

An annotated checklist of sucking lice (Phthiraptera: Anoplura) from domestic and wild mammals in Malaysia, with lists of hosts and pathogens

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Abstract

Literature records of sucking lice (Phthiraptera: Anoplura) from Malaysia were checked and reviewed, resulting in a list of 34 established species belonging to 11 genera (*Ancistroplax*, *Atopophthirus*, *Enderleinellus*, *Haematopinus*, *Hamophthirius*, *Hoplopleura*, *Linognathus*, *Neohaematopinus*, *Pedicinus*, *Polyplax* and *Sathrax*). Furthermore, three local and six cosmopolitan louse species are regarded as dubious in Malaysia, due to misidentifications or lack of locality records. Also, pathogens known to be associated with the sucking lice are listed. The alarming conservation status of some Malaysian mammalian host species and their sucking lice warrant more research and imminent action to preserve the biodiversity of the country. This paper presents the first complete checklist of anopluran lice from both Peninsular Malaysia and Malaysian Borneo, including localities, literature references and a host-louse list.

Key words: Sucking lice, Phthiraptera, Anoplura, checklist, mammal hosts, pathogens, Malaysia, localities, references

Introduction

Lice (Insecta: Phthiraptera) are wingless, obligate parasites that live mainly on the pelage or plumage of their hosts. Currently, there are four recognised suborders of parasitic lice which can be divided into two groups: chewing or biting lice (suborders Amblycera, Ischnocera and Rhynchophthirina; Price *et al.* 2003), and sucking lice (suborder Anoplura) with more than 500 species, 50 genera in 15 families (Durden & Musser 1994). Unlike chewing lice, which feed on feathers, mucus, skin debris and possibly fur, sucking lice feed on blood and can transmit microorganisms which cause diseases (Durden 2018).

Early records of sucking lice from Malaysia were published by Ferris (1919, 1921, 1923, 1933, 1934), and research on Indo-Malaysian species was published by Kim (1966, 1968, 1977) and Johnson (1964, 1969, 1972b) as part of their study of ectoparasites from the Oriental Region. These studies resulted in the description of new species, genera, and families found in Malaysia. Unfortunately, despite these contributions to the Malaysian louse fauna, there have been few subsequent studies on these blood-sucking insects from domestic and wild mammals in this country (Mustaffa-Babjee 1969; Shabrina 1990; Mariana *et al.* 2008; Madinah *et al.* 2014; Vivi-Susantie *et al.* 2020). Hence, we believe that a checklist of the sucking lice recorded from Malaysia would encourage future taxonomists and ecologists to collect and study these arthropods.

In this paper, we present an annotated list of sucking lice recorded from both Peninsular Malaysia and Malaysian Borneo. The list includes 34 confirmed species in 11 genera (*Ancistroplax*, *Atopophthirus*, *Enderleinellus*, *Haematopinus*, *Hamophthirius*, *Hoplopleura*, *Linognathus*, *Neohaematopinus*, *Pedicinus*, *Polyplax* and *Sathrax*) and seven families (Enderleinellidae, Haematopinidae, Hamophthiriidae, Hoplopleuridae, Linognathidae, Pedicinidae and Polyplacidae) as listed in Table 1. In addition, we discuss three local and six cosmopolitan louse species which we regard as dubious in Malaysia, due to misidentifications or lack of locality records. Also, a table of known pathogens associated with each louse species is given (Table 2).

TABLE 1. List of sucking louse species recorded from Malaysia.

Louse family	Louse species	Peninsular Malaysia	Malaysian Borneo
Enderleinellidae	<i>Atopophthirus emersoni</i>	x	
	<i>Enderleinellus kumadai</i>	x	x
Haematopinidae	<i>Haematopinus eurysternus</i>	x	
	<i>Haematopinus ludwigi</i>		x
	<i>Haematopinus quadripertusus</i>	x	
	<i>Haematopinus suis</i>	x	
	<i>Haematopinus tuberculatus</i>	x	
Hamophthiriidae	<i>Hamophthirius galeopitheci</i>		x
Hoplopleuridae	<i>Ancistroplax nasuta</i>	x	x
	<i>Hoplopleura diaphora</i>	x	
	<i>Hoplopleura dissicula</i>	x	x
	<i>Hoplopleura erismata</i>	x	
	<i>Hoplopleura kitti</i>	x	
	<i>Hoplopleura malaysiana</i>	x	
	<i>Hoplopleura pacifica</i>	x	
	<i>Hoplopleura pectinata</i>	x	x
	<i>Hoplopleura sicata</i>		x
Linognathidae	<i>Linognathus africanus</i>	x	
	<i>Linognathus setosus</i>	x	
	<i>Linognathus vituli</i>	x	
Pedicinidae	<i>Pedicinus ancoratus</i>	x	x
Polyplacidae	<i>Neohaematopinus callosciuri</i>	x	x
	<i>Neohaematopinus capitaneus</i>	x	
	<i>Neohaematopinus cognatus</i>		x
	<i>Neohaematopinus elbeli</i>	x	
	<i>Neohaematopinus kinabalensis</i>		x
	<i>Neohaematopinus pallidus</i>	x	
	<i>Neohaematopinus pansus</i>	x	x
	<i>Neohaematopinus robustus</i>	x	
	<i>Polyplax insulsa</i>	x	
	<i>Polyplax reclinata</i>	x	
	<i>Polyplax serrata</i>	x	
	<i>Polyplax spinulosa</i>	x	x
	<i>Sathrax durus</i>	x	x

TABLE 2. List of worldwide anopluran lice belonging to the genera recorded in Malaysia, with their known pathogens. It should be noted that these pathogens were detected in lice from countries other than Malaysia, and in most cases, transmission by lice has not been demonstrated for the listed pathogens.

Louse genus	Louse species	Known pathogens	Zoonotic potential of pathogens	References
<i>Atopophthirus</i>	-	-	-	-
<i>Enderleinellus</i>	-	-	-	-
<i>Haematopinus</i>	<i>H. eurysternus</i>	<i>Coxiella burnetii</i>	Yes	Reeves <i>et al.</i> (2006)
		<i>Rickettsia</i> sp.	Not determined	Hornok <i>et al.</i> (2010)
	<i>H. quadripertusus</i>	<i>Bartonella</i> sp.	Not determined	Gutiérrez <i>et al.</i> (2014); Ehlers <i>et al.</i> (2020); Promrangsee <i>et al.</i> (2019)
		<i>Rickettsia africae</i>	Yes	Ehlers <i>et al.</i> (2020)
	<i>H. suis</i>	<i>Anaplasma</i> sp.	Not determined	Hornok <i>et al.</i> (2010)
		<i>Mycoplasma suis</i>	No	Acosta <i>et al.</i> (2019)
		<i>M. parvum</i>	No	Durden (2019)
		Swinepox virus	No	Durden (2019)
	<i>H. tuberculatus</i>	<i>Anaplasma marginale</i>	No	Schafer da Silva <i>et al.</i> (2013); Hernández-Velasco <i>et al.</i> (2020)
		<i>Bartonella</i> sp.	Not determined	Gonçalvez <i>et al.</i> (2020)
		<i>Brucella abortus</i>	No	Neglia <i>et al.</i> (2013)
		<i>Trypanosoma vivax</i>	No	Souza-Dyonisio <i>et al.</i> (2021)
<i>Hamophthirius</i>	-	-	-	-
<i>Ancistroplax</i>	-	-	-	-
<i>Hoplopleura</i>	<i>Hoplopleura</i> sp.	<i>Bartonella cooper-splainsensis</i>	No	Klangthong <i>et al.</i> (2015)
		<i>B. phoceensis</i>	No	Klangthong <i>et al.</i> (2015)
		<i>B. rattimassiliensis</i>	No	Klangthong <i>et al.</i> (2015)
		<i>Francisella tularensis</i>	Yes	Durden (2019)
	<i>H. affinis</i>	<i>Bartonella japonica</i>	No	Reeves <i>et al.</i> (2015)
	<i>H. akanezumi</i>	<i>Rickettsia orientalis</i>	Yes	Reeves <i>et al.</i> (2015)
		<i>R. prowazekii</i>	Yes	Reeves <i>et al.</i> (2015)
		<i>R. typhi</i>	Yes	Reeves <i>et al.</i> (2015)
	<i>H. pacifica</i>	<i>Bartonella rattimas-siliensis</i>	No	Reeves <i>et al.</i> (2006)
		<i>B. phoceensis</i>	No	Reeves <i>et al.</i> (2006)
		<i>Rickettsia typhi</i>	Yes	Durden (2019)
	<i>H. sciuricola</i>	<i>Rickettsia prowazekii</i>	Yes	Durden (2019)
<i>Linognathus</i>	<i>Linognathus setosus</i>	<i>Acanthocheilonema reconditum</i>	No	Durden (2019)
	<i>Linognathus stenopsis</i>	<i>Anaplasma marginale</i>	No	Hornok <i>et al.</i> (2010)
		<i>Anaplasma ovis</i>	No	
		<i>Rickettsia helvetica</i>	Yes	
		<i>Rickettsia</i> sp.	Not determined	

.....continued on the next page

TABLE 2. (Contineud)

Louse genus	Louse species	Known pathogens	Zoonotic potential of pathogens	References
<i>Linognathus</i>	<i>Linognathus vituli</i>	<i>Anaplasma marginale</i>	No	Hornok <i>et al.</i> (2010)
		<i>Anaplasma ovis</i>	No	
		<i>Rickettsia helvetica</i>	Yes	
		<i>Theileria orientalis</i>	No	Hammer <i>et al.</i> (2016); Emery (2021)
<i>Neohaematopinus</i>	<i>Neohaematopinus sciuri</i>	<i>Bartonella</i> sp.	Not determined	Nelder <i>et al.</i> (2009)
	<i>N. sciuropteri</i>	<i>Rickettsia prowazekii</i>	Yes	Bozeman <i>et al.</i> (1981)
<i>Pedicinus</i>	<i>P. obtusus</i>	<i>Bartonella quintana</i>	Yes	Li <i>et al.</i> (2013)
<i>Polyplax</i>	<i>Polyplax</i> sp.	<i>Bartonella</i> sp.	Not determined	Klangthong <i>et al.</i> (2015)
		<i>B. coopersplainensis</i>	No	Klangthong <i>et al.</i> (2015)
	<i>P. serrata</i>	<i>B. phoceensis</i>	No	Klangthong <i>et al.</i> (2015)
		<i>B. rattimassiliensis</i>	No	Klangthong <i>et al.</i> (2015)
	<i>P. spinulosa</i>	<i>Francisella tularensis</i>	Yes	Durden (2019)
		<i>Mycoplasma coccoides</i>	No	Durden (2019)
	<i>P. spinulosa</i>	<i>Bartonella</i> near <i>tribocorum</i>	No	Reeves <i>et al.</i> (2006)
		<i>B. rattimassiliensis</i>	No	Reeves <i>et al.</i> (2006)
	<i>P. spinulosa</i>	<i>Borrelia duttoni</i>	Yes	Baker (2006)
		<i>Brucella brucei</i>	No	Baker (2006)
	<i>P. spinulosa</i>	<i>Mycoplasma haemomuris</i>	No	Baker (2006)
		<i>M. muris</i>	No	Durden (2019)
	<i>P. spinulosa</i>	<i>Rickettsia prialensis</i>	Yes	Reeves <i>et al.</i> (2015)
		<i>R. prowazekii</i>	Yes	Reeves <i>et al.</i> (2015)
	<i>P. spinulosa</i>	<i>R. typhi</i>	Yes	Reeves <i>et al.</i> (2015)
		<i>Trypanosoma lewisi</i>	Yes	Baker (2006)
<i>Sathrax</i>	-	-	-	-

Materials and methods

Species of sucking lice from Malaysia were first identified and taken from the checklists by Johnson (1964) and Durden & Musser (1994). The current checklist was prepared after a thorough review of literature with the aid of Google Scholar. Articles including Malaysian louse species were searched using specific keywords on the web's search engine (e.g., “*Hoplopleura erismata*” + “Malaysia”). Tables listing hosts, pathogens, localities and host conservation status were taken from Durden & Musser (1994) and other relevant sources.

The geographical distribution of Malaysian sucking lice was prepared from available locality records found in the literature. Louse species lacking locality information were excluded from the maps. The maps were created using the open-source geographical information software: Quantum Geographical Information System (QGIS), with Malaysian data obtained from the website <https://gadm.org>. Additional legends and visual cues were made using the open-source vector software: Inkscape.

In the following list, the sequence of families, genera and species of lice follows that used by Durden & Musser (1994).

Pattern used for species entries

Name of species author/s, date of publication.

Original genus and species author/s, date: page number, figs.

Combinations of species with other genera, date: page number, figs.

Current genus and species date: page number, figs.

Relevant synonymies, date: page number, figs.

Type host:

Malaysian host/s:

Malaysian locality/ies (references): [as in Figs 1–2].

Geographical distribution: [based on host/s]

Remarks: [Additional data on louse taxonomy, host status, host distribution, misidentifications, new records, biology, etc.]

List of species of Anoplura with confirmed records in Malaysia

Family ENDERLEINELLIDAE Ewing, 1929

Genus *Atopophthirus* Kim, 1977

Type species: *Atopophthirus emersoni* Kim, 1977.

Total number of species in genus: 2.

Hosts: Rodentia (Sciuridae).

Distribution: Oriental Region.

Atopophthirus emersoni Kim, 1977

Atopophthirus emersoni Kim, 1977: 417, figs 1–9.

Atopophthirus emersoni Kim, 1977; Durden & Musser 1994: 8.

Type host: *Petaurista elegans* (Müller, 1840)—Spotted giant flying squirrel.

Malaysian host: *Petaurista elegans*.

Malaysian locality: Mersing (Johor) Peninsular Malaysia (Kim, 1977).

Geographical distribution: Peninsular Malaysia (Durden & Musser 1994; Price & Graham 1997).

