Louse

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Louse (plural: **lice**) is the common name for members of the order Phthiraptera, which contains nearly 5,000 species of wingless insect. Lice are obligate parasites, living externally on warm-blooded hosts which include every species of bird and mammal, except for monotremes, pangolins, bats and cetaceans. Lice are vectors of diseases such as typhus.

Chewing lice live among the hairs or feathers of their host and feed on skin and debris, while sucking lice pierce the host's skin and feed on blood and other secretions. They usually spend their whole life on a single host, cementing their eggs, which are known as nits, to hairs or feathers. The eggs hatch into nymphs, which moult three times before becoming fully grown, a process that takes about four weeks.

Humans host three species of louse, the head louse, the body louse and the pubic louse. The body louse has the smallest genome of any known insect; it has been used as a model organism and has been the subject of much research.

Lice were ubiquitous in human society until at least the Middle Ages. They appear in folktales, songs such as *The Kilkenny Louse House*, and novels such as James Joyce's *Finnegans Wake*. They commonly feature in the psychiatric disorder delusional parasitosis. A louse was one of the early subjects of microscopy, appearing in Robert Hooke's 1667 book, *Micrographia*.

Phthiraptera

Light micrograph of *Fahrenholzia pinnata*

Scientific classification

Kingdom:	Animalia
Phylum:	Arthropoda
Class:	Insecta
Subclass:	Pterygota
Infraclass:	Neoptera
Superorder:	Exopterygota
Order:	**Phthiraptera** Haeckel, 1896

Suborders

Anoplura
Rhyncophthirina

Contents

Classification

Ischnocera
Amblycera

The order Phthiraptera is clearly a monophyletic grouping, united as the members are by a number of derived features including their parasitism on warm-blooded vertebrates and the combination of their metathoracic ganglia with their abdominal ganglia to form a single ventral nerve junction.[1] The order has traditionally been divided into two suborders, the sucking lice (Anoplura) and the chewing (Mallophaga); however, recent classifications suggest that the Mallophaga are paraphyletic and four suborders are now recognized:[2]

- Anoplura: sucking lice, occurring on mammals exclusively
- Rhynchophthirina: parasites of elephants and warthogs
- Ischnocera: mostly avian chewing lice, however, one family parasitizes mammals
- Amblycera: a primitive suborder of chewing lice, widespread on birds, however, also live on South-American and Australian mammals

Nearly 5,000 species of louse have been identified, about 4,000 being parasitic on birds and 800 on mammals. Lice are present on every continent in all the habitats that their host animals and birds occupy.[2] They are found even in the Antarctic, where penguins carry 15 species of lice (in the genera *Austrogonoides* and *Nesiotinus*).[3]

Ricinus bombycillae, an Amblyceran louse from the bohemian waxwing

Trinoton anserinum, an Amblyceran louse from a mute swan

Damalinia limbata is an Ischnoceran louse from goats. The species is sexually dimorphic, with the male smaller than the female.

Description

Sucking lice are small wingless insects ranging from 0.5 to 5 mm (0.02 to 0.20 in) in length. They have narrow heads and oval, flattened bodies. They have no ocelli, and their compound eyes are reduced in size or absent. Their antennae are short with three to five segments, and their mouth parts, which are retractable into their head, are adapted for piercing and sucking.[4] There is a cibarial pump at the start of the gut; it is powered by muscles attached to the inside of the cuticle of the head. The mouthparts consist of a proboscis which is toothed, and a set of stylets arranged in a cylinder inside the proboscis, contaiing a salivary canal (ventrally) and a food canal (dorsally).[5] The thoracic segments are fused, the abdominal segments are separate, and there is a single large claw at the tip of each of the six legs.[4]

Chewing lice are also flattened and can be slightly larger than sucking lice, ranging in length from 0.5 to 6 mm

(0.02 to 0.24 in). They are similar to sucking lice in form but the head is wider than the thorax and all species have compound eyes. There are no ocelli and the mouthparts are adapted for chewing. The antennae have three to five segments and are slender in the suborder Ischnocera, but club-shaped in the suborder Amblycera. The legs are short and robust, and terminated by one or two claws. Many lice are specific to a single species of host and have co-evolved with it. They are usually cryptically coloured to match the fur or feathers of the host.[4][6]

