin, preening and pulling feathers) which may result in self-trauma with skin lesions (scabs, scales, crusts) and unsightly appearance due to damaged plumage (broken rough feathers losing colour, dirty feathers near the vent) and depluming (feather loss, bald spots). This may result in impaired thermoregulation (birds unable to keep warm), poor health (weakness, debility, inappetence, pallor, sometimes anaemia, predisposition to secondary infections) and reduced productivity (reduced growth, poor weight gain or weight loss, decreased egg production, and occasionally death). Birds can often control philopterid louse populations through preening as these lice are relatively sedentary and hide in the plumage (they are less agile than amblyceran lice and therefore less able to escape preening). Lice numbers increase on birds unable to groom effectively, and debeaked birds become more heavily infested. Clinical infestations are more prevalent in colder weather, particularly on younger birds, presumably due to their immunological immaturity, gregarious behaviour and limited grooming skills.

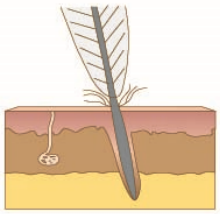
Developmental cycle and mode of transmission: Bird lice are intimate ectoparasites that live permanently in the plumage of their avian hosts. Gravid female lice attach eggs to feathers singly or in clusters where they develop and hatch after 4-7 days releasing first-stage nymphs. These stages feed and undergo hemimetabolous development with gradual (incomplete) metamorphosis through another 2 nymphal stages before moulting to adults. All motile stages (nymphs and adults) cling to feathers and feed on keratinized elements (feathers and/or skin). Each nymphal stage lasts for 5-15 days depending on prevailing environmental conditions (shorter duration in mild moist conditions) and adult lice may live for up to 36 days. After mating, female lice begin laying around 2 eggs per day for up to 30 days. The entire life-cycle may be completed in 18-35 days. There are no free-living stages and any lice dislodged from hosts do not survive long (hours to days depending on climatic conditions). Transmission between hosts is therefore direct and only occurs when lice move from one host to another when in prolonged close or direct contact. Lice are more active and abundant in autumn and winter when temperature and moisture conditions favour louse development and survival and hosts may exhibit more gregarious behaviours associated with shared thermoregulation (flocking) and reproduction (mating and nesting). While ischnoceran philopterid lice are well adapted to move about feathers and hide in plumage, they are more sedentary and not as agile as amblyceran menoponid lice and are therefore more susceptible to predation by host preening. Healthy fully-fledged birds are often able to control louse populations by grooming, including preening, sunning and dust-bathing, especially over summer months. Some lice (mostly ischnoceran chewing lice) have also been observed to be transmitted between hosts by phoresy, that is, by temporary attachment to external surfaces of larger arthropods that move between hosts (particularly hippoboscid or muscid flies).

Differential diagnosis: Infestations may be suspected on the grounds of symptomatology when birds become restless and relentlessly scratch and peck themselves. Definitive diagnosis is achieved by the direct detection of louse developmental stages (eggs, nymphs, adults) by visual examination of bird feathers and skin, performed by parting feathers in suspect areas (especially the vent if dirty) looking for attached eggs and lice moving away from light. Physical examination may be aided by using magnifying glasses and blunt instruments to probe feathers and fluffy down. Lice may be collected for microscopic examination and identification. Modern molecular biological techniques have been used to characterize various philopterid species and examine their phylogenetic relationships following polymerase chain reaction (PCR) amplification of nuclear (elongation factor 1-alpha) and mitochondrial (cytochrome oxidase 1) genes.

