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Phthiraptera of Canada

Terry D. Galloway[1]

1 *Department of Entomology, University of Manitoba, Winnipeg, Manitoba, R3T 2N2, Canada*

Corresponding author: *Terry D. Galloway* (terry.galloway@umanitoba.ca)

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Abstract

There are approximately 463 species of parasitic lice recorded in Canada, in three suborders: Amblycera, six families; Ischnocera, two families; Anoplura, eight families. At least an additional 361 species may eventually be recorded based on presence of suitable hosts and proximity to known distributions. Approximately 41 species are introduced non-native species. Only about 54% of the expected chewing louse fauna has been recorded, and considerable collecting effort is needed, especially for lice infesting passerine birds, shorebirds, and seabirds. The sucking louse fauna is well known, with approximately 88% of the expected fauna recorded. Investigations into ecology of lice and the nature of relationships with their hosts are badly needed. Barcode Index Numbers are available for only 13 species of parasitic lice in Canada.

Keywords

biodiversity assessment, Biota of Canada, lice, Phthiraptera

Lice are ubiquitous, obligate external parasites of birds and mammals. At one time, they were treated as two separate orders (see discussion in Palma and Barker 1996), the Mallophaga (chewing lice, parasites of birds and mammals) and the Anoplura (sucking lice, parasites of mammals). They have been consolidated within the order Phthiraptera, divided into four suborders: Anoplura (sucking lice, parasites of mammals), Amblycera, Ischnocera (both chewing lice infesting birds and mammals) and Rhynchophthirina (chewing lice infesting elephants and warthogs, and not known to occur in Canada) (Palma and Barker 1996). Although there is support for combining Psocoptera and

Phthiraptera into one order, Psocodea, based on morphological and molecular evidence (Yoshizawa and Johnson 2010, Trautwein et al. 2012), Phthiraptera as an order for parasitic lice is retained here.

Lice have never received a great deal of attention in Canada, and the fauna, especially chewing lice (Amblycera and Ischnocera), is not well known. Based on the compilation of species by Martin (1979), Galloway and Danks (1990) identified chewing lice as one of two highest priority groups of arthropod ectoparasites that warranted particular investigation, and this situation remains unchanged today. There are several studies where lice were collected locally in general surveys (e.g., Twinn 1935, Judd 1953, Teskey 1960, Thompson 1968) or from specific hosts (e.g., Buscher 1965, Judd 1968, Ballard and Ring 1979, Dick 1981, Colwell et al. 2008, Yunik et al. 2016). In regional initiatives, Spencer (1928, 1939, 1948, 1957) collected intensively in British Columbia, and species lists of chewing lice were compiled for Quebec by Rayner (1932) and Whitehead (1934, 1954) and for Alberta by Brown and Wilk (1944). William Threlfall and his students recorded lice from a number of hosts in Newfoundland (e.g., Andrews and Threlfall 1975, Bourgeois and Threlfall 1981, Eveleigh and Threlfall 1974, Fitzpatrick and Threlfall 1977, Threlfall et al. 1979, Threlfall and Wheeler 1986, Wheeler and Threlfall 1986). Galloway et al. (2014) provided a list of species of chewing list infesting grassland birds in Canada. There are a number of recent studies on lice infesting several species of birds in Manitoba (Galloway 2007, 2012, Galloway and Palma 2008, Galloway and Lamb 2014, 2016). The most comprehensive compilations of species of lice found in Canada are those of Wheeler and Threlfall (1989) for birds, and Kennedy (1986) and Kennedy and Newman (1986) for domestic and terrestrial mammals, respectively.

There are many publications to aid identification of lice in Canada. Kim et al. (1986) provided a well-illustrated manual for the identification of the species of Anoplura of North America. With the checklists for the Anoplura and their mammal hosts by Durden and Musser (1994a, b), it should be possible to identify all of the species known to occur in Canada. Unfortunately, there is no such guide to the identification of chewing lice found on birds; keys to the genera are found in Keirans (1966), Ledger (1980), and Price et al. (2003a), but these keys are specialised and not always well illustrated so it takes a considerable length of time to become sufficiently familiar with the terminology to use the keys effectively. Keys to the species of lice on birds are scattered throughout the primary literature, usually focused on species in individual genera, or on species found on selected hosts. No attempt to summarise these is made here. Earlier checklists for the chewing lice by Emerson (1972a, b, c, d), Price and Graham (1997) and Poole (1997a, b) have been eclipsed by the outstanding checklist of Price et al. (2003a). Nomenclature in this latter checklist is adopted here.