Biology

Lice are divided into two groups: sucking lice, which obtain their nourishment from feeding on the sebaceous secretions and body fluids of their host; and chewing lice, which are scavengers, feeding on skin, fragments of feathers or hair, and debris found on the host's body. Most are found on only specific types of animals, and, in some cases, on only a particular part of the body; some animals are known to host up to fifteen different species, although one to three is typical for mammals, and two to six for birds. For example, in humans, different species of louse inhabit the scalp and pubic hair. Lice generally cannot survive for long if removed from their host.[7] Some species of chewing lice house symbiotic bacteria in bacteriocytes in their bodies. These may assist in digestion because if the insect is deprived of them, it will die. If their host dies, lice can opportunistically use phoresis to hitch a ride on a fly and attempt to find a new host.[8]

A louse's color varies from pale beige to dark gray; however, if feeding on blood, it may become considerably darker. Female lice are usually more common than males, and some species are parthenogenetic, with young developing from unfertilized eggs. A louse's egg is commonly called a nit. Many lice attach their eggs to their hosts' hair with specialized saliva; the saliva/hair bond is very difficult to sever without specialized products. Lice inhabiting birds, however, may simply leave their eggs in parts of the body inaccessible to preening, such as the interior of feather shafts. Living louse eggs tend to be pale whitish, whereas dead louse eggs are yellower.[7]

Lice are exopterygotes, being born as miniature versions of the adult, known as nymphs. The young moult three times before reaching the final adult form, usually within a month after hatching.[7]

Ecology

The average number of lice per host tends to be higher in large-bodied bird species than in small ones.[9] Lice have an aggregated distribution across bird individuals, i.e. most lice live on a few birds, while most birds are relatively free of lice. This pattern is more pronounced in territorial than in colonial—more social—bird species.[10] Host organisms that dive under water to feed on aquatic prey harbor fewer taxa of lice.[11][12] Bird taxa that are capable of exerting stronger antiparasitic defense—such as stronger T cell immune response or larger uropygial glands—harbor more taxa of Amblyceran lice than others.[13][14] Reductions in the size of host populations may cause a long-lasting reduction of louse taxonomic richness,[15] for example, birds introduced into New Zealand host fewer species of lice there than in Europe.[16][17] Louse sex ratios are more balanced in more social hosts and more female-biased in less social hosts, presumably due to the stronger isolation among louse subpopulations (living on separate birds) in the latter case.[18] The extinction of a species results in the extinction of its host-specific lice. Host-switching is a random event that would seem very rarely likely to be successful, but speciation has occurred over evolutionary time-scales so it must be successfully accomplished sometimes.[15]

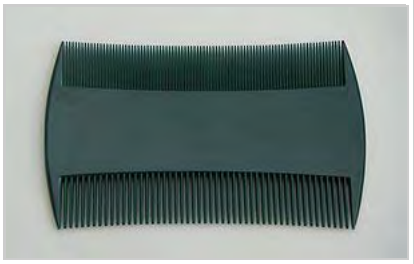
Lice may reduce host life expectancy if the infestation is heavy,[19] but most seem to have little effect on their host. The habit of dust bathing in domestic hens is probably an attempt by the birds to rid themselves of lice.[4]

Lice may transmit microbial diseases and helminth parasites,[20] but most individuals spend their whole life cycle on a single host and are only able to transfer to a new host opportunistically.[4] Ischnoceran lice may reduce the thermoregulation effect of the plumage; thus heavily infested birds lose more heat than others.[21] Lice infestation is a disadvantage in the context of sexual rivalry.[22][23]

The human body louse *Pediculus humanus humanus* had its genome sequenced in 2010, and at that time it had the smallest insect genome known.[24] This louse can transmit certain diseases while the human head louse (*P. h. capitis*), to which it is closely related, cannot. With their simple life history and small genomes, the pair make ideal model organisms to study the molecular mechanisms behind the transmission of pathogens and vector competence.[25] In 2015 there were 5 cases of louse-borne relapsing fever being transmitted to locals reported in Italy.[26]