Remarks: Kim (1977) described the adult male, the female and a second instar nymph of *Atopophthirus emersoni*.

As there are no further records of this species, the known distribution of *A. emersoni* is limited to Peninsular Malaysia.

Genus *Enderleinellus* Fahrenholz, 1912b

Type species: *Enderleinellus nitzschi* Fahrenholz, 1916.

Total number of species in genus: 45.

Hosts: Rodentia (Sciuridae).

Distribution: Afrotropical, Nearctic, Neotropical, Oriental and Palearctic Regions.

Enderleinellus kumadai Kaneko, 1954

Enderleinellus kumadai Kaneko, 1954: 49, figs 1–2.

Enderleinellus kumadai Kaneko, 1954; Johnson 1959: 573, figs 6–9.

Enderleinellus kumadai Kaneko, 1954; Johnson 1964: 70.

Enderleinellus kumadai Kaneko, 1954; Durden & Musser 1994: 10.

Enderleinellus kumadai Kaneko, 1954; Hartini 2000: 259, figs 1–2.

Type host: *Callosciurus erythraeus* (Pallas, 1779)—Pallas's squirrel.

Malaysian hosts: *Callosciurus notatus* (Boddaert, 1785), *Callosciurus prevostii* (Desmarest, 1822), *Callosciurus nigrovittatus* (Horsfield, 1824), *Glyphotis simus* Thomas, 1898.

Malaysian localities: Gunung Kinabalu & Ranau (Sabah) Malaysian Borneo (Johnson 1964); Selangor, Peninsular Malaysia (Johnson 1964); Peninsular Malaysia (Durden & Musser 1994).

Geographical distribution: Belgium, Borneo, France, Japan, Malaysia, Inner Mongolia: People's Republic of China, Taiwan, Thailand (Durden & Musser 1994; Price & Graham 1997; Dozières *et al.* 2010).

Remarks: The adult male and female of *Enderleinellus kumadai* were described and illustrated by Kaneko (1954).

Johnson (1959) provided a morphological comparison with close species and figures of the male genitalia, the female and paratergal plates. Johnson (1964) commented that *E. kumadai* had a broad host spectrum and was more common than records would indicate, since this species was often overlooked in louse studies. This statement holds true to this day, as recent studies have not reported *E. kumadai* from small wild mammals in Malaysia (Mariana *et al.* 2008; Madinah *et al.* 2014). Although *E. kumadai* is native to South East Asia, it has been introduced to other regions, namely Europe and Japan (Durden & Musser 1994; Dozières *et al.* 2010).

Family HAEMATOPINIDAE Enderlein, 1904a

Genus *Haematopinus* Leach, 1815

Type species: *Haematopinus suis* (Linnaeus, 1758).

Total number of species in genus: 21.

Hosts: Artiodactyla (Bovidae, Cervidae, Suidae); Perissodactyla (Equidae).

Distribution: Cosmopolitan, but most species occur in the Afrotropical and Oriental Regions.

Haematopinus eurysternus (Denny, 1842)

Pediculus eurysternus Nitzsch, 1818: 305. *Nomen nudum*.

Pediculus eurysternus Burmeister, 1838: Species 14. Suppressed by Opinion 1050 (I.C.Z.N. 1976).

Haematopinus eurysternus Denny, 1842: 29, pl. 25: fig. 5. Preserved by Opinion 1050 (I.C.Z.N. 1976).

Haematopinus eurysternus Denny, 1842; Giebel 1874: 41, pl. 2: fig. 8.

Haematopinus eurysternus (Nitzsch, 1818) [sic]; Ferris 1933: 448, figs 263–264.

Haematopinus eurysternus (Nitzsch) [sic]; Webb 1946: 91, figs 189–204.

Haematopinus eurysternus; Roberts 1950: 136, figs 1D–E, 2A.

Haematopinus eurysternus (Nitzsch, 1818) [sic]; Ferris 1951: 88, figs 39–40.

Haematopinus brevipes Fiedler & Stampa 1956: 63, figs 23–27.

Haematopinus palpebrae Gretillat, 1957: 167, figs 1–3. In part.

Haematopinus eurysternus (Nitzsch) [sic]; Stimie & van der Merwe 1968: 190, figs 3–4.

Haemotopinus [sic] *eurysternus*; Mustaffa-Babjee 1969: 37.

Haematopinus eurysternus Denny, 1842; Kim & Weisser 1973: 45.

Haematopinus eurysternus Denny, 1842; Meleney & Kim 1974: 511, figs 1–3, 18, 22, 24, 27, 30, 33.

Haematopinus eurysternus Denny, 1842; Kim *et al.* 1986: 82, pl. 18.

Haematopinus eurysternus (Nitzsch, 1818) [sic]; Durden & Musser 1994: 15.

Type host: *Bos taurus* Linnaeus, 1758—Domestic cattle.

Malaysian host: *Bos taurus*.

Malaysian localities: Kota Bharu (Kelantan) Peninsular Malaysia (Ferris 1933, see Remarks); “West Malaysia” (Mustaffa-Babjee 1969).

Geographical distribution: Cosmopolitan, in temperate, subtropical and tropical regions (Durden & Musser 1994; Price & Graham 1997).

Remarks: The adult male and female of *Haematopinus eurysternus* were redescribed and illustrated by Ferris (1933).

Roberts (1950) provided a morphological comparison and a dichotomous key to distinguish *H. eurysternus* from *H. quadripertusus*. Meleney & Kim (1974) revised the three morphologically close species that infest cattle: *H. eurysternus*, *Haematopinus quadripertusus* Fahrenholz, 1916 and *Haematopinus tuberculatus* (Ferris 1933).

Durden & Musser (1994) stated that the distribution of *Haematopinus eurysternus* was in temperate zones, although several studies have recorded it in subtropical and tropical regions (Rawat *et al.* 1992; Lasisi *et al.* 2010; Rony *et al.* 2010; Bilkis *et al.* 2011; Houssain *et al.* 2016; Al-Mayah & Hatem 2018; Mannan *et al.* 2019).

Ferris (1933) recorded *H. eurysternus* from a “bull” and “calf” in “Kota Bharu, Kelantan, Malay Peninsula” but,

considering that he regarded *H. quadripertusus* as a junior synonym under *H. eurysternus*, it is not possible to determine which species Ferris (1933) had actually examined. Pathogens previously detected in *H. eurysternus* include the zoonotic *Coxiella burnetii* and *Rickettsia* (Reeves *et al.* 2006; Hornok *et al.* 2010).

***Haematopinus ludwigi* Weisser, 1974**

Haematopinus ludwigi Weisser, 1974: 127, figs 1–4, 6–7, 8A–F, 9II.

Haematopinus ludwigi Weisser, 1974; Durden & Musser 1994: 16.

Type host: “Wild pig from Luzon, Philippines”, likely *Sus philippensis* Nehring, 1886—Philippine warty pig (Durden & Musser 1994).

Malaysian host: *Sus barbatus* Müller, 1838.

Malaysian locality: Tinjar (Sarawak) Malaysian Borneo (Weisser 1974).

Geographical distribution: Philippines, Malaysian Borneo (Durden & Musser 1994; Price & Graham 1997).

Remarks: Weisser (1974) described and illustrated male and female adults of *Haematopinus ludwigi*, and the second nymphal instar without illustrations. Weisser (1974) incorrectly identified the “Wild pig from Luzon” as *Sus verrucosus* Boie, 1832, which only lives in the Indonesian islands of Java and Bawean. In Malaysia, the native Bornean *Sus barbatus* is classified as vulnerable according to the IUCN Red List (Luskin *et al.* 2017). *Haematopinus ludwigi* is considered unique as it infests two isolated species of insular wild boars, not belonging to the *Sus scrofa*-group usually found in the Palearctic and continental Oriental Regions (Weisser 1974).

***Haematopinus quadripertusus* Fahrenholz, 1916**

Haematopinus quadripertusus Fahrenholz, 1916: 19, figs 15–17.

Haematopinus parviprocursus Fahrenholz, 1916: 21.

“*Haematopinus eurysternus* (Nitzsch)” [sic]; Ferris 1933: 448. Not *Haematopinus eurysternus* Denny, 1842.

Haematopinus quadripertusus Fahrenholz, 1916; Bruce 1947: 590.

Haematopinus quadripertusus Fahrenholz, 1916; Creighton & Dennis 1947: 911.

Haematopinus quadripertusus Fahrenholz, 1916; Roberts 1950: 136, figs 1A–C, 2B.

“*Haematopinus eurysternus* (Nitzsch)” [sic]; Ferris 1951: 88. Not *Haematopinus eurysternus* Denny, 1842.

Haematopinus palpebrae Gretillat, 1957: 167, figs 1–3. In part.

“*Haematopinus eurysternus* (Nitzsch)” [sic]; Stimie & van der Merwe 1968: 190. Not *Haematopinus eurysternus* Denny, 1842.

Haemotopinus [sic] *quadripertusus*; Mustaffa-Babjee 1969: 37.

Haematopinus quadripertusus Fahrenholz, 1916; Meleney & Kim 1974: 513, figs 4–17, 21, 23, 26, 29, 32.

Haematopinus quadripertusus Fahrenholz, 1916; Kim *et al.* 1986: 84, pl. 19.

Haematopinus quadripertusus Fahrenholz, 1916; Durden & Musser 1994: 17.

Type host: *Bos taurus* Linnaeus, 1758—Domestic cattle.

Malaysian host: *Bos taurus*.

Malaysian localities: “West Malaysia” (Mustaffa-Babjee (1969); Puchong (Selangor) Peninsular Malaysia (Meleney & Kim 1974); Terengganu, Peninsular Malaysia (Meleney & Kim 1974).

Geographical distribution: Worldwide in subtropical and tropical zones (Durden & Musser 1994; Price & Graham 1997).

Remarks: Both *Haematopinus quadripertusus* and *H. parviprocursus* were described from Africa, but later synonymized under *H. eurysternus* by Ferris (1933). However, Bruce (1947) and Creighton & Dennis (1947) resurrected *H. quadripertusus* as a distinct species based on specimens collected from the tails of cattle in Florida. Roberts (1950) provided a morphological comparison and a dichotomous key to distinguish *H. quadripertusus* from *H. eurysternus*, and Meleney & Kim (1974) revised the three morphologically close species that infest cattle.

The first Malaysian record of *H. quadripertusus* in Ferris (1933) is uncertain, as at the time *H. quadripertusus* was still a junior synonym of *H. eurysternus* (see *H. eurysternus* for details and locality in Malaysia). Currently, knowledge of *H. quadripertusus* in Malaysia is poor, and it has not been recorded from Malaysian Borneo. Several papers have reported a number of pathogens detected in *Haematopinus quadripertusus*, including *Barberonella* sp. and the zoonotic *Rickettsia africae* Kelly *et al.* 1996 (Gutiérrez *et al.* 2014, Promrangsee *et al.* 2019, Ehlers *et al.* 2020).

***Haematopinus suis* (Linnaeus, 1758)**

Pediculus suis Linnaeus, 1758: 611.
Haematopinus suis (Linnaeus, 1758); Leach 1815: 77.
Pediculus urius Nitzsch, 1818: 305.
Haematopinus suis (Linnaeus); Denny 1842: 34, pl. 25: fig. 2.
Haematopinus urius (Nitzsch, 1818); Giebel 1874: 45, pl. 2: fig. 6.
Haematopinus urius (Nitzsch, 1818); Piaget 1880: 654, pl. 48: fig. 4.
Haematopinus suis (Linnaeus, 1758); Ferris 1933: 425, figs 252A, 253A, 254, 255E–X, 256.
Haematopinus suis (Linnaeus, 1758); Ferris 1951: 91, figs 41, 42.
Haematopinus suis; Mustaffa-Babjee 1969: 37.
Haematopinus suis (Linnaeus, 1758); Kim *et al.* 1986: 86, pl. 20.
Haematopinus suis (Linnaeus, 1758); Durden & Musser, 1994: 17.
Type host: *Sus scrofa* Linnaeus, 1758—Wild boar.
Malaysian host: *Sus scrofa*.
Malaysian localities: “West Malaysia” (Mustaffa-Babjee (1969); Pahang, Peninsular Malaysia (Ferris 1933); Bukit Mertajan, Peninsular Malaysia (Ferris 1933).
Geographical distribution: Cosmopolitan, except Polar Regions (Durden & Musser 1994; Price & Graham 1997).
Remarks: Ferris (1933, 1951) redescribed and illustrated *Haematopinus suis*, including a complete list of many described subspecies, which he regarded as junior synonyms. Kwak *et al.* (2019) documented the first record of *H. suis* in Singapore, located south of Peninsular Malaysia. Considering that Singapore wild boars originated from Peninsular Malaysia in the 21st century (Yong *et al.* 2010, Kwak *et al.* 2020), it follows that *H. suis* was already established in Malaysia, although there are few records of this louse species from this country (see above).
Song *et al.* (2014) found variation in the mitochondrial minichromosome composition between *Haematopinus suis* and *H. asini*. *Haematopinus suis* is known to harbor a multitude of disease-causing pathogens, such as the swine pox and African swine fever viruses (Doster 1995; Sánchez-Cordón *et al.* 2018). *Haematopinus suis* is known as a vector of *Mycoplasma suis*, the aetiological agent of porcine infectious anaemia, recognized as medically important due its zoonotic potential, (Hu *et al.* 2009; Acosta *et al.* 2019). Although hog lice are not known to bite humans, other vectors, such as ticks, may transmit pathogens from pigs to humans (Wu *et al.* 2006).