There is considerable disagreement about the application of subspecies names to louse taxa. It is assumed that Martin (1979) did not include subspecies as separate taxa in his totals. I have not attempted to address this issue, and therefore ignore all subspecies for the current biodiversity assessment, even where the evidence for their validity is strongly supported (e.g., in some taxa of *Actornithophilus*, *Quadraceps*, and *Saemundssonia*).

There has been little attention on taxonomy at the molecular level for species of lice collected specifically in Canada, with only 13 Barcode Index Numbers (BINs) in the Barcode of Life Data Systems (BOLD) database (Table 1). Grossi et al. (2014) synonymised two species of *Anatoecus* infesting anseriforms in Canada, based on molecular analysis using sequence data from the COI region of mitochondrial DNA.

In compiling the following data on lice in Canada, certain decisions were made about what species should be included. Because lice are permanent ectoparasites of their hosts, they go wherever their hosts go. During winter, many species of birds are far away on their overwintering grounds, so their lice are no longer present in Canada. Many species of birds disperse from their breeding ranges in Eurasia and the United States, for example, and occur in Canada with varied degrees of frequency, though not necessarily to breed. The current list of the louse fauna includes species on such avian hosts, however infrequently they might actually occur within the geographic boundaries of Canada. Therefore, lice from all native and non-native mammals (Banfield 1974) and birds (Godfrey 1986) known to occur in Canada are cited here, including domestic animals and naturalised non-native birds (e.g., rock pigeon, *Columba livia* Gmelin; European starling, *Sturnus vulgaris* Linnaeus; house sparrow, *Passer domesticus* (Linnaeus)) and mammals (e.g., house mouse, *Mus domesticus*; Norway rat, *Rattus norvegicus* Linnaeus). Not all species of lice known to infest non-native introduced hosts are known to occur currently in Canada (Paterson et al. 1999). Some of those may already be present and undetected and others may be introduced in the future (see Galloway and Palma 2008). There is extensive trade and importation of exotic animals into Canada, and although these animals may pass through strict quarantine, it is possible that their lice may initially escape detection. I have made no attempt to compile the records from these exotic species.

Our knowledge of the louse fauna in Canada has only modestly progressed since 1979 (Martin 1979), especially for chewing lice. Currently 463 species of lice, 41 of which are non-native, are known from Canada, 418 of which are chewing lice and only 45 are sucking lice (Table 1). In comparison, Martin (1979) reported 362 species, 329 and 33 of which were chewing and sucking lice, respectively. Although the exact composition of species included by Martin (1979) is not known, he estimated that only 45% of the chewing louse fauna of Canada had been recorded. I estimate about 54% of the chewing lice fauna to be documented (Table 1). In comparison, the sucking lice fauna was believed to have been 94% documented in 1979 (Martin 1979) and 88% documented today (Table 1), the decrease attributed to the fact that the total fauna is now believed to be larger than anticipated in 1979.

There are many specimens of undescribed species in collections and there are many more awaiting discovery. Kim et al. (1990) estimated the numbers of species of lice in North America by extrapolation from known host/parasite associations. I have refrained from adopting their strategy in this paper. In the case of chewing lice on birds, there are a great many host species, especially among the Passeriformes, for which no lice have been recorded. It is not known whether this is because of insufficient collect-

Table 1. Census of Phthiraptera in Canada.

