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Size Correlations between Sucking Lice and Their Hosts Including a Test of Harrison's Rule

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by

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(Under the Direction of Lance A. Durden)

ABSTRACT

Ectoparasite size can be influenced by many factors; one is host size. Harrison's rule states that larger hosts typically have larger parasites. In this study, sucking lice (Insecta: Anoplura) were used to test this rule. Sucking lice should provide a good test for this rule because they are generally host-specific and because, as a group, they parasitize hosts of different sizes. Also, sucking lice use their tibio-tarsal claws to grasp host hairs, therefore, correlations between claw size and host hair diameters were also tested. Raw analyses including 206 species of slide-mounted sucking lice from throughout the world, followed by analyses of phylogenetically subtracted data, were used to test the hypotheses that sucking louse body size is correlated with host body size and that sucking louse claw size is correlated with host hair diameters. Data from 3 separate louse families, Hoplopleuridae, Linognathidae and Polyplacidae, were also analyzed. Lice, their claws, and hairs were measured using a calibrated graticule fitted into the eyepiece of a compound microscope. The combined raw data showed that louse body and claw size were positively correlated with host body and hair size, respectively. However, after phylogenetic subtraction, the overall data showed that another indicator of louse size, female louse second tarsal segment length, was positively correlated to host body mass and length. However, male louse thorax width was negatively correlated to host body length. Within the family Hoplopleuridae, both male and female louse thorax width were significantly correlated with host body mass and length, as well as, second tarsal segment length and host body length. Within the family Polyplacidae, male and female thorax width was positively correlated to host body length. Phylogenetically subtracted data revealed significant positive correlations for the families Hoplopleuridae and Polyplacidae between indicators of host and louse size but not between host hair diameters and louse claw measurements. Overall, the data show sucking lice have adapted morphologically to their hosts and conform to Harrison's rule.

INDEX WORDS: Sucking lice, host-parasite body size, tibio-tarsal claw size, mammalian hair, phylogenetic subtraction, Harrison's rule

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DEDICATION

This thesis is dedicated to my friends and family who encouraged me to follow my dream.

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INTRODUCTION

Parasites are ubiquitous and even the smallest of organisms have some form of parasite (Hamilton et al. 1990). Parasitism can be influenced by a number of factors including host age, sex, and ecological conditions (Hauschka 1947, Atkinson and van Riper 1991, Desser and Bennett 1993, Zuk and McKean 1996). For example, one sex of the host might be more susceptible to parasitism (Marshall 1981b). This is often due to host hormone levels, behavior and stress levels (Bundy 1988, Grossman 1985, Schuurs and Verheul 1990, Zuk 1990, Zuk and Mckean 1996). Although mammals are often sexually size dimorphic, this does not have an effect on the susceptibility to parasitism (McCurdey et al. 1998).

Parasites often show close evolutionary and phylogenetic associations with their hosts and host-parasite cospeciation is widespread (Lyal 1987, Hafner and Nadler 1988, Clayton et al. 2003, Clayton and Johnson 2003, Smith et al. 2008). Co-speciation has been especially well studied in several groups of ectoparasites (Kim 1985a), particularly lice (Tompkins and Clayton 1999, Hafner et al. 1994, Clayton and Johnson 2003, Clayton et al. 2003, Johnson and Clayton 2004, Smith et al. 2008). These close host-parasite evolutionary relationships are often manifested as morphologically specialized traits in parasites, especially ectoparasites (Kim 1985a). They have been shown to track certain morphological traits of their hosts such as skin thickness, hair size and anti-parasitic host traits such as grooming-adapted claws, teeth or beaks (Kim 1985a, Lehane 1991, Tompkins and Clayton 1999, Clayton and Walther 2001, Clayton et al. 2003, Johnson et al. 2005)

For this study, I focused on analyzing host-influenced morphological adaptations of one group of ectoparasites, the sucking lice (Order Phthiraptera, Suborder Anoplura). Lice are small, wingless, dorsoventrally flattened ectoparasites that parasitize mammals and birds (Durden 2001). They are divided into four suborders; Anoplura (sucking lice), Ischnocera, Amblycera and Rhynchophthirina (collectively, the chewing lice) (Barker 1994, Durden and Musser 1994, Durden 2001, Durden and Lloyd 2009). There are about 550 described species of sucking lice, in 16 families and 49 genera (Durden and Musser 1994). Sucking lice are obligate blood-feeding ectoparasites of placental (eutherian) mammals (Kim 1988, Durden and Musser 1994). They have specialized sucking mouthparts attached to a head that is narrower than the thorax (Durden 2001). The head size, mouthparts and claws distinguish sucking lice from chewing lice (Snodgrass 1944, Durden and Lloyd 2009). In sucking lice, mouthparts are stylet-like (similar in some ways to those of many other blood sucking insects); they are skin-piercers highly adapted for blood feeding (Durden 2001).