***Haematopinus tuberculatus* (Burmeister, 1838)**

Pediculus tuberculatus Burmeister, 1838*: Species 20.
Haematopinus tuberculatus (Burmeister, 1839) [sic]; Lucas 1852: 529, pl. 11: fig. 2.
Pediculus tuberculatus Burmeister, 1839 [sic]; Nitzsch 1864: 32.
Pediculus punctatus Rudow, 1869: 167.
Haematopinus tuberculatus (Burmeister); Giebel 1874: 46.
Haematopinus punctatus (Rudow, 1869); Giebel 1874: 47.
Haematopinus tuberculatus (Burmeister); Piaget 1880: 650, pl. 53: fig. 2.
Haematopinus tuberculatus (Burmeister, 1839) [sic]; Ferris 1933: 455, figs 267–269.
Haematopinus tuberculatus (Burmeister, 1839) [sic]; Ferris 1951: 95, figs 43–44.
Haematopinus tuberculatus (Burmeister, 1839) [sic]; Stimie & van der Merwe 1968: 186, figs 1–2.
Haematopinus tuberculatus; Mustaffa-Babjee 1969: 37.
Haematopinus tuberculatus (Burmeister); Meleney & Kim 1974: 518, figs 19–20, 25, 28, 31.
Haematopinus tuberculatus (Burmeister, 1839) [sic]; Durden & Musser, 1994: 17.
Type host: “*Bos bubalo*” = *Bubalus bubalis* (Linnaeus, 1758)—Asian water buffalo.
Malaysian host: *Bubalus bubalis*.
Malaysian localities: “West Malaysia” (Mustaffa-Babjee (1969); Kota Bharu (Kelantan) Peninsular Malaysia (Ferris 1933); Sungai Sekong (Sabah) Malaysian Borneo (Ferris 1933).
Geographical distribution: Worldwide in subtropical and tropical zones (Durden & Musser 1994; Price & Graham 1997).
Remarks: Ferris (1933, 1951) redescribed and illustrated *Haematopinus tuberculatus*, a louse species originally described from India, now known from the warmer regions of the globe (Durden & Musser 1994). *Haematopinus tuberculatus* mainly infests water buffaloes, but there are reports from camels and other unrelated hosts, which were in close contact with buffaloes (Ferris 1933). Several pathogens have been detected in *Haematopinus tu-*

berculatus, such as *Anaplasma marginale*, *Bartonella* sp., *Brucella abortus* and *Trypanosoma vivax* (see Schäfer da Silva *et al.* 2013; Neglia *et al.* 2013; Promrangsee *et al.* 2019; Gonçalves *et al.* 2020; Hernández-Velasco *et al.* 2020; Souza-Dyonisio *et al.* 2021).

* For clarification of Burmeister's date of publication, see Durden *et al.* (2014) and Palma (2017).

Family HAMOPHTHIRIIDAE Johnson, 1969

Genus *Hamophthirius* Mjöberg, 1925

Total number of species in genus: 1.

Type species: *Hamophthirius galeopitheci* Mjöberg, 1925.

Hosts: Dermoptera: Cynocephalidae.

Distribution: Malaysian Borneo.

Hamophthirius galeopitheci Mjöberg, 1925

Hamophthirius galeopitheci Mjöberg, 1925: 283, fig. 1.

Hamophthirius galeopitheci Mjöberg, 1925; Ferris 1932a: 307, fig. 187.

Hamophthirius galeopitheci Mjöberg, 1925; Ferris 1951: 183.

Hamophthirius galeopitheci Mjöberg, 1925; Johnson 1969: 420, figs 1–12.

Hamophthirius galeopitheci Mjöberg, 1925; Kim & Ludwig 1978: 271.

Hamophthirius galeopitheci Mjöberg, 1925; Durden & Musser 1994: 17.

Type host: “*Galeopithecus* sp.” = *Cynocephalus variegatus* (Audebert, 1799)—Sunda flying lemur.

Malaysian host: *Cynocephalus variegatus*.

Malaysian localities: “Jesselton” = Kota Kinabalu (Sabah) Malaysian Borneo (Johnson 1969); Ranau (Sabah) Malaysian Borneo (Johnson 1969)

Geographical distribution: Southeast Asia (Durden & Musser 1994).

Remarks: Considering the unique morphology of *Hamophthirius galeopitheci*, Mjöberg (1925) was not able to place it in any known family of sucking lice. Johnson (1969) studied new material and was able to redescribe and illustrate the male, the female and two nymphal instars of *H. galeopitheci*, concluding that a new family—Hamophthiriidae—was needed to accommodate this species.

Family HOPOPLEURIDAE Ewing, 1929

Genus *Ancistroplax* Waterson, 1929

Total number of species in genus: 5.

Type species: *Ancistroplax crocidurae* Waterson, 1929.

Hosts: Insectivora (Soricidae).

Distribution: Oriental Region.

Ancistroplax nasuta Johnson, 1964

Ancistroplax nasuta Johnson, 1964: 76, figs 37–40.

Ancistroplax nasuta Johnson, 1964; Durden & Musser 1994: 18.

Type host: “Ground shrew”, “probably either *Suncus* sp. or *Crocidura* sp.” (Johnson 1964).

Malaysian hosts: “Ground shrew”, *Callosciurus prevostii* (Desmarest, 1822), *Maxomys ochraceiventer* (Thomas, 1894) (see Remarks).

Malaysian localities: Ulu Kaingaran, Pampang (Sabah) Malaysian Borneo (Johnson 1964), Mount Brinchang (Pahang) Peninsular Malaysia (Johnson 1964).

Geographical distribution: Malaysia (Durden & Musser 1994; Price & Graham 1997).

Remarks: Johnson (1964) described *Ancistroplax nasuta* from three females, the holotype and two paratypes from

an unidentified ground shrew, but the male and nymphal instars are still unknown. In Malaysia, Madinah *et al.* (2014) reported *A. nasuta* from one Prevost's squirrel (*Callosciurus prevostii*) and from one chestnut-bellied spiny rat (*Maxomys ochraceiventer*). However, considering that all known species of *Ancistroplax* are parasitic on shrews, the records from rodents in Madinah *et al.* (2014) may be the result of sampling contaminations or accidental host switches, but these authors did not discuss the apparent anomaly about their reported hosts of *A. nasuta*.

Genus *Hoplopleura* Enderlein, 1904b

Total number of species in genus: 165.

Type species: *Haematopinus acanthopus* (Burmeister, 1838)*.

Hosts: Rodentia (Muridae—Arvicolinae, Cricetinae, Dendromurinae, Gerbillinae, Murinae, Sigmodontinae—Echimyidae, Octodontidae, Sciuridae); Lagomorpha (Ochotonidae).

Distribution: Cosmopolitan, except Antarctica.

Hoplopleura diaphora Johnson, 1964

Hoplopleura diaphora Johnson, 1964: 75, figs 29–34.

Hoplopleura diaphora Johnson, 1964; Kim 1968: 701.

Hoplopleura diaphora Johnson, 1964; Johnson 1972a: 231, 3, 6–7, 10–11, 15–16, 19.

Hoplopleura diaphora Johnson, 1964; Durden & Musser 1994: 23.

Type host: “*Rattus bowersi*” = *Berylmys bowersi* (Anderson, 1879)—Bower’s white-toothed rat.

Malaysian host: *Berylmys bowersi*.

Malaysian localities: Ulu Langat Forest Reserve (Selangor) Peninsular Malaysia (Johnson 1964, Johnson 1972a);

Fraser’s Hill & Pine Tree Hill (Pahang) Peninsular Malaysia (Johnson 1964); Mount Brinchang (Perak) Peninsular Malaysia (Johnson 1964).

Geographical distribution: Peninsular Malaysia, Vietnam (Durden & Musser 1994; Price & Graham 1997).

Remarks: The adult male and female of *Hoplopleura diaphora* were described and illustrated by Johnson (1964), and Johnson (1972a) described and illustrated all three nymphal stages, and also recorded this louse species from Vietnam. *Hoplopleura diaphora* is morphologically similar to *H. kitti*, and both are considered to be sibling species (Johnson 1972a).

Hoplopleura dissicula Johnson, 1964

Hoplopleura dissicula Johnson, 1964: 72, figs 3, 14, 17–21.

Hoplopleura dissicula Johnson, 1964; Johnson 1972b: 221, figs 10, 22, 27.

Hoplopleura dissicula Johnson, 1964; Durden & Musser 1994: 23.

Hoplopleura dissicula Johnson, 1964; Madinah *et al.* 2014: Appendix 2: 3.

Type host: “*Rattus mulleri*” = *Sundamys muelleri* (Jentink, 1879)—Müller’s giant Sunda rat.

Malaysian host: *Sundamys muelleri*.

Probable Malaysian hosts: *Sundamys infraluteus* (Thomas, 1888), *Leopoldamys sabanus* (Thomas, 1887), *Maxomys whiteheadi* (Thomas, 1894), *Niviventer cremoriventer* (Miller, 1900), *Rattus argentiventer* (Robinson & Kloss, 1916), *Rattus baluensis* (Thomas, 1894), *Rattus rattus* (Linnaeus, 1758) (see Johnson 1964).

Malaysian localities: “Pahang Road”, 35 mi. north of Kuala Lumpur (Selangor) Peninsular Malaysia (Johnson 1964); Ulu Gombak Forest Reserve (Selangor) Peninsular Malaysia (Johnson 1964, Shabrina 1990); Gunung Kinabalu, Ranau, Tenompak & Bundu Tuhan (Sabah) Malaysian Borneo (Johnson 1964); Bukit Lanjan Forest Reserve, Kepong (Selangor) Peninsular Malaysia (Johnson 1972b); Bukit Aup Jubilee Park, Sibu, (Sarawak) Malaysian Borneo (Madinah *et al.* 2014).

Geographical distribution: Malaysia (Durden & Musser 1994; Price & Graham 1997).

Remarks: The adult male and female of *Hoplopleura dissicula* were described and illustrated by Johnson (1964), and Johnson (1972b) described and illustrated the first and second nymphal instars. Durden & Musser (1994) noted that collections at the National Museum of Natural History, Washington, D.C. contain specimens of *H. dissicula* that are labelled as having been collected in Nepal from *Niviventer eha* (Wroughton, 1916), but they did not comment if the data of those collections are likely to be incorrect or not.

Hoplopleura erismata Ferris, 1921

Hoplopleura erismata Ferris, 1921: 113, figs 72B, E, F.
Hoplopleura erismata Ferris, 1921; Hopkins 1949: 459.
Hoplopleura erismata Ferris, 1921; Ferris 1951: 136.
Hoplopleura erismata Ferris, 1921; Johnson 1959: 580, figs 20–21, 24, 26.
Hoplopleura erismata Ferris, 1921; Johnson 1964: 74.
Hoplopleura erismata Ferris, 1921; Kim 1966: 611.
Hoplopleura erismata Ferris, 1921; Mishra 1981: 34.
Hoplopleura erismata Ferris, 1921; Durden & Musser 1994: 24.
Type host: “*Sciurus ferrugineus cinnamomeus*” = *Callosciurus finlaysonii* (Horsfield, 1823)—Finlayson’s squirrel.
Malaysian host: *Callosciurus nigrovittatus* (Horsfield, 1824).
Malaysian locality: Selangor, Peninsular Malaysia (Johnson 1964).
Geographical distribution: Burma, India (Punjab), Malaysia, Nepal, People’s Republic of China (Yunnan Province), Thailand (Durden & Musser 1994; Price & Graham 1997; Zuo *et al.* 2011).
Remarks: The adult male and female of *Hoplopleura erismata* were described by Ferris (1921), with illustrations of plates and male genitalia only. Besides the type host, other hosts of *H. erismata* include *Callosciurus caniceps* (Gray, 1842), *Callosciurus erythraeus* (Pallas, 1779), *Callosciurus inornatus* (Gray, 1867) and *Callosciurus pygerythrus* (Saint Hilaire, 1832), all in the family Sciuridae (Durden & Musser 1994). Johnson (1964) noted that the record published by Ferris (1921) of *H. erismata* from the Asian striped squirrel (*Tamiops* sp.) was most likely a mechanical contamination between hosts, after the specimen arrived in the museum. However, Zuo *et al.* (2011) reported *H. erismata* from all 25 specimens of *Tamiops swinhoei* (Milne-Edwards, 1874) examined for lice in China.

***Hoplopleura kitti* Kim, 1968**

“*Hoplopleura diaphora* Johnson, 1964”: 75. In part.
Hoplopleura kitti Kim, 1968: 701, figs 1–9.
Hoplopleura kitti Kim, 1968; Johnson 1972a: 227, figs 1–2, 4–5, 8–9, 12–14, 17–18.
Hoplopleura kitti Kim, 1968; Durden & Musser 1994: 28.
Type host: “*Rattus berdmorei* Blyth” = *Berylmys berdmorei* (Blyth, 1851)—Small white-toothed rat.
Malaysian host: “*Rattus bowersi*” = *Berylmys bowersi* (Anderson, 1879).
Malaysian locality: “Maxwell’s Hill”, Bukit Larut (Perak) Peninsular Malaysia (Johnson (1972a).
Geographical distribution: Laos, Malaysia, People’s Republic of China (Guizhou and Yunnan Provinces), Thailand ((Durden & Musser 1994; Price & Graham 1997; Guo *et al.* 2004a,b)).
Remarks: Kim (1968) described and illustrated the adult male and female, as well as the second and third nymphal instars of *Hoplopleura kitti*. Johnson (1972a) redescribed and illustrated the adults and all the nymphal instars. Johnson (1972a) identified specimens from Bukit Larut (Perak) as *H. kitti*, which were mistakenly identified as *H. diaphora* by Johnson (1964). This is still the only record of *H. kitti* in Malaysia. Besides the type host and *Berylmys bowersi*, other hosts of *H. kitti* are *Niviventer fulvescens* (Gray, 1847) and *Leopoldamys edwardsi* (Thomas, 1882) (see Guo *et al.* 2004a,b; Durden & Musser 1994).
A molecular study of *Hoplopleura kitti* and *H. akanezumi* Sasa, 1950 by Dong *et al.* (2014a) produced evidence that fragmented mitochondrial genomes were present in two major clades of sucking lice (see also Shao *et al.* 2015, Jiang *et al.* 2013).