Interaction with humans

Prehistory


A louse (nit) comb

Humans host three different kinds of lice: head lice, body lice, and pubic lice. Lice infestations can be controlled with lice combs, and medicated shampoos or washes.[27]

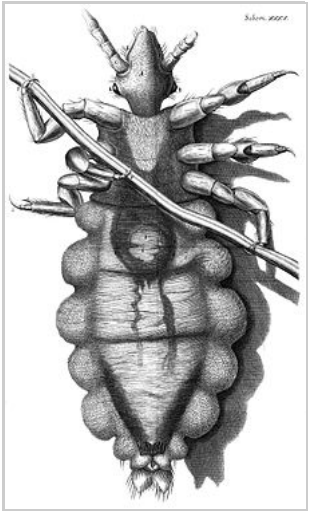
Lice have been the subject of significant DNA research in the 2000s that led to discoveries on human evolution. The three species of sucking lice that parasitize human beings belong to two genera, *Pediculus* and *Phthirus*: head lice (*Pediculus humanus capitis*), body lice (*Pediculus humanus corporis*), and pubic lice (*Phthirus pubis*). Human head and body lice (genus *Pediculus*) share a common ancestor with chimpanzee lice, while pubic lice (genus *Phthirus*) share a common ancestor with gorilla lice. Using phylogenetic and cophylogenetic analysis, Reed et al. hypothesized that *Pediculus* and *Phthirus* are sister taxa and monophyletic.[28] In other words, the two genera descended from the same common ancestor. The age of divergence between *Pediculus* and its common ancestor is estimated to be 6-7 million years ago, which matches the age predicted by chimpanzee-hominid divergence.[28] Because parasites rely on their hosts, host-parasite cospeciation events are likely.

For example, genetic evidence suggests that our human ancestors acquired pubic lice from gorillas approximately 3-4 million years ago.[28] Unlike the genus *Pediculus*, the divergence in *Phthirus* does not match the age of host divergence that likely occurred 7 million years ago. Reed et al. propose a *Phthirus* species host-switch around 3-4 million years ago. While it is difficult to determine if a parasite-host switch occurred in evolutionary history, this explanation is the most parsimonious (containing the fewest evolutionary changes).[28]

Additionally, the DNA differences between head lice and body lice provide corroborating evidence that humans used clothing between 80,000 and 170,000 years ago, before leaving Africa.[29] Human head and body lice occupy distinct ecological zones: head lice live and feed on the scalp, while body lice live on clothing and feed on the body. Because body lice require clothing to survive, the divergence of head and body lice from their common ancestor provides an estimate of the date of introduction of clothing in human evolutionary history.[29][30]

The mitochondrial genome of the human species of body lice (*Pediculus humanus humanus*), the head louse (*Pediculus humanus capitis*) and the pubic louse (*Phthirus pubis*) fragmented into a number of minichromosomes, at least seven million years ago.[31] Analysis of mitochondrial DNA in human body and hair lice reveals that greater genetic diversity existed in African than in non-African lice.[30][32] Human lice can also shed light on human migratory patterns in pre-history. The dominating theory of anthropologists regarding human migration is the Out of Africa Hypothesis. Genetic diversity accumulates over time, and mutations occur at a relatively constant rate. Because there is more genetic diversity in African lice, the lice and their human hosts must have existed in Africa before anywhere else.[32]

Modern history



Drawing of a louse clinging to a human hair. Robert Hooke, *Micrographia*, 1667

Lice have been intimately associated with human society throughout history. In the Middle Ages, they were essentially ubiquitous. At the death of Thomas Becket, Archbishop of Canterbury in 1270, it was recorded that "The vermin boiled over like water in a simmering cauldron, and the onlookers burst into alternate weeping and laughing".[33] A mediaeval treatment for lice was an ointment made from pork grease, incense, lead, and aloe.[34]

Robert Hooke's 1667 book, *Micrographia: or some physiological descriptions of minute bodies made by magnifying glasses with observations and Inquiries thereupon*, illustrated a human louse, drawn as seen down an early microscope.[35]