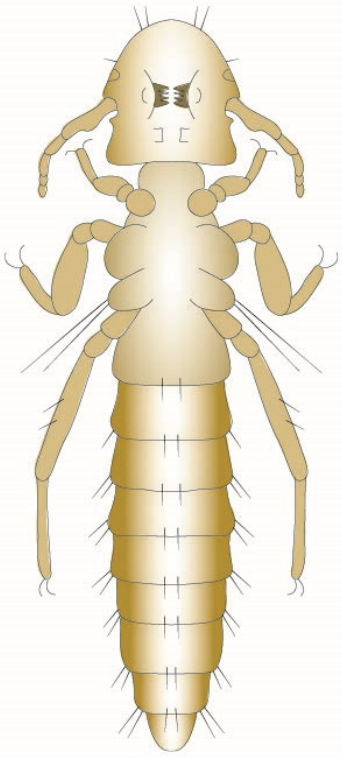
Treatment and control: A range of insecticides have been used to treat clinical infestations, including organophosphates (malathion, tetrachlorvinphos), pyrethroids (permethrin), spinosyns (spinosad), macrocyclic lactones (ivermectin, moxidectin) and some natural products (such as rotenone (recently banned in several countries). Careful attention should be given to recommendations and regulations governing chemical usage (including with-holding periods, residues, contra-indications, environmental toxicity). It is advisable to treat the entire flock simultaneously, and to repeat treatments 1-2 weeks later as the eggs

are often resistant and may hatch to reinfest the flock. Chemicals are available as topical applications (powders, sprays, baths) or as systemic formulations (injectable, oral or spot-on). Small numbers of birds are often treated using insecticidal powders or spray solutions ensuring thorough coverage by manually ruffling the plumage. Head lice have also been treated by mixing powders with petroleum jelly or vaseline and rubbing the mixture onto affected areas. Powders may also be mixed with diatomaceous earth, sulphur dust, sand or wood ash and made available for self-administration in dust boxes in open aviaries, but not all bird species avail themselves of dust baths, nor do all individuals of compliant species. Liquid sprays, washes and baths have exhibited variable efficacy as feathers often provide waterproof barriers, and wet chilled birds may develop respiratory conditions. More recently, a range of liquids containing essential oil extracts were reported to have some efficacy, but some caused skin, eye or respiratory irritation, and many apparently acted only as repellents and birds quickly became re-infested. Several macrocyclic lactones have been used for the systemic treatment of infestations, with better residual activity providing longer term protection, but they are not registered for use in poultry destined for human consumption (including both meat and egg production). Preventive control is based around disease detection (routine monitoring), minimizing contact with infested individuals (quarantine/isolation of infested birds, exclusion of wild birds), maintaining hygienic conditions (avoid crowded conditions, regular cleaning and decontamination of shared facilities and equipment) and maintaining healthy well-nourished birds (more resistant to infestations) which are able to self-groom (de-beaked birds are unable to preen effectively).

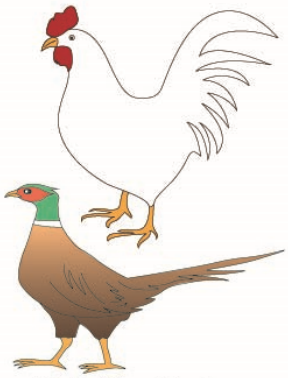
Lipeurus



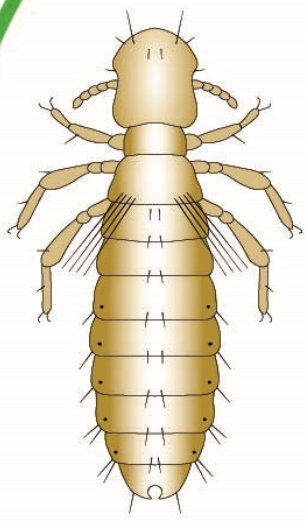
skin/plumage
(irritation, inflammation,
damaged feathers,
reduced productivity)



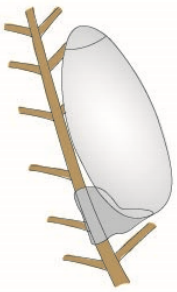
adult (ventral)
(~ 4 mm)



Definitive Hosts
(birds)



nymph (dorsal)
(~ 2 mm)

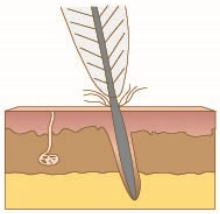


egg
(~ 1 mm)