***Hoplopleura malaysiana* Ferris, 1921**

Hoplopleura malaysiana Ferris, 1921: 79, figs 44–45.
Ferrisella malaysiana (Ferris, 1921); Ewing 1929: 198.
Hoplopleura malaysiana Ferris, 1921; Ferris 1951: 138.
Hoplopleura malaysiana Ferris, 1921; Johnson 1964: 74, figs 25–28, 35–36.
Hoplopleura malaysiana Ferris, 1921; Durden & Musser 1994: 28.
Type host: “*Rattus vociferans lancavensis*” = *Leopoldamys sabanus* (Thomas, 1887)—Long-tailed giant rat.
Malaysian hosts: *Leopoldamys sabanus*, *Sundamys muelleri* (Jentink, 1879).
Malaysian localities: Langkawi Island, Straits of Malacca (Kedah) Peninsular Malaysia (Ferris 1921, Johnson 1964);

Selangor, Peninsular Malaysia (Johnson 1964).

Geographical distribution: Peninsular Malaysia and its offshore islands (Durden & Musser 1994; Price & Graham 1997).

Remarks: The adult male and female of *Hoplopleura malaysiana* were described by Ferris (1921). Johnson (1964) illustrated the male, the female, the paratergal plates and the male genitalia based on specimens collected from the type host and *Sundamys muelleri*. Johnson (1964) noted that there appeared to be a rigid host specificity between *Hoplopleura malaysiana* and *L. sabanus*.

***Hoplopleura pacifica* Ewing, 1924**

Hoplopleura pacifica Ewing, 1924: 9, figs 1b,c, 2.

“*Hoplopleura oenomydis*”; Ferris 1932b: 121, figs 37a–i, 38a–k, 39. In part.

Hoplopleura pacifica Ewing, 1924; Hopkins 1949: 481.

“*Hoplopleura oenomydis*”; Ferris 1951: 139. In part.

Hoplopleura pacifica Ewing, 1924; Johnson 1959: 577.

Hoplopleura pacifica Ewing, 1924; Johnson 1964: 71, figs 1, 5, 9–11, 15.

Hoplopleura pacifica Ewing, 1924; Voss 1966: 30, figs 1–6.

Hoplopleura pacifica Ewing, 1924; Johnson 1972b: figs 13, 15–17, 19, 26.

Hoplopleura pacifica Ewing, 1924; Kim *et al.* 1986: 112, pl. 32.

Hoplopleura pacifica Ewing, 1924; Durden & Musser 1994: 31.

Hoplopleura pacifica; Chuluun *et al.* 2005: 245.

Hoplopleura pacifica; Paramasvaran *et al.* 2009: 306.

Hoplopleura pacifica; Nur-Syazana *et al.* 2013: 3.

Type host: “*Rattus exulans hawaiiensis* Stone, 1917” = *Rattus exulans* (Peale, 1848)—Polynesian rat.

Malaysian hosts: *Rattus argentiventer* (Robinson & Kloss, 1916), *Rattus exulans*, *Rattus norvegicus* (Berkenhout, 1769), *Rattus rattus* (Linnaeus, 1758), *Rattus tiomanicus* (Miller, 1900).

Malaysian localities: Pulau Jarak Island (Perak) Peninsular Malaysia (Johnson 1964); Selangor, Peninsular Malaysia (Johnson 1964); Sarawak, Malaysian Borneo (Johnson 1972b); Kuala Selangor Nature Park (Selangor) Peninsular Malaysia (Chuluun *et al.* 2005); Chow Kit, Datuk Keramat, Jinjang, Kepong & Setapak (Kuala Lumpur) Peninsular Malaysia (Paramasvaran *et al.* 2009); Carey Island (Selangor) Peninsular Malaysia (Nur-Syazana *et al.* 2013); Serdang, Sepang, Rembau & Seremban, (Negeri Sembilan) Peninsular Malaysia (Mohd-Said *et al.* 2014).

Geographical distribution: Tropical, subtropical and temperate regions (Durden & Musser 1994; Price & Graham 1997).

Remarks: The adult male and female of *Hoplopleura pacifica* were described and partially illustrated by Ewing (1924). Ferris (1932b) considered that *Hoplopleura pacifica* had no significant morphological differences from *Hoplopleura oenomydis* and, therefore, synonymised the former species under *H. oenomydis*. Considering their different hosts, Hopkins (1949) doubted that *H. pacifica* was a junior synonym of *H. oenomydis*. Later, based on a morphological and size analysis, Johnson (1964) resurrected *H. pacifica* as a valid species different from *H. oenomydis*. Voss (1966) designated, described and illustrated a lectotype for *H. pacifica*.

In Malaysia, *H. pacifica* was collected in large numbers from several subspecies of *Rattus rattus* in the states of Negeri Sembilan, Selangor, Perak and Sarawak. In some localities, *Hoplopleura pacifica* has been recorded co-infesting rats with *Polyplax spinulosa* (Chuluun *et al.* 2005; Paramasvaran *et al.* 2009; Nur-Syazana *et al.* 2013).

***Hoplopleura pectinata* (Cummings, 1913)**

Polyplax pectinata Cummings, 1913: 35.

Polyplax pectinata Cummings, 1913; Ferris 1916: 174.

Hoplopleura pectinata (Cummings, 1913); Ferris 1916: 205.

Hoplopleura pectinata (Cummings, 1913); Ferris 1921: 99, figs 61–62.

Ctenura pectinata (Cummings, 1913); Ewing 1929: 199.

Hoplopleura pectinata (Cummings, 1913); Ferris 1932a: 282.

Hoplopleura pectinata (Cummings, 1913); Ferris 1951: 142.

Hoplopleura pectinata (Cummings, 1913); Johnson 1964: 74.

Hoplopleura pectinata (Cummings, 1913); Johnson 1972b: 226, figs 8, 24, 28.

Hoplopleura pectinata (Cummings, 1913); Durden & Musser 1994: 32.

Type host: “*Epymis surifer* Miller, 1900” = *Maxomys surifer* (Miller, 1900)—Red spiny rat.

Malaysian hosts: *Maxomys alticola* (Thomas, 1888); *Maxomys rajah* (Thomas, 1894), *Maxomys whiteheadi* (Thomas, 1894), *Niviventer cremoriventer* (Miller, 1900), *Niviventer niviventer* (Hodgson, 1836), *Niviventer rapit* (Bonhote, 1903).

Malaysian localities: States of Kedah, Pahang, Perak, Selangor & Terengganu, Peninsular Malaysia (Johnson 1964); Gunung Kinabalu & Ranau (Sabah) Malaysian Borneo (Johnson 1964); Kuala Selangor Nature Park (Selangor) Peninsular Malaysia (Chuluun *et al.* 2005).

Geographical distribution: Borneo, Peninsular Malaysia, Thailand (Durden & Musser 1994; Price & Graham 1997).

Remarks: The adult male and female of *Hoplopleura pectinata* were redescribed and illustrated by Ferris (1921). Johnson (1972b) described and illustrated the second and third nymphal instars. The type locality of *Hoplopleura pectinata* was given as “Malay Peninsula: Bisera, Jalor” by Cummings (1913) and Ferris (1921). Durden & Musser (1994) also stated Bisera, Jalor as being in “Peninsular Malaysia”, but this is incorrect because Jalor is in Thailand. Johnson (1964) commented that most hosts of *H. pectinata* were likely natural, but there were also some “scattered specimens from other *Rattus* species” due to contaminations. Notwithstanding the several species of *Niviventer* listed as hosts of many specimens of *H. pectinata* by Johnson (1964), Durden & Musser (1994) only listed four species of *Maxomys* as “Principal hosts”, but none of *Niviventer*.

***Hoplopleura sicata* Johnson, 1964**

Hoplopleura sicata Johnson, 1964: 73, figs 13, 16, 22–24.

Hoplopleura sicata Johnson, 1964; Johnson 1972b: 221, figs 3, 5, 11–12, 21, 25.

Hoplopleura sicata Johnson, 1964; Mishra 1981: 59, figs 125–132.

Hoplopleura sicata Johnson, 1964; Durden & Musser 1994: 34.

Type host: “*Rattus cremoriventer*” = *Niviventer cremoriventer* (Miller, 1900)—Dark-tailed tree rat.

Malaysian host: *Niviventer cremoriventer*.

Malaysian localities: Tenompak, Gunung Kinabalu, Ulu Kaingaran, Pampang & Ranau (Sabah) Malaysian Borneo (Johnson 1964).

Geographical distribution: India (Jammu & Kashmir, Sikkim, West Bengal States), Laos, Malaysian Borneo, Nepal (Mishra 1981; Durden & Musser 1994; Price & Graham 1997).

Remarks: The adult male and female of *Hoplopleura sicata* were described and illustrated by Johnson (1964).

Johnson (1972) described and illustrated all three nymphal instars. To date, the original description is the only record of *Hoplopleura sicata* in Malaysia. Apart from Malaysian Borneo, *H. sicata* has been found on a number of other species of *Niviventer* and *Rattus* from India, Laos and Nepal (Johnson 1972b; Mishra 1981; Durden & Musser 1994).

Family LINOGNATHIDAE Webb, 1946

Genus *Linognathus* Enderlein, 1905

Total number of species in genus: 53.

Type species: *Linognathus setosus* (von Olfers, 1816).

Hosts: Artiodactyla (Bovidae, Cervidae, Giraffidae); Carnivora (Canidae).

Distribution: Cosmopolitan except Antarctica.

***Linognathus africanus* Kellogg & Paine, 1911**

Linognathus africanus Kellogg & Paine, 1911: 146, pl. 4: figs 1, 5.

“*Linognathus stenopsis*”; Ferris 1916: 165. In part.

“*Linognathus stenopsis*”; Bedford 1927: 737. In part.

Linognathus africanus Kellogg & Paine, 1911; Ferris 1932a: 353, figs 212B,E,G–213.
Linognathus africanus Kellogg & Paine, 1911; Ferris 1951: 225, figs 97–98.
Linognathus africanus; Mustaffa-Babjee 1969: 37.
Linognathus africanus Kellogg & Paine, 1911; Kim *et al.* 1986: 124, pl. 37.
Linognathus africanus Kellogg & Paine, 1911; Durden & Musser 1994: 38.
Type host: “Sheep” = *Ovis aries* Linnaeus, 1758.
Malaysian host: *Capra hircus* Linnaeus, 1758.
Malaysian locality: “West Malaysia” (Mustaffa-Babjee 1969); Kelantan, Peninsular Malaysia (Vivi-Susantie *et al.* 2020).
Geographical distribution: Cosmopolitan, in temperate, subtropical and tropical regions (Durden & Musser 1994; Price & Graham 1997).
Remarks: The adult male and female of *Linognathus africanus* were redescribed and illustrated by Ferris (1932a, 1951). *Linognathus africanus* is a common parasite of goats and sheep (Durden & Musser 1994), but there are also reports of massive infestations on deer (*Odocoileus hemionus* and *O. virginianus*) in North America (Brunetti & Cribbs 1971; Foreyt *et al.* 1986). It is of great concern that *L. africanus* is poorly documented in Malaysia (Vivi-Susantie *et al.*, 2020) because life-threatening pathogens, such as *Rickettsia*, have been reported in this louse species (Ehlers *et al.* 2019).

***Linognathus setosus* (von Olfers, 1816)**

Pediculus setosus von Olfers, 1816: 80.
Pediculus piliferus Burmeister, 1838*: Species 13.
Haematopinus piliferous [sic] (Burmeister); Denny 1842: 28, pl. 25: fig. 4.
Haematopinus bicolor Lucas, 1847: 538, pl. 9: fig. 2a.
Pediculus isopus Nitzsch [in Giebel], 1861: 290.
Pediculus flavidus Nitzsch, 1864: 27.
Haematopinus piliferus (Burmeister, 1839) [sic]; Giebel 1874: 40.
Haematopinus piliferus (Burmeister, 1838); Piaget 1880: 643, pl. 52: fig. 6.
Haematopinus piliferus (Burmeister, 1838); Osborn 1896: 169, fig. 98.
Trichaulus piliferus (Burmeister, 1838); Enderlein 1904a: 142.
Linognathus piliferus (Burmeister, 1838); Enderlein 1905: 194.
Linognathus piliferus (Burmeister, 1838); Mjöberg 1910: 157, fig. 77.
Linognathus setosus (von Olfers, 1816); Ferris 1916: 205.
Linognathus piliferus (Burmeister, 1838); Ewing 1929: 39, fig. 75.
Linognathus setosus (von Olfers, 1816); Ferris 1932: 340, figs 206–207, 216E.
Linognathus setosus (von Olfers, 1816); Ferris 1951: 235, figs 103–104.
Linognathus setosus (von Olfers, 1816); Kim *et al.* 1986: 130, pl. 40.
Linognathus setosus (von Olfers, 1816); Durden & Musser, 1994: 42.
Type host: *Canis lupus familiaris* Linnaeus, 1758—Domestic dog.
Malaysian host: *Felis catus* Linnaeus, 1758 (see Remarks).
Malaysian locality: Not given (Collela *et al.* 2020).

Geographical distribution: Cosmopolitan (Durden & Musser 1994; Price & Graham 1997).

Remarks: The adult male and female of *L. setosus* were redescribed and illustrated by Ferris (1932a). In Malaysia, Colella *et al.* (2020) recorded *Linognathus setosus* from approximately 21 out of 1152 cats examined (1.8% relative frequency), but the authors did not discuss the unusual occurrence of this louse on cats, given that *L. setosus* was known as a specific parasite of domestic dogs and other canines (Durden & Musser 1994). Unlike *Heterodoxus spiniger* (Enderlein, 1909), which some regarded as a general “carnivore” louse (Colless 1959; Price & Graham 1997; Norhidayu *et al.* 2012), the occurrence of *L. setosus* from domestic cats is most likely erroneous.