Taxon[1]	No. species reported in Martin (1979)	No. species currently known from Canada[2]	No. BINs[3] available for Canadian species	Est. no. described but unrecorded species in Canada[4]	General distribution by ecozone[5] and host range	Information sources[6]
Suborder Amblycera						
Menoponidae	100	116 (5)	2	110	all ecozones; birds	Klockenhoff (1984), Martinho Guimarães (1988), Price et al. (2002, 2003a), Price and Dalgleish 2007, Cicchino and González-Acuña (2012), Gustafsson and Olsson (2012); CNCI, WRME
Ricinidae	3	15	1	15	all ecozones but perhaps barren-ground; passerine birds, hummingbirds	Nelson (1972), Price et al. (2003); CNCI, WRME
Laemobothriidae	2	6	0	2	all ecozones; coots, eagles, hawks, falcons	Nelson and Price (1965), Price et al. (2003a); CNCI, WRME
Gyropidae	2	2 (2)	0	1	caviomorph rodents	Price et al. (2003a); CNCI, WRME
Boopiidae	1	1 (1)	0	0	domestic dogs	Price et al. (2003a); CNCI, WRME
Trimenoponidae[7]	1	0	0	0		Price et al. (2003a); CNCI, WRME
Suborder Ischnocera						
Philopteridae	200	250 (17)	6	223	all ecozones; birds	Cicchino (1980), Eichler and Vasjukova (1981), Balát (1982), Mey (1982), Price et al. (2003a, b), Gustafsson and Olsson (2012), Gustafsson and Bush (2017); CNCI, WRME
Trichodectidae	20	31 (7)	1	4	all ecozones; mammals	Hopkins (1960), Lyal (1985), Price et al. (2003a); CNCI, WRME
Suborder Anoplura						
Echinophthiriidae	3	6	0	0	widespread in marine and estuarine habitats; marine mammals	Kim et al. (1986), Durden and Musser (1994a); CNCI, WRME
Enderleinellidae[8]	?	5	0	0	all ecozones; small mammals	Kim et al. (1986), Durden and Musser (1994a); CNCI, WRME
Polyplacidae[8]	?	13 (1)	1	3	all ecozones; small mammals	Kim et al. (1986), Durden and Musser (1994a); CNCI, WRME
Haematopinidae	3	3 (3)	0	1	all ecozones; hoofed mammals, including domestic animals	Kim et al. (1986), Durden and Musser (1994a); CNCI, WRME
Hoplopleuridae[8]	19	7	1	1	all ecozones; small mammals	Kim et al. (1986), Durden and Musser (1994a); CNCI, WRME
Linognathidae	6	9 (5)	0	1	most ecozones; hoofed mammal and canids, including domestic animals	Kim et al. (1986), Durden and Musser (1994a); CNCI, WRME
Pediculidae	1	1	1	0	all ecozones; humans	Kim et al. (1986), Durden and Musser (1994a); CNCI, WRME
Pthiridae	1	1	0	0	all ecozones; humans	Kim et al. (1986), Durden and Musser (1994a); CNCI, WRME
Total	**362**	**463 (41)**	**13**	**361**		

[1]Classsifcation follows that of Price et al. (2003) for chewing lice and Durden and Musser (1994a) for sucking lice. [2]The numbers in parentheses represents the number of non-native species included in the total. [3]Barcode Index Number, as defined in Ratnasingham and Hebert (2013). [4]No attempt was made to include undescribed species that may occur in Canada. [5]See figure 1 in Langor (2019) for a map of ecozones. [6]References are relevant to species described since 1979 and are known or suspected to occur in Canada. WRME – Wallis/Roughley Museum of Entomology, University of Manitoba, Winnipeg, Manitoba; CNCI – Canadian National Collection of Insects, Arachnids, and Nematodes, Ottawa, Ontario. [7]Martin (1979) listed one species of Trimenoponidae in his table. There are no endemic species of this family in Canada. The only record I can find of a trimenoponid in the CNCI, for *Harrisonia uncinata* Ferris, 1922, is from Trinidad. This family is not included in the current list. [8]Martin (1979) presumably included the Enderleinellidae and Polyplacidae as subfamilies of Hoplopleuridae, by inference from his reference to Ferris (1951). Since Martin provided no tally of species included in each subfamily, only his total number of species for Hoplopleuridae is presented here.

ing, or whether these hosts, in fact, are parasitised by few or no species of lice. Until such gaps are addressed and data are produced, extrapolations based on the known fauna may result in artificially inflated estimates of numbers of taxa.

It is likely that there are many undescribed species of lice, especially in some of the hyperdiverse genera, e.g., *Myrsidea*, *Brueelia* (see Valim and Weckstein 2013, Bush et al. 2016, Gustafsson and Bush 2017). Advanced tools used to explore the molecular basis for species separation should also clarify some relationships among species of lice and add to the growing list of new species. As populations of birds and mammals continue to decline and the numbers of threatened and endangered species increase, many of which are hosts for a great diversity of ectosymbionts, including parasitic lice, it is important that the recommendations of Galloway and Danks (1990) not be forgotten. Of course, having a list of species with relevant geographic and host associations is only the first step in understanding the real nature of the complex relationships among ectoparasites and their hosts.

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