There are five stages in the louse life cycle; nit (egg), three nymphal instars and adult, all of which live on the host, which makes them permanent ectoparasites (Figure 1) (Durden 2001). Depending on the louse species, each nymphal instar can last from 2-8 days, while the adult stage can typically last up to 30 days (Durden 2001). In total, most species of sucking lice live an average of 45 days (Durden 2001). The short generation times of these ectoparasites gives them the ability to rapidly adapt to their mammalian hosts. This short generation time combined with their permanent presence on the host and high host-specificity make them an ideal model for studying parasite host-tracking (Hamilton et al. 1990).

In nature, lice rarely transfer from one host species to another, which promotes host specificity (Durden and Lloyd 2009). Lice can transfer from one individual to another, usually in the same species, through close body contact, usually from mother to offspring contact or during sexual or aggressive encounters (Durden 1983, Durden and Lloyd 2009, Rozsa 1993, Barker 1994).

Parasites, especially host-specific parasites, have intimate associations with their hosts and these close associations should be reflected in certain parasite morphological traits. For example, some ectoparasites can only survive on a particular sized host (Clay 1949, Reed and Hafner 1997, Thompkins and Clayton 1999, Bush and Clayton 2006). Bush and Clayton (2006) found that feather lice survival (fitness) is dependent on the size of its bird host. The feather lice were transferred to "novel" hosts smaller, larger and similar in size to that of the native host (columbiform birds). A similar study conducted on chewing lice of pocket gophers also found that if their chewing lice were transferred to similar sized "novel hosts", the chewing lice population still thrived (Reed and Hafner 1997).

Host size also seems to be an important part of parasite host specificity. When a parasite cannot stay attached to a different sized host than the "novel" host, then the parasite is often host specific (Clay 1949). For example, Tompkins and Clayton (1999) found this to be true for cave-swiftlet lice. When they transferred cave-swiftlet lice to different hosts, they were not able to survive due to adaptive limitations. It appears that these ectoparasites have tracked the resources of their hosts.

Harrison's Rule states that larger species of hosts typically have larger parasites (Harrison 1915). This relationship has been verified for example, for chewing lice of pocket gophers, rhizocephalan barnacles and some groups of fleas and nematodes (Kirchner et al. 1980, Harvey and Keymer 1991, Kirk 1991, Morand et al. 1996, 2000, Poulin and Hamilton 1997, Morand and Sorci 1998). However, there have been varying results for different types of parasites, with some conforming and some not conforming to Harrison's rule. For example, Morand and Sorci (1998) and Kirchner et al. (1980) showed an increase in nematode body size in relation to host size (i.e., a positive correlation) which conforms to Harrison's rule, while Poulin (1995) showed a negative relationship between parasitic isopod body size and host size which does not conform to this rule. Harrison's rule has not been previously tested on sucking lice and one aspect of this study was to investigate if sucking lice conform to it. Some of the largest species of sucking lice are host-specific ectoparasites of relatively large hosts such as ungulates and pinnipeds, whereas some of the smallest species are parasites of shrews and rodents (Durden and Musser 1994). Therefore, it would appear that Anoplura may conform to Harrison's rule. Nevertheless, rigorous analyses are warranted to further investigate this phenomenon.

For sucking lice to survive as permanent ectoparasites, they must have adaptations that allow them to stay on the host (Wall and Shearer 2001). Because lice have short generation times (compared to their hosts) and adapt to their host to survive, I hypothesized that larger hosts will have sucking lice that are larger in body size compared to lice of smaller host species.