***Linognathus vituli* (Linnaeus, 1758)**

Pediculus vituli Linnaeus, 1758: 611.
Pediculus tenuirostris Burmeister, 1838*: Species 17.
Haematopinus vituli (Linnaeus, 1758); Denny 1842: 31, pl. 25: fig. 3.
Pediculus oxyrrhynchus Nitzsch, 1864: 21.
Haematopinus tenuirostris (Burmeister, 1838); Giebel 1874: 43, pl. 2: fig. 9.
Haematopinus vituli (Linnaeus, 1758); Osborn 1896: 176, fig. 101.
Trichaulus vituli (Linnaeus, 1758); Enderlein 1904a: 142.
Linognathus vituli (Linnaeus, 1758); Enderlein 1905: 194.
Linognathus vituli (Linnaeus, 1758); Ferris 1916: 166.
Linognathus vituli (Linnaeus, 1758); Ferris 1932a: 356, figs 214–215, 216C.
Linognathus vituli (Linnaeus, 1758); Ferris 1951: 241, figs 107–108.
Linognathus vituli; Mustaffa-Babjee 1969: 37.
Linognathella vituli (Linnaeus, 1758); Ribbeck 1972: 72.
Linognathus vituli (Linnaeus, 1758); Kim *et al.* 1986: 134, pl. 42.
Linognathus vituli (Linnaeus, 1758); Durden & Musser 1994: 44.
Type host: *Bos taurus* Linnaeus, 1758—Domestic cattle.
Malaysian host: *Bos taurus*.
Malaysian locality: “West Malaysia” (Mustaffa-Babjee 1969).
Geographical distribution: Cosmopolitan, except Antarctica (Durden & Musser 1994; Price & Graham 1997).
Remarks: The adult male and female of *Linognathus vituli* were redescribed and illustrated by Ferris (1932a, 1951) and Kim *et al.* (1986). Studies of *L. vituli* in Malaysia are lacking, with only one record (Mustaffa-Babjee 1969). Considering that *Anaplasma marginale*, *A. ovis*, *Rickettsia helvetica* and *Theileria orientalis* were detected in *L. vituli* (see Hornok *et al.* 2010; Emery *et al.* 2021), surveys and studies are needed to establish levels of parasitism and to apply control methods where necessary.
* For clarification of Burmeister’s date of publication, see Durden *et al.* (2014) and Palma (2017).

Family PEDICINIDAE Enderlein, 1904a

Genus *Pedicinus* Gervais, 1844

Total number of species in genus: 19.
Type species: *Pedicinus eurygaster* (Burmeister, 1838)*.
Hosts: Primates (Cercopithecidae).
Distribution: Afrotropical, Australasian, Oriental, and Palearctic Regions.

Pedicinus ancoratus Ferris, 1934

Pedicinus ancoratus Ferris, 1934: 516, figs 299, 300A–F, H–I.
Pedicinus (Neopedicinus) ancoratus Ferris, 1934; Kuhn & Ludwig 1967: 182, figs 29–36.
Pedicinus ancoratus Ferris, 1934; Durden & Musser 1994: 47.
Pedicinus ancoratus Ferris, 1934; Durden *et al.* 2020: 227.
Type host: “*Presbytis pullata* Thomas & Wroughton 1909” = *Trachypithecus cristatus* (Raffles, 1821).
Malaysian host: *Trachypithecus selangorensis* Roos, Nadler & Walter, 2008.
Malaysian locality: Kuala Lumpur, Peninsular Malaysia (Kuhn & Ludwig 1967).
Geographical distribution: Borneo, India (Jammu State, Kashmir State), Indonesia (Sumatra), Malaysia, People’s Republic of China (Jiangsu Province), Sri Lanka, Thailand (Durden & Musser 1994; Price & Graham 1997).
Remarks: The adult male and female of *Pedicinus ancoratus* were described and illustrated by Ferris (1934) and redescribed by Kuhn & Ludwig (1967). Ferris (1934) and Durden & Musser (1994) listed other cercopithecid hosts of *P. ancoratus*. There is only one record of *P. ancoratus* (six males, ten females and seven larvae) removed from a Selangor silvered langur in a Kuala Lumpur pet shop (Kuhn & Ludwig 1967). Mey (2010) commented that *Pedicinus ancoratus* was a member of a species group consisting of *P. tongkinensis* Mey, 1994, *P. atratulus* Mey, 1994 and *P. curtipenitus* Mey, 2010.

Family POLYPLACIDAE Fahrenholz, 1912a

Genus *Neohaematopinus* Mjöberg, 1910

Total number of species in genus: 31.

Type species: *Neohaematopinus sciuropteri* (Osborn, 1891).

Hosts: Rodentia (Sciuridae, Muridae—Sigmodontinae).

Distribution: Holarctic, Oriental and Neotropical Regions.

Neohaematopinus callosciuri Johnson, 1959

Neohaematopinus callosciuri Johnson, 1959: 581, figs 27–28, 34b, 35c, 42–43.

Neohaematopinus callosciuri Johnson, 1959; Johnson 1964: 78, figs 43A–E.

Neohaematopinus callosciuri Johnson, 1959; Kim 1971: 51, figs 6–8.

Neohaematopinus callosciuri Johnson, 1959; Durden & Musser 1994: 61.

Type host: *Callosciurus finlaysoni* (Horsfield, 1823)—Finlayson's squirrel.

Malaysian hosts: *Callosciurus caniceps* (Gray, 1842), *Callosciurus nigrovittatus* (Horsfield, 1824), *Callosciurus notatus* (Boddaert, 1785), *Callosciurus prevostii* (Desmarest, 1822), *Glyphotes simus* Thomas, 1898, *Lariscus insignis* (Cuvier, 1821), *Sundasciurus tenuis* (Horsfield, 1824).

Malaysian localities: Ranau & Gunung Kinabalu (Sabah) Malaysian Borneo (Johnson 1959, 1964); Perak & Selangor, Peninsular Malaysia (Johnson 1964); “Malaysia” (Madinah *et al.* 2014).

Geographical distribution: Borneo, Japan, Malaysia, People’s Republic of China (Yunnan Province), Taiwan, Thailand (Durden & Musser 1994; Price & Graham 1997; Shinozaki *et al.* 2004; Zuo *et al.* 2011).

Remarks: The adult male and female of *Neohaematopinus callosciuri* were described and illustrated by Johnson (1959), and Kim (1971) described and illustrated the three nymphal instars. Madinah *et al.* (2014) recorded seven specimens of *N. callosciuri* from *Callosciurus notatus* from Malaysia, without specifying the exact location. Zuo *et al.* (2011) reported *N. callosciuri* from 187 of 191 specimens of *Callosciurus erythraeus* (Pallas, 1779) examined for lice in China. Shinozaki *et al.* (2004) reported the human introduction of *N. callosciuri* to Japan with *C. erythraeus*.

Neohaematopinus capitaneus Johnson, 1959

Neohaematopinus capitaneus Johnson, 1959: 587, figs 45–47, 50, 56–57, 60.

Neohaematopinus capitaneus Johnson, 1959; Durden & Musser 1994: 61.

Type host: *Hylopetes phayrei* (Blyth, 1849)—Indochinese flying squirrel.

Malaysian host: *Hylopetes spadiceus* (Blyth, 1847).

Malaysian localities: Labis & Paloh Forest Reserves (Johor) Peninsular Malaysia; “Maxwell’s Hill”, Bukit Larut (Perak) Peninsular Malaysia.

Geographical distribution: Malaysia, Thailand (Durden & Musser 1994; Price & Graham 1997).

Remarks: The adult male and female of *Neohaematopinus capitaneus* were described and illustrated by Johnson (1959). Voucher specimens of Malaysian records are held in the collection of the Smithsonian National Museum of Natural History, Washington D.C.

Neohaematopinus cognatus Johnson, 1959

Neohaematopinus cognatus Johnson, 1959: 583, figs 35a, 35d, 39, 44.

Neohaematopinus cognatus Johnson, 1959; Johnson 1964: 78.

Neohaematopinus cognatus Johnson, 1959; Durden & Musser 1994: 62.

Type host: *Menetes berdmorei* Blyth, 1849—Berdmore’s ground squirrel.

Malaysian hosts: *Exilisciurus whiteheadi* (Thomas 1887), *Sundasciurus everetti* (Thomas 1890), *Sundasciurus jentinki* (Thomas 1887).

Malaysian localities: Gunung Kinabalu & Gunung Trusmadi (Sabah) Malaysian Borneo (Johnson 1964).

Geographical distribution: Malaysia, Thailand (Durden & Musser 1994; Price & Graham 1997).

Remarks: The adult male and female of *Neohaematopinus cognatus* were described and illustrated by Johnson (1959). Johnson (1964) stated that *Sundasciurus everetti* [as *Dremomys everetti*] in Borneo may be an ecologi-

cal “replacement” for *Menetes berdmorei* which is only found in Thailand, and that *S. everetti* may be a secondary host of *N. cognatus*. Also, Johnson (1964) noted a difference between the enlarged dorsal seta of the basal antennal segment of lice from *Exilisciurus whitehadi* and *Sundasciurus jentinki* and those from typical Thai specimens but, due to the small number of specimens available from these two hosts, it could not be decided if that difference was significant.

***Neohaematopinus elbeli* Johnson, 1959**

Neohaematopinus elbeli Johnson, 1959: 592, figs 64–68.

Neohaematopinus elbeli Johnson, 1959; Johnson 1964: 79.

Neohaematopinus elbeli Johnson, 1959; Durden & Musser 1994: 62.

Type host: *Dremomys rufigenis* (Blanford, 1878)—Asian red-cheeked squirrel.

Malaysian host: *Dremomys rufigenis*.

Malaysian locality: Gunung Batu Brinchang (Pahang) Peninsular Malaysia (Johnson 1964).

Geographical distribution: Malaysia, People’s Republic of China (Yunnan Province), Taiwan, Thailand (Durden & Musser 1994; Price & Graham 1997; Zuo *et al.* 2011).

Remarks: The adult male and female of *Neohaematopinus elbeli* were described and illustrated by Johnson (1959).

The only record of this louse species in Malaysia was published by Johnson (1964). Zuo *et al.* (2011) reported *N. elbeli* from one specimen of *Dremomys pernyi* (Milne-Edwards, 1867) examined for lice in China.

***Neohaematopinus kinabalensis* Johnson, 1959**

Neohaematopinus kinabalensis Johnson, 1959: 589, figs 48, 51, 55, 61–63.

Neohaematopinus kinabalensis Johnson, 1959; Johnson 1964: 79.

Neohaematopinus kinabalensis Johnson, 1959; Durden & Musser 1994: 62.

Type host: “*Hylopetes sagitta harrisoni*” = *Hylopetes sagitta* (Linnaeus, 1766)—Grey-cheeked flying squirrel.

Malaysian host: *Hylopetes sagitta*.

Malaysian locality: Tenompak Gunung Kinabalu (Sabah) Malaysian Borneo (Johnson 1959, 1964).

Geographical distribution: Malaysia, Thailand (Durden & Musser 1994; Price & Graham 1997).

Remarks: The adult male and female of *Neohaematopinus kinabalensis* were described and illustrated by Johnson (1959). The original description is the only record of this louse species in Malaysia.

***Neohaematopinus pallidus* Johnson, 1964**

Neohaematopinus pallidus Johnson, 1964: 80, figs 49, 52–53, 55, 59–60, 62, 65.

Neohaematopinus pallidus Johnson, 1964; Durden & Musser 1994: 63.

Type host: “*Petaurista taylori*” = *Petaurista petaurista* (Pallas, 1766)—Red giant flying squirrel.

Malaysian host: *Petaurista petaurista*.

Malaysian localities: “Pahang Road”, 17th mile (Selangor) Peninsular Malaysia (Johnson 1964); Ulu Gombak Forest Reserve (Selangor) Peninsular Malaysia (Shabrina 1990).

Geographical distribution: Malaysia, Thailand (Durden & Musser 1994; Price & Graham 1997).

Remark: The adult male and female of *Neohaematopinus pallidus* were described and illustrated by Johnson (1964).

***Neohaematopinus pansus* Johnson, 1964**

Neohaematopinus pansus Johnson, 1964: 79, figs, 41A, 42, 44–46.

Neohaematopinus pansus Johnson, 1964; Durden & Musser 1994: 63.

Type host: *Petaurillus hosei* (Thomas 1900)—Hose’s pygmy flying squirrel.

Malaysian hosts: *Petaurillus hosei*; *Petinomys vordermanni* (Jentink, 1890).

Malaysian localities: Ulu Gombak Forest Reserve (Selangor) Peninsular Malaysia; Ranau (Sabah) Malaysian Borneo (Johnson 1964).

Geographical distribution: Malaysia (Durden & Musser 1994; Price & Graham 1997).

Remarks: The adult female of *Neohaematopinus pansus* was described and illustrated by Johnson (1964), and the male is still unknown. Voucher specimens from Ulu Gombak are held in Smithsonian National Museum of Natural History, Washington D.C.

***Neohaematopinus robustus* Johnson, 1964**

Neohaematopinus robustus Johnson, 1964: 80, figs 47–48, 50, 56–57, 66.

Neohaematopinus robustus Johnson, 1964; Durden & Musser 1994: 63.

Type host: “*Petaurista elegans punctatus*” = *Petaurista elegans* (Müller, 1840)—Spotted giant flying squirrel.

Malaysian host: *Petaurista elegans*.

Malaysian locality: Gunung Batu Brinchang (Pahang) Peninsular Malaysia (Johnson 1964).

Geographical distribution: Malaysia (Durden & Musser 1994; Price & Graham 1997).

Remarks: The adult male and female of *Neohaematopinus robustus* were described and illustrated by Johnson (1964).