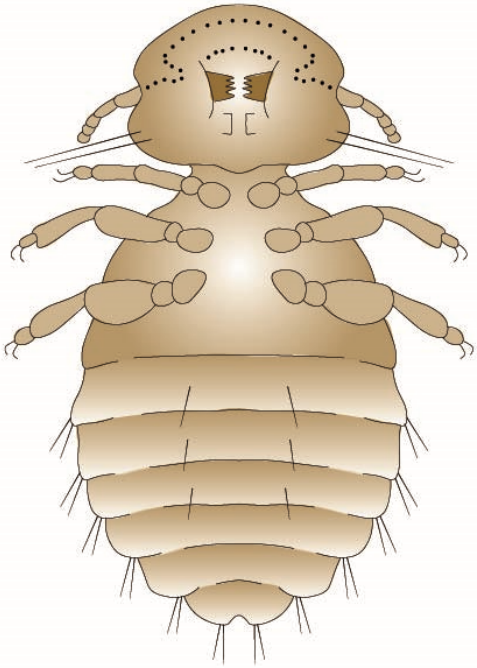
all stages ectozoic on host
(motile stages feed on skin/feathers)

transmission between hosts
through transfer of motile stages
by direct contact or via fomites

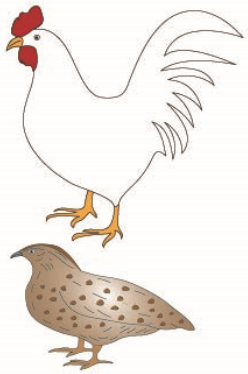
Goniocotes



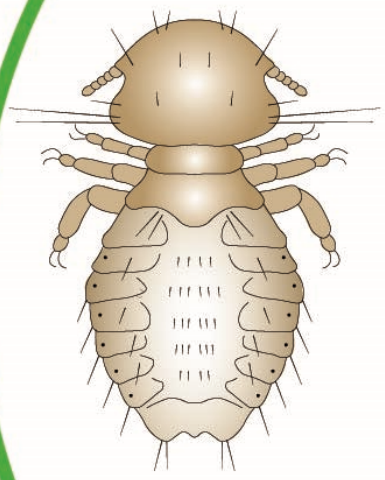
skin/plumage
(irritation, inflammation,
damaged feathers,
reduced productivity)



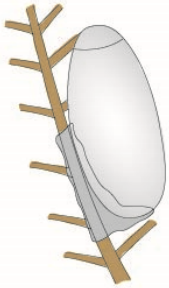
adult (ventral)
(~ 3 mm)



Definitive Hosts
(birds)



nymph (dorsal)
(~ 2 mm)

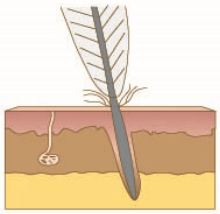


egg
(~ 1 mm)

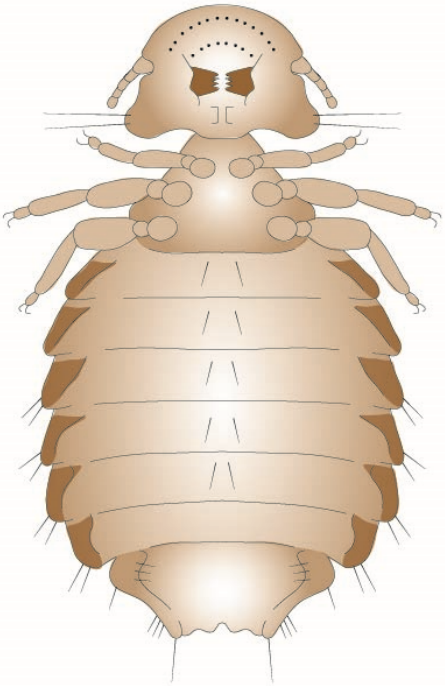
all stages ectozoic on host
(motile stages feed on skin/feathers)

transmission between hosts
through transfer of motile stages
by direct contact or via fomites