Margaret Cavendish's satirical *The Description of a New World, Called The Blazing-World* (1668) has "Lice-men" as "mathematicians", investigating nature by trying to weigh the air like the real scientist Robert Boyle.[36][37]

In 1935 the Harvard medical researcher Hans Zinsser wrote the book *Rats, Lice and History*, alleging that both body and head lice transmit typhus between humans.[38] Despite this, the modern view is that only the body louse can transmit the disease.[39]

Soldiers in the trenches of the First World War suffered severely from lice, and the typhus they carried. The Germans boasted that they had lice under effective control, but themselves suffered badly from lice in the Second World War on the Eastern Front, especially in the Battle of Stalingrad. "Delousing" became a grim euphemism for the extermination of Jews in concentration camps such as Auschwitz under the Nazi regime.[40]

In the psychiatric disorder delusional parasitosis, patients express a persistent irrational fear of animals such as lice and mites, imagining that they are continually infested and complaining of itching, with "an unshakable false belief that live organisms are present in the skin".[41]

Detail showing delousing from Jan Siberechts' painting *Cour de ferme* ("Farmyard"), 1662

In literature and folklore

James Joyce's 1939 book *Finnegans Wake* has the character Shem the Penman infested with "foxtrotting fleas, the lieabed lice, ... bats in his belfry".[44]

Mother Louse, a notorious Alewife in Oxford during the mid 18th century. Her crest includes 3 lice. Image by David Loggan.[42][43]

Clifford E. Trafzer's *A Chemehuevi Song: The Resilience of a Southern Paiute Tribe* retells the story of Sinawavi (Coyote)'s love for Poowavi (Louse). Her eggs are sealed in a basket woven by her mother, who gives it to Coyote, instructing him not to open it before he reaches home. Hearing voices coming from it, however, Coyote opens the basket and the people, the world's first human beings, pour out of it in all directions.[45]

The Irish songwriter John Lyons (b. 1934) wrote the popular[46] song *The Kilkenny Louse House*. The song contains the lines "Well we went up the stairs and we put out the light, Sure in less than five minutes, I had to show fight. For the fleas and the bugs they collected to march, And over me stomach they formed a great arch". It has been recorded by Christie Purcell (1952), Mary Delaney on *From Puck to Appleby* (2003), and the Dubliners on *Double Dubliners* (1972) among others.[46][47]

Robert Burns dedicated a poem to the Louse, inspired by witnessing one on a lady's bonnet in church: "Ye ugly, creepin, blastid wonner, Detested, shunn'd, by saint and sinner, How dare ye set your fit upon her, sae fine lady! Gae somewhere else, and seek your dinner on some poor body." John Milton in *Paradise Lost* mentioned the biblical plague of lice visited upon pharaoh: "Frogs, lice, and flies must all his palace fill with loathed intrusion, and filled all the land." John Ray recorded a Scottish proverb, "Gie a beggar a bed and he'll repay you with a Louse." In Shakespeare's *Troilus and Cressida*, Thersites compares Menelaus, brother of Agamemnon, to a louse: "Ask me not what I would be, if I were not Thersites; for I care not to be the louse of a lazar, so I were not Menelaus."[48]

See also

- Pest (organism)
- Use of DNA in forensic entomology

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External links

- National Pesticide Information Center – Understanding and Controlling Lice (http://npic.orst.edu/pest/lice.html)
- body and head lice (http://entomology.ifas.ufl.edu/creatures/urban/human_lice.htm) on the University of Florida/Institute of Food and Agricultural Sciences Featured Creatures Web site
- crab louse (http://entomology.ifas.ufl.edu/creatures/urban/crab_louse.htm) on the University of Florida/Institute of Food and Agricultural Sciences Featured Creatures Web site
- *Pediculus humanus capitis* head louse facts, myths, life cycle at MetaPathogen (http://www.metapathogen.com/lice/phumanus/)
- Parasitic Insects, Mites and Ticks: Genera of Medical and Veterinary Importance (https://en.wikibooks.org/wiki/Parasitic_Insects,_Mites_and_Ticks:_Genera_of_Medical_and_Veterinary_Importance/Sucking_lice) Wikibooks

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