Genus *Polyplax* Enderlein, 1904a

Total number of species in genus: 81.

Type species: *Polyplax spinulosa* (Burmeister, 1838).

Hosts: Rodentia (Muridae—Arvicolinae, Calomyscinae, Cricetinae, Cricetomyinae, Dendromurinae, Gerbillinae, Murinae, Mystromyinae, Nesomyinae, Otomyinae, Rhizomyinae, Sigmodontinae—Sciuridae); Insectivora (Soricidae).

Distribution: Cosmopolitan.

***Polyplax insulsa* Ferris, 1923**

Polyplax insulsa Ferris, 1923: 231, figs 151, 152A–C.

Ahaematopinus insulsus (Ferris, 1923): Ewing 1929: 198.

Polyplax insulsa Ferris, 1923; Ferris 1951: 208.

Polyplax insulsa Ferris, 1923; Johnson 1958: 77.

Polyplax insulsa Ferris, 1923; Johnson 1964: 84.

Polyplax insulsa Ferris, 1923; Durden & Musser 1994: 69.

Type host: “*Epymis sabanus*” = *Leopoldamys sabanus* (Thomas, 1887)—Long-tailed giant rat.

Malaysian host: *Leopoldamys sabanus*. Probable host: *Sundamys muelleri* (Jentink, 1879).

Malaysian localities: Ulu Gombak Forest Reserve & Bukit Lanjan Forest Reserve (Selangor) Peninsular Malaysia (Johnson 1964); Kuala Lumpur, Peninsular Malaysia (Johnson 1964); Terengganu, Peninsular Malaysia (Johnson 1964).

Geographical distribution: Indonesia (Natuna Islands), Malaysia, People’s Republic of China (Guizhou Province) (Durden & Musser 1994; Price & Graham 1997).

Remarks: The adult male and female of *Polyplax insulsa* were described and illustrated by Ferris (1923). *Polyplax insulsa* mainly infests members of the subfamily Murinae and has a patchy distribution in the Indo-Malayan Region (Chin 1980; Durden & Musser 1994). A single female of *P. insulsa* recorded from *Sundamys muelleri* in Kuala Lumpur may be a straggler (Johnson 1964).

***Polyplax reclinata* (Nitzsch, 1864)**

Pediculus reclinatus Nitzsch, 1864: 23.

Haematopinus reclinatus (Nitzsch, 1864); Giebel 1874: 37.

Haematopinus reclinatus (Nitzsch, 1864); Piaget 1880: 639.

Polyplax reclinata (Nitzsch, 1864); Enderlein 1904a: 142.

Hoplopleura reclinata (Nitzsch, 1864); Enderlein 1904b: 222.

Haematopinus (Polyplax) spiniger reclinatus (Nitzsch); Neumann 1909: 524.

Polyplax reclinata (Nitzsch, 1864); Fahrenholz 1912a: 37, figs 11–12, pl. 1: figs 12–14, pl. 2: figs 1–4, pl. 3: fig. 7.

Polyplax reclinata (Nitzsch, 1864); Ferris 1923: 192, figs 120C, G.

Polyplax reclinata leucodontis Jancke, 1932: 525, fig. 2b.

Polyplax reclinata reclinata (Nitzsch); Jancke 1932: 525, fig. 2a.

Polyplax reclinata (Nitzsch); Fahrenholz 1938: 254, figs 9–11.

Polyplax deltoides Fahrenholz, 1938: 256, figs 12, 23d.

Polyplax reclinata leucodontis Jancke; Fahrenholz 1938: 256.

Polyplax deltoides Fahrenholz, 1938; Ferris 1951: 207.

Polyplax reclinata (Nitzsch, 1864); Ferris 1951: 210.
Polyplax shimizui Kaneko, 1957: 271, fig. 2.
Polyplax reclinata (Nitzsch, 1864); Johnson 1960: 55.

Polyplax reclinata (Nitzsch, 1864); Johnson 1964: 83.
Polyplax reclinata (Nitzsch, 1864); Beaucournu & Houin 1967: 67, figs 1–6.

Polyplax reclinata (Nitzsch); Benoit 1969: 102, fig. 7.
Polyplax reclinata (Nitzsch); Kim 1971: 51, figs 11–13.

Polyplax reclinata (Nitzsch); Mishra 1981: 98, figs 223–225.
Polyplax reclinata (Nitzsch); Durden & Musser 1994: 72.

Type host: *Sorex araneus* Linnaeus, 1758—Common shrew

Malaysian host: *Suncus murinus* (Linnaeus, 1766).

Malaysian locality: Kuala Lumpur & Selangor, Peninsular Malaysia (Johnson 1964).

Geographical distribution: Africa, Eurasia (Durden & Musser 1994; Price & Graham 1997).

Remarks: *Polyplax reclinata* has been reported and redescribed by several authors (see synonymy above) and is regarded as polytypic (Beaucournu & Houin 1967; Kim & Emerson 1974). Johnson (1960, 1964) discussed the morphological variation of *P. reclinata* and provided a list of synonyms. Beaucournu & Houin (1967) discussed and illustrated in detail the diverse morphology of *P. reclinata* from various hosts. Kim (1971) described and illustrated the three nymphal instars of *P. reclinata*. This louse is known to infest a wide range of species of the genera *Crocidura*, *Neomys*, *Scutisorex*, *Sorex*, *Suncus* and *Sylvisorex* in the family Soricidae (Kim & Emerson 1974; Durden & Musser 1994). The known host species of *P. reclinata* were listed by Durden & Musser (1994), noting that future studies may even expand the number of hosts.

***Polyplax serrata* (Burmeister, 1838)**

Pediculus serratus Burmeister, 1838*: Species 6.

Haematopinus serratus; Denny 1842: 36.

Polyplax serrata (Burmeister, 1838); Enderlein 1904a: 142.

“*Polyplax affinis* (Burm.)”; Fahrenholz 1912a: 39, figs 13–15. Not *Polyplax affinis* Burmeister, 1838

Polyplax serrata (Burmeister, 1839) [sic]; Ferris 1923: 191, figs 120B, E.

Polyplax serrata (Burmeister); Jancke 1932: 252.

Polyplax affinis Fahrenholz, 1938: 261.

Polyplax serrata (Burmeister, 1839) [sic]; Ferris 1951: 210.

Polyplax serrata (Burmeister, 1839) [sic]; Wegner 1974: 203, figs 1–6.

Polyplax serrata (Burmeister, 1839) [sic]; Mishra 1981: 101, figs 226–228, 232–234.

Polyplax serrata (Burmeister, 1839) [sic]; Kim *et al.* 1986: 204, pl. 74.

Polyplax serrata (Burmeister, 1839) [sic]; Durden & Musser 1994: 73.

Polyplax serrata (Burmeister, 1838); Durden *et al.* 2014: 258.

Polyplax serrata (Burmeister, 1838); Palma 2017: 243, figs 210–211.

Type host: *Mus musculus* Linnaeus, 1758—House mouse.

Malaysian host: “Rats”.

Malaysian localities: Negeri Sembilan & Selangor, Peninsular Malaysia (Mohd-Said *et al.* 2014).

Geographical distribution: Cosmopolitan except Antarctica (Durden & Musser 1994; Price & Graham 1997).

Remarks: The adult male and female of *Polyplax serrata* were illustrated by Kim *et al.* (1986), and Wegner (1974) made a detailed analysis of the morphological variation of *P. serrata* from several hosts. Mohd-Said *et al.* (2014) collected *Polyplax serrata* from unidentified rats in Selangor and Negeri Sembilan, but the authors noted that *Rattus tiomanicus* was the most dominant species in the collecting areas. Considering that *P. serrata* is mainly infests mice of the genus *Apodemus* and the house mouse (Durden & Musser 1994), the Malaysian records are likely to be stragglers.

* For clarification of Burmeister’s date of publication, see Durden *et al.* (2014) and Palma (2017).

***Polyplax spinulosa* (Burmeister, 1838)**

Pediculus spinulosus Burmeister, 1838*: Species 8.

Haematopinus spinulosus (Burmeister); Denny 1842: 26, pl. 24: fig. 5.

Haematopinus spiniger (Burmeister); Denny 1842: 27, pl. 24: fig. 6.
Pediculus denticulatus Nitzsch, 1864: 24.
Haematopinus spinulosus (Burmeister, 1839) [sic]; Giebel 1874: 38, pl. 1: fig. 7.
Haematopinus spinulosus (Burmeister); Piaget 1880: 636, pl. 52: fig. 2.
Haematopinus spinulosus (Burmeister); Osborn 1896: 181.
Polyplax spinulosa (Burmeister, 1838); Enderlein 1904a: 142.
Polyplax spinulosa (Burmeister); Enderlein 1905: 192, figs 1–4.
Haematopinus (Polyplax) spinulosus (Burmeister); Neumann 1909: 526, fig. 26.
Polyplax spinulosa (Burmeister); Fahrenholz 1912a: 30, figs 8–10, pl. 2: figs 8–13.
Polyplax spinulosa (Burmeister); Cummings 1915: 256, 268, figs 7, 15, 16.
Polyplax spinulosa (Burmeister, 1839) [sic]; Ferris 1923: 187, figs 119, 120A, D, F, H.
Polyplax spinulosa (Burmeister, 1838); Fahrenholz 1938: 249, figs 1–8, 23c.
Polyplax spinulosa (Burmeister, 1839) [sic]; Ferris 1951: 211.
Polyplax spinulosa (Burmeister, 1839) [sic]; Johnson 1964: 83.
Polyplax spinulosa (Burmeister, 1839) [sic]; Mishra 1981: 103, figs 229–231.
Polyplax spinulosa (Burmeister, 1839) [sic]; Durden & Musser 1994: 73.
Polyplax spinulosa; Chuluun *et al.* 2005: 245.
Polyplax spinulosa; Paramasvaran *et al.* 2009: 306.
Polyplax spinulosa; Nur-Syazana *et al.* 2013: 3.
Polyplax spinulosa (Burmeister, 1838); Palma 2017: 243.
Type host: *Rattus norvegicus* (Berkenhout, 1769)—Brown rat.
Malaysian hosts: *Leopoldamys edwardsi* (Thomas, 1882), *Leopoldamys sabanus* (Thomas, 1887), *Maxomys whiteheadi* Thomas, 1894), *Rattus argentiventer* (Robinson & Kloss, 1916), *Rattus exulans* (Peale, 1848), *Rattus norvegicus*, *Rattus rattus* (Linnaeus, 1758), *Rattus tiomanicus* (Miller, 1900).
Malaysian localities: Ulu Muda Forest Reserve (Kedah) Peninsular Malaysia (Mariana *et al.* 2008); Chow Kit, Datuk Keramat, Jinjang, Kepong & Setapak (Kuala Lumpur) Peninsular Malaysia (Johnson 1964, Paramasvaran *et al.* 2009); Port Dickson, Seremban & Rembau (Negeri Sembilan) Peninsular Malaysia (Mohd-Said *et al.* 2014); Kuantan & Pulau Tioman (Pahang) Peninsular Malaysia (Ferris 1923, Johnson 1964); Perak, Peninsular Malaysia (Johnson 1964); Pulau Pinang, Peninsular Malaysia (Nur-Syazana *et al.* 2013); Bukit Lajan Forest Reserve, Carey Island, Kuala Selangor Nature Park, Sepang, Serdang, Tanjung Karang & Ulu Gombak Forest Reserve (Selangor) Peninsular Malaysia (Johnson 1964; Chuluun *et al.* 2005, Paramasvaran *et al.* 2009, Nur-Syazana *et al.* 2013); Gunung Kinabalu (Sabah) Malaysian Borneo (Johnson 1964).
Geographical distribution: Cosmopolitan except Antarctica (Durden & Musser 1994; Price & Graham 1997; Wang *et al.* 2020).
Remarks: The adult male and female of *Polyplax spinulosa* have been redescribed and/or illustrated by several authors (see synonymy above). In Malaysia, *P. spinulosa* has been collected from rodents living in forest, island, coastal and urban habitats, showing the capability of this species to infest new hosts (Paramasvaran *et al.* 2009; Nur-Syazana *et al.* 2013). This is further demonstrated by Wang *et al.* (2020) in Australia, where the introduced *P. spinulosa* has expanded its host range by infesting several endemic rodent species. Chuluun *et al.* (2005) reported *P. spinulosa* from *Maxomys whiteheadi* in Selangor, but did not discuss that the host was new for this louse (see Durden & Musser 1994). Despite the many literature reports of *P. spinulosa* in Malaysia, its ecology and its interaction with hosts and pathogens are still poorly known (e.g. Dong *et al.* 2014b).

* For clarification of Burmeister's date of publication, see Durden *et al.* (2014) and Palma (2017).

Genus *Sathrax* Johnson, 1964

Total number of species in genus: 1.

Type species: *Sathrax durus* Johnson, 1964.

Hosts: Scandentia (Tupaiidae).

Distribution: Oriental Region,

***Sathrax durus* Johnson, 1964**

Sathrax durus Johnson, 1964: 81, figs 67–75.

Tupaiphthirus dolabrifer Chin, 1975: figs 1–8.

Sathrax durus Johnson, 1964; Durden & Musser 1994: 75.

Type host: *Tupaia glis* (Diard & Duvaucel, 1820)—Common treeshrew.

Malaysian hosts: *Tupaia glis*, *Rattus exulans* (Peale, 1848).

Malaysian localities: Bukit Lagong Forest Reserve &, Ulu Langat Forest Reserve. (Selangor) Peninsular Malaysia (Johnson, 1964); “Maxwell’s Hill”, Bukit Larut (Perak) Peninsular Malaysia (Johnson, 1964).

Geographical distribution: Indonesia (Kalimantan), Malaysia, People’s Republic of China (Yunnan Province), Vietnam (Durden & Musser 1994; Price & Graham 1997; Guo *et al.* 2004a,b; Dong *et al.* 2009; Zuo *et al.* 2011).