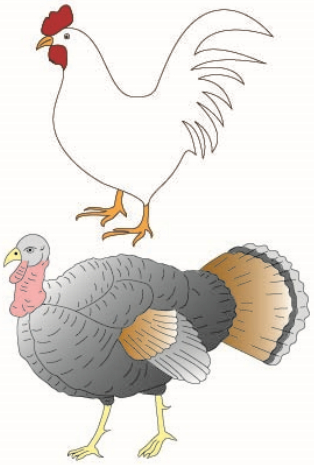
Goniodes



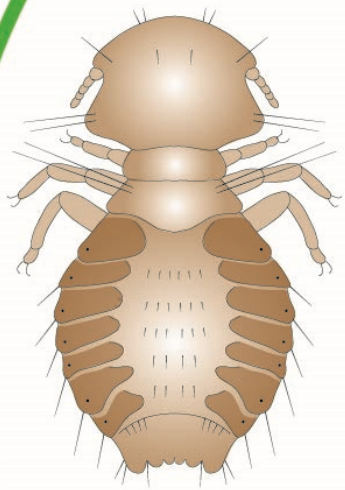
skin/plumage
(irritation, inflammation,
damaged feathers,
reduced productivity)



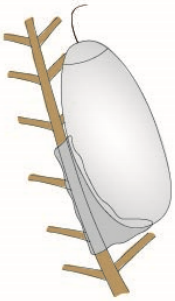
adult (ventral)
(~ 3 mm)



Definitive Hosts
(birds)



nymph (dorsal)
(~ 2 mm)

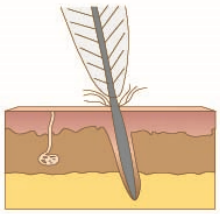


egg
(~ 1 mm)

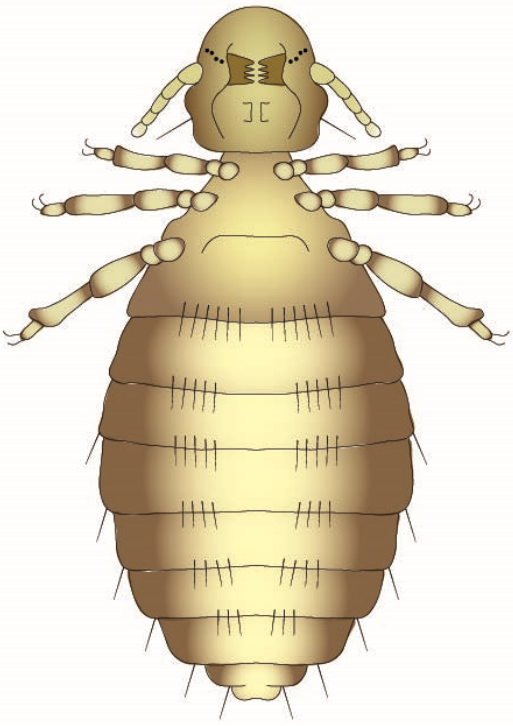
all stages ectozoic on host
(motile stages feed on skin/feathers)

transmission between hosts
through transfer of motile stages
by direct contact or via fomites

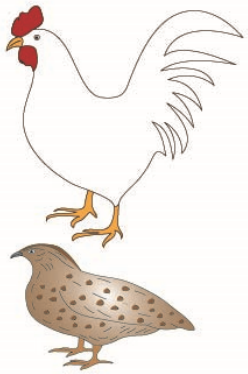
Cuclotogaster



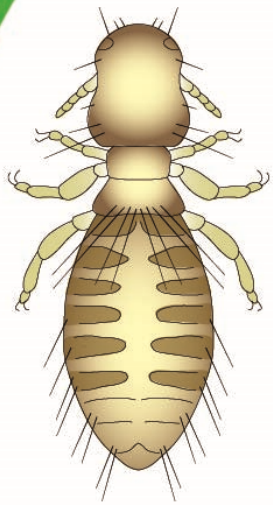
skin/plumage
(irritation, inflammation,
damaged feathers,
reduced productivity)



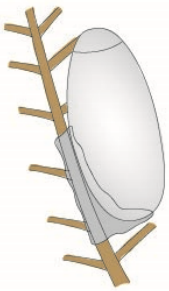
adult (ventral)
(~ 3 mm)