Remarks: The adult male and female of *Sathrax durus* were described and illustrated by Johnson (1964). Besides the type host, *S. durus* has been recorded from northern treeshrews, *Tupaia belangeri* (Wagner, 1841) in China (Guo *et al.* 2004a,b; Dong *et al.* 2009; Zuo *et al.* 2011). Further, Madinah *et al.* (2014) listed three nymphs of a *Sathrax* sp. collected from *Rattus exulans* in the Malaysian tropical rainforests, but they did not discuss the fact that *R. exulans* is an unlikely natural host for a louse species from shrews. Considering the current patchy geographical distribution of *S. durus*, and the large number of known species of *Tupaia*, more collections are needed to determine the complete host range and distribution of this louse species in the Oriental Region.

In a scanning electron microscopy study of sucking lice parasitic on treeshrews, Durden (1984) suggested that the cephalic interspine outgrowths on the head of *S. durus* enabled the parasite to grip on the host epidermis, instead of interlocking with the host underfur hairs.

Anopluran species with dubious records in Malaysia

***Enderleinellus malaysianus* Ferris, 1919**

This species is an interesting case with respect to the localities of the type series. In his description of the species, Ferris (1919) gave the host and locality of the holotype as “*Sciurus lucas* [now *Callosciurus caniceps*], St. Lukes Id., Mergui Archipelago, Malaysia”. Also, Ferris (1919) designated paratypes of *E. malaysianus* collected from the same and other hosts in other localities, some of which were then part of “Malaya”. However, today, the Mergui Archipelago belongs to Myanmar, and the other localities are in Thailand or Indonesia. The only *E. malaysianus* specimen to have been reported closest to the Malaysian mainland was from Pulau Teratau, about 10 km north of Pulau Langkawi, Kedah, which now belongs to Thailand. Subsequent authors have followed Ferris (1919) in regarding *E. malaysianus* as a native species in Malaysia (Johnson 1959, 1964; Durden & Musser 1994). Although the type host of this louse species does occur in Malaysia, there have not been any actual records of *E. malaysianus* from this country. Therefore, more collections and studies are needed to determine the presence of *E. malaysianus* in Peninsular Malaysia.

***Neohaematopinus batuanae* Ferris, 1923**

The type locality of *Neohaematopinus batuanae* was given by Ferris (1923) as “Batu Islands, Malaysia”. However, the Batu Islands, located in the west coast of Sumatra, are currently under the Indonesian sovereignty, as clarified by Durden (1991). Considering that there have not been any additional records of this louse species from this country, more collections are needed to determine whether *N. batuanae* does occur in Malaysia.

Pedicinus eurygaster* (Burmeister, 1838)

Notwithstanding that some old and recent studies have listed “Malaysia” as a country where *Pedicinus eurygaster* is present (*e.g.* Durden & Musser 1994; Durden *et al.* 2020), there is no evidence of any actual record for *P. eurygaster* in this country. Considering the many reports of this louse species from many countries and old specimens labelled with now archaic geographical names, the presence of *P. eurygaster* in Malaysia is unconfirmed. As an example, Kellogg (1914) mentioned that specimens of *Pedicinus longiceps* Piaget—collected from “*Macacus cynomolgus*” (now *Macaca fascicularis*)—were from the “Malaysian region”. Years later, Ferris (1934) argued that these specimens were actually *P. eurygaster* from Natuna Island (as Natouna). However, Natuna Island is under Indonesian sovereignty, not Malaysian. More collections of lice from Malaysian macaques are needed to determine whether *P. eurygaster* is indeed present in Malaysia.

* For clarification of Burmeister’s date of publication, see Durden *et al.* (2014) and Palma (2017).

Cosmopolitan species excluded from this Checklist, without records in Malaysia

Haemodipsus ventricosus (Denny, 1842)

This louse species mainly infests European rabbits (*Oryctolagus cuniculus*), and is usually reported with a worldwide distribution (Durden & Musser 1994). Although European rabbits are not native in Malaysia (PERHILITAN 2010, 2017), they have been introduced in this country as laboratory animals and exotic pets. Since there have been no attempts to investigate the possible presence of *Haemodipsus ventricosus* in Malaysia, its current status must remain as absent.

Haematopinus asini (Linnaeus, 1758)

This louse species infests horses (*Equus caballus*), plain zebras (*Equus burchellii*) and donkeys (*Equus asinus*) (Webb 1948; Durden & Musser 1994; Attia 2018; Attia *et al.* 2018; Gharbi *et al.* 2020; Sazmand *et al.* 2020). Due to the global geographical distribution of these equine hosts, especially horses, *H. asini* was considered as a cosmopolitan species (Durden & Musser 1994). None of these mammals are native to Malaysia, but they have been introduced in this country as farm or recreational animals (Bashir 1993; Abdullah and Mammalian Research Group 2013). However, there have been no records of *H. asini* from these hosts in Malaysia.

Hoplopleura captiosa Johnson, 1960

Durden & Musser (1994) noted that *Hoplopleura captiosa* was probably a cosmopolitan species, possibly on the basis that this louse species had been recorded from the Nearctic, Palearctic and Oriental Regions (Johnson 1960; Arzamasov & Trukhan 1966; Kim 1966; Smetana & Daniel 1970; Beaucournu 1972; Rao *et al.* 1973; Sosnina & Davydov 1973; Kim & Emerson 1974; Gaaboub *et al.* 1981, 1982; Wegner 1991; Krištofík & Dudich 2000; Khosravani 2018; Hamidi & Nassirkhani 2019; Kozina *et al.* 2022). However, in Southeast Asia, *H. captiosa* was only reported in Thailand by Johnson (1960) and Kim (1966). Currently, there are no records of this louse species in Malaysia, although the type host of *H. captiosa*, *Mus musculus*, and several other species of *Mus* are known to be indigenous in this country (Abdullah & Mammalian Research Group 2013).

Linognathus ovillus (Neumann, 1907)

This species is known to mainly infest sheep, and sometimes goats (Durden & Musser 1994). These hosts are distributed worldwide, hence, it was assumed that the distribution of *Linognathus ovillus* was also cosmopolitan (Durden & Musser 1994). However, *L. ovillus* has not been reported in Malaysia yet. Given the lack of knowledge about this louse species compared to the chewing lice *Bovicola caprae* and *B. ovis* (see Mustaffa-Babjee 1969; Vivi-Susantie *et al.* 2020), more studies are needed to determine whether *L. ovillus* is present in Malaysia, and if any pathogens are transmitted by this louse to sheep and goats.

Linognathus pedalis (Osborn, 1896)

Similar to *Linognathus ovillus*, *Linognathus pedalis* typically infests sheep and was regarded as having a cosmopolitan distribution by Durden & Musser (1994). Still, there are no records of this louse species from sheep or any other host from Malaysia (Mustaffa-Babjee 1969; Vivi-Susantie *et al.* 2020). Currently, information of pathogens transmitted by *L. pedalis* is scarce (Durden 2019). Hence, it is important that more studies of sucking lice on goats and sheep be conducted in Malaysia.

Linognathus stenopsis (Burmeister, 1838)*

Although *Linognathus stenopsis* is a common parasite of goats (*Capra hircus*), there are no records of *Linognathus stenopsis* from Malaysia, as studies on sucking lice from domestic animals and livestock are lacking (Mohd-Zain *et al.* 2015). Ferris (1933) reported that the ibex (*Capra ibex*) and chamois (*Rupicapra rupicapra*) can also be hosts to this louse species. Unlike *Linognathus africanus*, no pathogens of medical or veterinary importance have yet been detected in *L. stenopsis* (Durden 2019).

* For clarification of Burmeister's date of publication, see Durden *et al.* (2014) and Palma (2017).

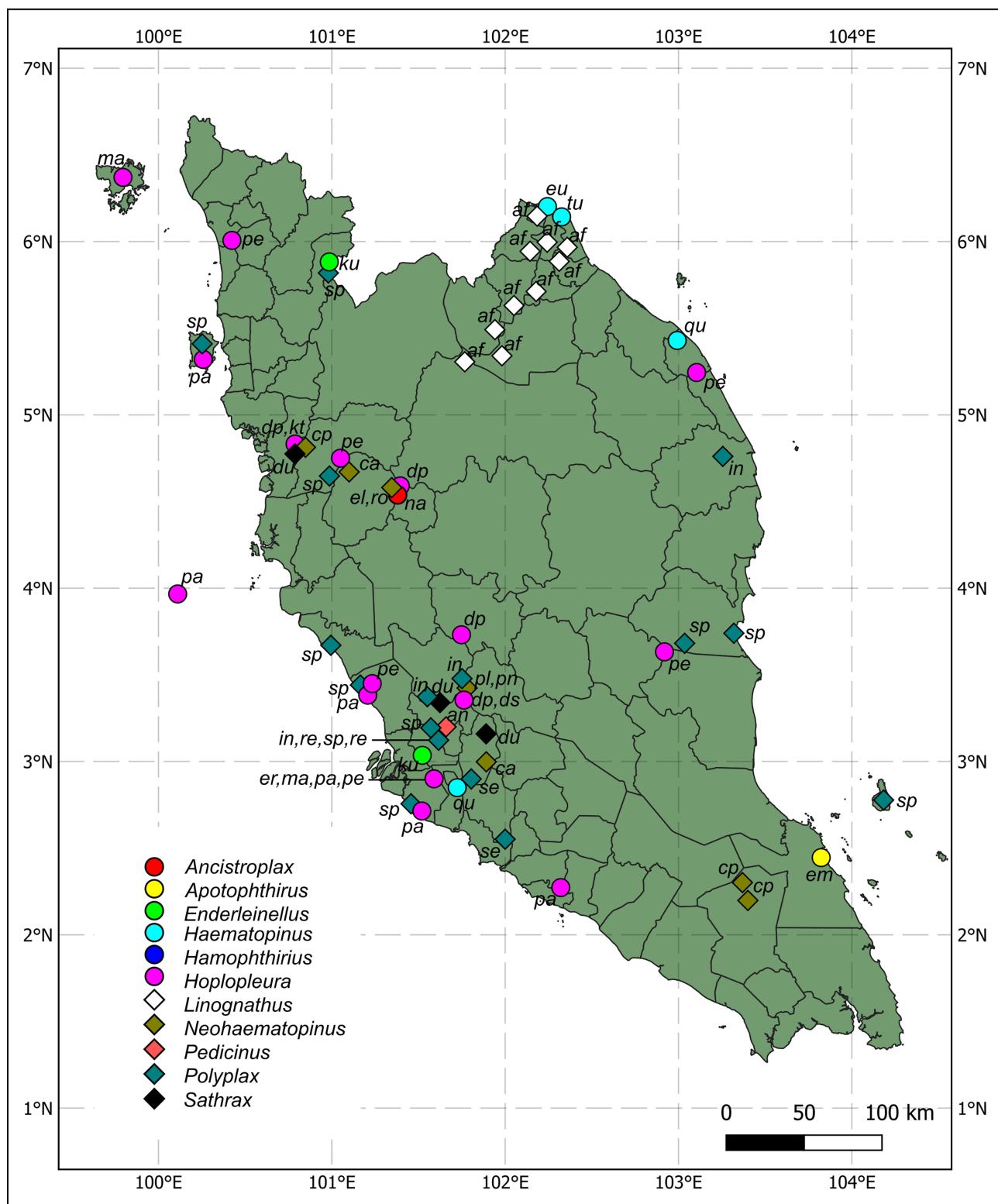


FIGURE 1. Map of Peninsular Malaysia showing the geographical distribution of sucking lice. Some species are excluded from the map due to the lack of locality information. Abbreviations of louse species names: af, *africanus*; an, *ancoratus*; ca, *callosciuri*; cp, *capitaneus*; dp, *diaphora*; ds, *dissicula*; el, *elbeli*; em, *emersoni*; er, *erismata*; eu, *eurysternus*; in, *insulsa*; kt, *kitti*; ku, *kumadai*; ma, *malaysiana*; na, *nasuta*; pa, *pacifica*; pe, *pectinata*; pl, *pallidus*; qu, *quadripertitus*; re, *reclinata*; ro, *robustus*; se, *serrata*; sp, *spinulosa*; tu, *tuberculatus*. Malaysian map data obtained from the website <https://gadm.org>.