Definitive Hosts
(birds)



nymph (dorsal)
(~ 2 mm)

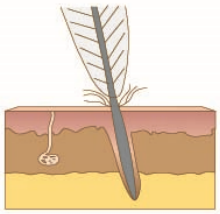


egg
(~ 1 mm)

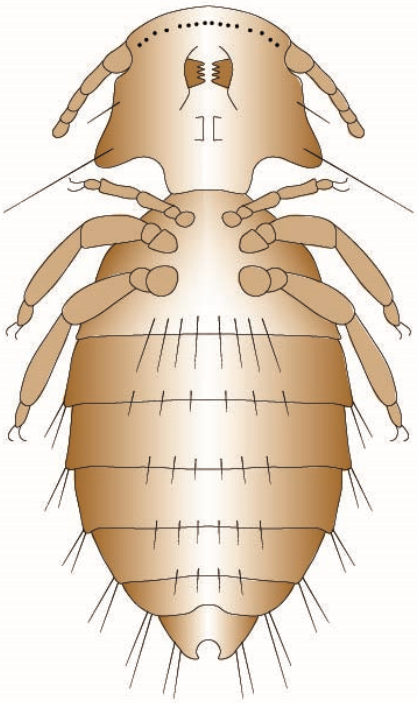
all stages ectozoic on host
(motile stages feed on skin/feathers)

transmission between hosts
through transfer of motile stages
by direct contact or via fomites

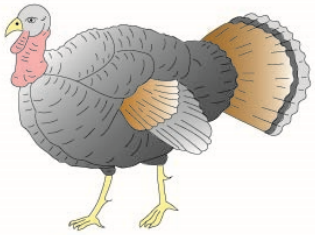
Chelopistes



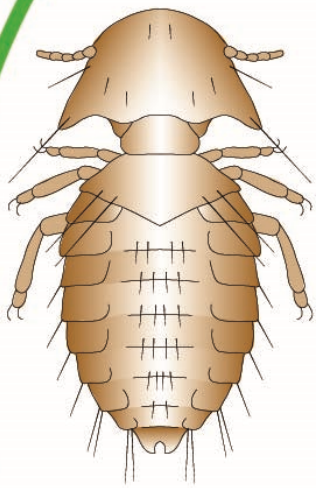
skin/plumage
(irritation, inflammation,
damaged feathers,
reduced productivity)



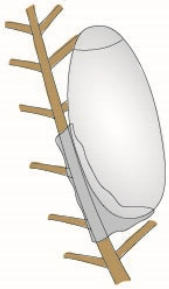
adult (ventral)
(~ 3 mm)



Definitive Hosts
(birds)



nymph (dorsal)
(~ 2 mm)



egg
(~ 1 mm)

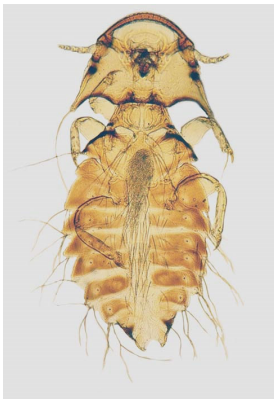
all stages ectozoic on host
(motile stages feed on skin/feathers)

transmission between hosts
through transfer of motile stages
by direct contact or via fomites

Lipeurus adult

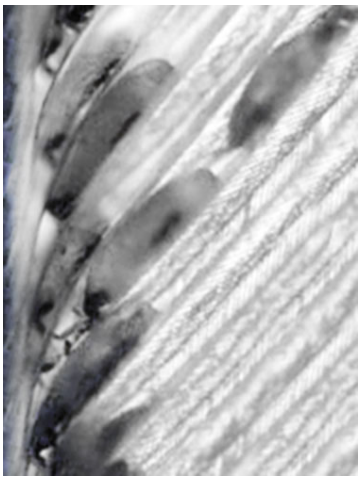
Goniodes adult

Gonicotes adult



Chelopistes adult

Cuclotogaster adult



Goniodes eggs