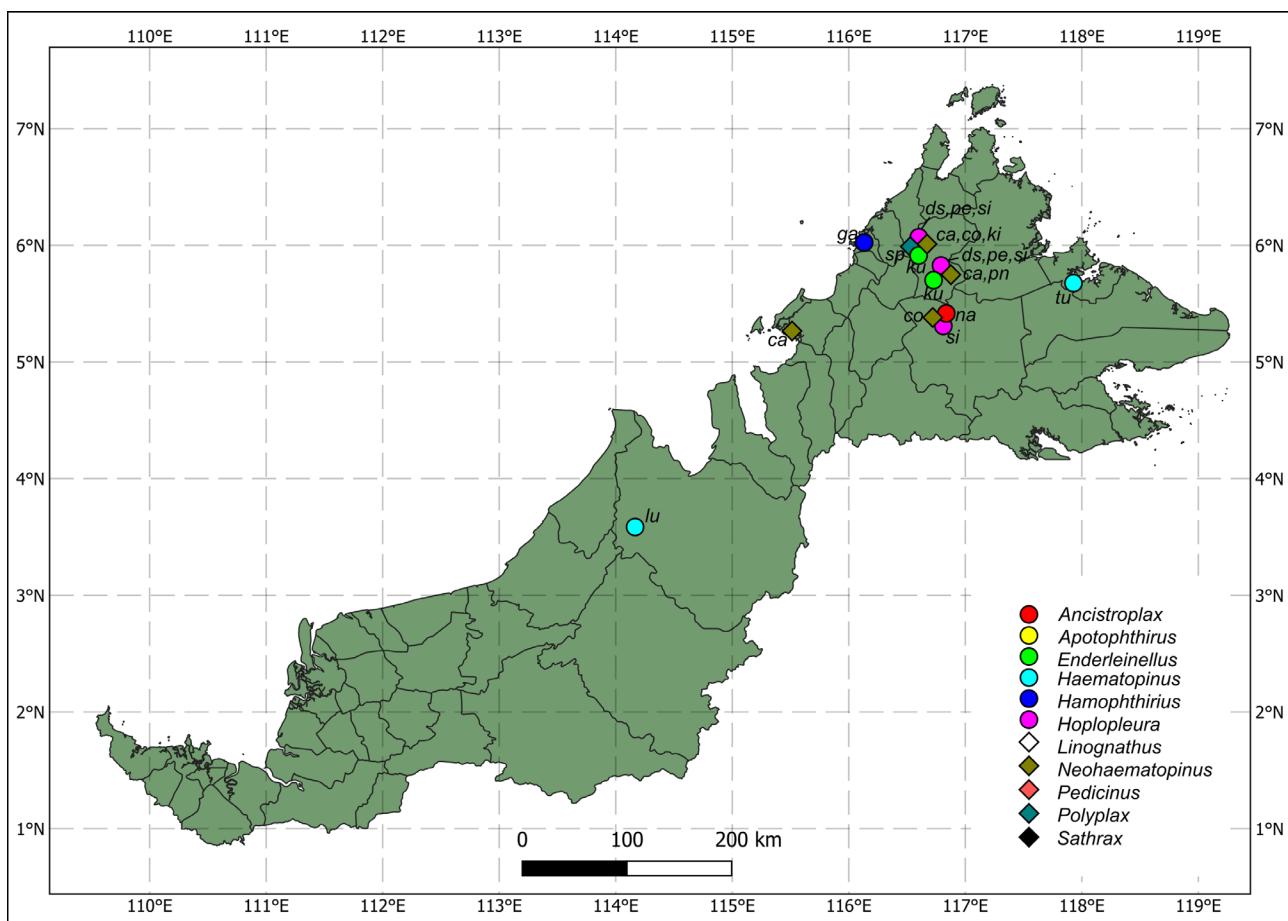


FIGURE 2. Map of Malaysian Borneo showing the geographical distribution of sucking lice. Some species are excluded from the map due to the lack of locality information. Abbreviations of louse species names: *ca*, *callosciuri*; *co*, *cognatus*; *ds*, *dissicula*; *ga*, *galeopitheci*; *ki*, *kinabalensis*; *ku*, *kumadai*; *lu*, *ludwigi*; *na*, *nasuta*; *pe*, *pectinata*; *pn*, *pansus*; *si*, *sicata*; *sp*, *spinulosa*; *tu*, *tuberculatus*. Malaysian map data obtained from the website <https://gadm.org>.

Discussion

Excluding *Enderleinellus malaysianus* and two other louse species with dubious locality records (see above), there are 10 species of sucking lice originally described from Malaysia (Durden & Musser 1994). Some of these species are still only known from Malaysia, as there are no additional records from other countries. In addition, Sabah (Malaysian Borneo) is the only locality where both the monotypic louse genus *Hamophthirius* and the family Hamophthiriidae have been recorded (Mjöberg 1925; Johnson 1969). Despite the apparent uniqueness of the louse fauna of Malaysia, scientific studies are scarce because research on other ectoparasites from domestic and wild animals, such as ticks and mites, have often taken priority over lice. For example, Malaysian ectoparasite surveys by Mariana *et al.* (2008) and Madinah *et al.* (2014) contain more records of ticks and mites than of lice. Another possible reason is that lice are considered to have less medical and veterinary importance compared to other ectoparasites, as evident from the scarce knowledge of pathogens transmitted by lice (Table 2; Durden 2019).

Generally, lice are regarded as host-specific, each species living only on one host species or on several closely related species (Thomas 2015). Therefore, as a host becomes extinct, it is possible that its lice or other ectoparasites may become extinct as well (Mihalca *et al.* 2011; Rózsa & Vas 2015). In Malaysia, there are numerous mammalian hosts that have been labelled as vulnerable, by the Jabatan Perlindungan Hidupan Liar dan Taman Negara Semenanjung Malaysia (PERHILITAN). It is even more concerning that these animals are hosts to louse species that are understudied in Malaysia. Conservation status is important in assessing the biodiversity in an ecosystem, but it is more important to initiate a response action to mitigate the threat of population decline of a given species (IUCN 2020; Minaya *et al.* 2021).

The aim of this checklist is to provide a summary of the information available regarding sucking lice associated with domestic and wild mammals in Malaysia. We hope it will serve as a tool for future research on sucking lice and their host associations, as well as highlighting gaps in our knowledge, which should be the subject of further studies to discover new louse-host associations, establish comprehensive and informative geographical records, investigating vectorial capacity, as well as identify new species for science.

Host-louse list

Louse taxa are listed under each host in alphabetical order according to genera. Vernacular names of host species are given in English and Malay. Possible erroneous records are asterisked.

ARTIODACTYLA

BOVIDAE

Bos taurus Linnaeus, 1758

Domestic cattle—Lembu

Haematopinus eurysternus (Nitzsch, 1818)

Haematopinus quadripertitus Fahrenholz, 1916

Linognathus vituli (Linnaeus, 1758)

Bubalus bubalis (Linnaeus, 1758)

Water buffalo—Kerbau sawah

Haematopinus tuberculatus (Burmeister, 1838)

Capra hircus Linnaeus, 1758

Domestic goat—Kambing

Linognathus africanus Kellogg & Paine, 1911

SUIDAE

Sus barbatus (Müller, 1838)

Bornean bearded pig—Babi bodoh

Haematopinus ludwigi Weisser, 1974

Sus scrofa Linnaeus, 1758

Wild boar—Babi hutan

Haematopinus suis (Linnaeus, 1758)

CARNIVORA

FELIDAE

Felis catus Linnaeus, 1758

Domestic cat—Kucing

**Linognathus setosus* (von Olfers, 1816)

EULIPOTYPHLA

SORICIDAE

Suncus murinus (Linnaeus, 1766)

Asian house shrew—Cencurut rumah

Polyplax reclinata (Nitzsch, 1864)

‘Ground shrew’

Ancistropalax nasuta Johnson, 1964

PRIMATES

CERCOPITHECIDAE

Trachypithecus selangorensis Roos,

Nadler & Walter, 2008

Silvery lutung—Lutong kelabu

Pedicinus ancoratus Ferris, 1934

CYNOCEPHALIDAE

***Cynocephalus variegatus* (Audebert, 1799)**
Hamophrithirus galeopithecus Mjöberg, 1925

Sunda flying lemur—Kubong

RODENTIA**MURIDAE**

***Berylmys bowersi* (Anderson, 1879)**

Hoplopleura diaphora Johnson, 1964
Hoplopleura kitti Kim, 1968

Bowser's white-toothed rat—Tikus bulu kasar

***Leopoldamys edwardsi* (Thomas, 1882)**

Polyplax spinulosa (Burmeister, 1838)

Edward's long-tailed giant rat—Tikus bukit besar

***Leopoldamys sabanus* (Thomas, 1887)**

Hoplopleura malaysiana Ferris, 1921
Polyplax insulsa Ferris, 1923
Polyplax spinulosa (Burmeister, 1838)

Long-tailed giant rat—Tikus mondok ekor panjang

***Maxomys alticola* (Thomas, 1888)**

Hoplopleura pectinata (Cummings, 1913)

Mountain spiny rat—Tikus duri bukit

***Maxomys ochraceiventer* (Thomas, 1894)**

Ancistroplax nasuta Johnson, 1964

Chestnut-bellied spiny rat—Tikus duri dada perang

***Maxomys rajah* (Thomas, 1894)**

Hoplopleura pectinata (Cummings, 1913)

Rajah spiny rat—Tikus duri hitam pudar

***Maxomys whiteheadi* (Thomas, 1894)**

Hoplopleura pectinata (Cummings, 1913)
Polyplax spinulosa (Burmeister, 1838)

Whitehead's spiny rat—Tikus bangkung

***Niviventer cremoriventer* (Müller, 1900)**

Hoplopleura pectinata (Cummings, 1913)
Hoplopleura sicata Johnson, 1964

Dark-tailed tree rat—Tikus akar

***Niviventer niviventer* (Hodgson, 1836)**

Hoplopleura pectinata (Cummings, 1913)

White-bellied rat—Tikus dada putih

***Niviventer rapit* (Bonhote, 1903)**

Hoplopleura pectinata (Cummings, 1913)

Long-tailed mountain rat—Tikus bukit ekor panjang

***Rattus argentiventer* (Robinson & Kloss, 1916)**

Hoplopleura pacifica Ewing, 1924
Polyplax spinulosa (Burmeister, 1838)

Ricefield rat—Tikus sawah

***Rattus exulans* (Peale, 1848)**

Hoplopleura pacifica Ewing, 1924
Polyplax spinulosa (Burmeister, 1838)
Sathrax durus Johnson, 1964

Polynesian rat—Tikus kecil

***Rattus norvegicus* (Berkenhout, 1769)**

Hoplopleura pacifica Ewing, 1924
Polyplax spinulosa (Burmeister, 1838)

Brown rat—Tikus mondok

<i>Rattus rattus</i> (Linnaeus, 1758)	Black rat—Tikus rumah
<i>Hoplopleura pacifica</i> Ewing, 1924	
<i>Polyplax spinulosa</i> (Burmeister, 1838)	
<i>Rattus tiomanicus</i> (Müller, 1900)	Malayan field rat—Tikus belukar
<i>Hoplopleura pacifica</i> Ewing, 1924	
<i>Polyplax spinulosa</i> (Burmeister, 1838)	
<i>Sundamys muellieri</i> (Jentink, 1879)	Müller's Sunda rat—Tikus lembah
<i>Hoplopleura dissicula</i> Johnson, 1964	
<i>Hoplopleura malaysiana</i> Ferris, 1921	
“Rats”	
<i>Polyplax serrata</i> (Burmeister, 1838)	
SCIURIDAE	
<i>Callosciurus caniceps</i> (Gray, 1842)	Grey-bellied squirrel—Tupai dada kelabu
<i>Neohaematopinus callosciuri</i> Johnson, 1959	
<i>Callosciurus notatus</i> (Boddaert, 1785)	Plantain squirrel—Tupai kampung
<i>Enderleinellus kumadai</i> Kaneko, 1954	
<i>Neohaematopinus callosciuri</i> Johnson, 1959	
<i>Callosciurus prevostii</i> (Desmarest, 1822)	Prevost's squirrel—Tupai gading
<i>Enderleinellus kumadai</i> Kaneko, 1954	
<i>Ancistroplax nasuta</i> Johnson, 1964	
<i>Neohaematopinus callosciuri</i> Johnson, 1959	
<i>Callosciurus nigrovittatus</i> (Horsfield, 1824)	Black-striped squirrel—Tupai tompok
<i>Enderleinellus kumadai</i> Kaneko, 1954	
<i>Hoplopleura erismata</i> Ferris, 1921	
<i>Neohaematopinus callosciuri</i> Johnson, 1959	
<i>Dremomys rufigenis</i> (Blanford, 1878)	Asian red-cheeked squirrel—Tupai pipi merah
<i>Neohaematopinus elbeli</i> Johnson, 1959	
<i>Exilisciurus whiteheadi</i> (Thomas, 1887)	Tufted pygmy squirrel—Tupai kecil Whitehead
<i>Neohaematopinus cognatus</i> Johnson, 1959	
<i>Glyphotes simus</i> Thomas, 1898	Sculptor squirrel—Tupai pengukir
<i>Enderleinellus kumadai</i> Kaneko, 1954	
<i>Neohaematopinus callosciuri</i> Johnson, 1959	
<i>Hylopetes sagitta</i> (Linnaeus, 1766)	Grey-cheeked flying squirrel—Tupai terbang pipi kelabu
<i>Neohaematopinus kinabalensis</i> Johnson, 1959	
<i>Hylopetes spadiceus</i> (Blyth, 1847)	Red-cheeked flying squirrel—Tupai terbang pipi merah
<i>Neohaematopinus capitaneus</i> Johnson, 1959	
<i>Lariscus insignis</i> (Cuvier, 1821)	Three-striped ground squirrel—Tupai belang tiga
<i>Neohaematopinus callosciuri</i> Johnson, 1959	

Petaurillus hosei (Thomas, 1900)	Hose's pygmy flying squirrel—Tupai terbang kecil
<i>Neohaematopinus pansus</i> Johnson, 1964	
Petaurista elegans (Müller, 1840)	Spotted giant flying squirrel—Tupai terbang bintang
<i>Atopophthisirus emersoni</i> Kim, 1977	
<i>Neohaematopinus robustus</i> Johnson, 1964	
Petaurista petaurista (Pallas, 1766)	Red giant flying squirrel—Tupai terbang merah
<i>Neohaematopinus pallidus</i> Johnson, 1964	
Petinomys vordermanni Jentink, 1890	Vorderman's flying squirrel—Tupai terbang Vorderman
<i>Neohaematopinus pansus</i> Johnson, 1964	
Sundasciurus everetti (Thomas, 1890)	Bornean mountain ground squirrel—Tupai tanah bukit
<i>Neohaematopinus cognatus</i> Johnson, 1959	
Sundasciurus jentinki (Thomas, 1887)	Jentink's squirrel—Tupai Jentink
<i>Neohaematopinus cognatus</i> Johnson, 1959	
Sundasciurus tenuis (Horsfield, 1824)	Slender squirrel—Tupai cerleh
<i>Neohaematopinus callosciuri</i> Johnson, 1959	
SCANDENTIA	
TUPAIIDAE	
<i>Tupaia glis</i> (Diard & Duvaucel, 1820)	Common treeshrew—Kenchong
<i>Sathrax durus</i> Johnson, 1964	

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