Many ectoparasites utilize specialized morphological structures to enhance their attachment to the host. For example, ectoparasites such as fleas (Siphonaptera), streblid batflies (Diptera, Streblidae) and bat bugs (Hemiptera, Polyctenidae) have specialized comb-like structures called ctenidia (Marshall 1981a, Lehane 1991). Humphries (1966) and Amin and Sewell (1977) have shown that, for host specific flea species, there is a positive correlation between maximum host guard hair diameter and the distance between the spine tips in the ctenidia. Similarly, certain host specific fur mites (members of the families Myobiidae, Chirodiscidae, Listrophoridae and Myocoptidae) have highly modified grasping legs with ambulacral discs that fit snuggly around, or onto, host underfur hairs (Labrzycka 2006). While a few sucking louse species have hook-like processes of unknown function on their heads (Kim 1985b), all sucking lice have highly adapted tibio-tarsal claws (Ferris 1951) that grasp individual host hairs (Figure 2). For this reason, it was decided to also further investigate tibio-tarsal claws with respect to host hair diameters.

Sucking lice have three pairs of legs, each with a tibio-tarsal claw (Durden 2001). In this study, I focused on the second and third (largest) tibio-tarsal claws of sucking lice because the first claw has a simple (non-opposable) claw. The claws allow the lice to grasp host hairs and orient themselves next to the host skin while feeding on blood (Durden and Lloyd 2009).

Mammalian fur usually consists of two types of hairs, guard hairs and underfur hairs (Reed et al. 2000). Guard hairs are long and thick while underfur hairs are short and thin (Reed et al. 2000). Reed et al. (2000) observed that chewing lice of pocket gophers spend most of their lives on guard hairs. Similar information has not been recorded for sucking lice. Mathiak (1938) found that the greatest diameter of most mammalian guard hairs is midway between the root and tip of the hair shaft. I hypothesized that the third (largest) tibio-tarsal claw would correlate with the greatest diameter of the host hair shaft and the second tibio-tarsal claw would correlate with the base diameter of the guard hair (where the hair is closest to the skin). If the claws are too large or too small, it is possible that the louse could more easily be removed through host grooming (Durden and Lloyd 2009). Morand et al. (2000) showed that the size of of the semi-circular head groove of chewing lice that are host-specific parasites of various species of pocket gophers was positively correlated to the host guard hair diameter. This previous study allows the prediction that if chewing louse head groove size is adapted to host hair diameter, then the sucking louse second and third tibio-tarsal claw may have adapted similarly to conform to the host hair diameter.

This study provides a test of how sucking lice have evolved to morphologically track two key mammalian host traits, body size and hair size. Previous works on certain groups of chewing lice have demonstrated tracking of these host traits to varying degrees. Therefore, the hypotheses to be investigated in this study are that sucking lice have also adapted to track these host traits. Nevertheless, the general morphology of sucking and chewing lice is different (chewing lice do not have tibio-tarsal claws, for example) so the manner in which sucking lice have morphologically tracked their hosts is likely to be different from that of chewing lice. The hypotheses tested were that sucking louse body size is correlated with host body size and that sucking louse claw size is correlated with host hair diameters.

MATERIALS AND METHODS

Measurement of lice

Adult slide-mounted lice were obtained from the collection of Dr. Lance A. Durden (Georgia Southern University, Statesboro, Georgia). This collection contains cleared, slide-mounted species from every Continent and is one of the top five collections in the world with respect to number of species. Only adult lice were used for measurements since they are at their maximum size at this stage in the life cycle and few immature lice (nymphs) are in the collection. Each specimen had previously been slide mounted using the same mounting techniques. Each of specimen was cleared using 10% potassium hydroxide, dehydrated using alcohols of ascending concentrations, further cleared in xylene and slide mounted in Canada balsam (Palma 1978). As with all dehydrated, slide-mounted specimens, there is slight shrinkage during the dehydration phase (~1-2% of overall size), but as every specimen was slide mounted using the same procedure, variation due to shrinkage should be similar across species.

Male and female lice representing a total of 206 species (representing 27 genera) of Anoplura were measured (in mm) using a compound microscope (National Optical, San Antonio, Texas) fitted with a calibrated eyepiece graticule (American Optical Company, Buffalo, New York) (i.e., a measuring scale for making micrometric measurements). The eyepiece was calibrated for the objective magnification using a stage micrometer slide (American Optical Company, Buffalo, New York).

Males and females of each species were measured and analyzed separately, since females are typically larger than conspecific males (Durden 2001). Louse body size measurements (in mm) recorded were 1) total body length (anterior-most part of the head to posterior-most part of the abdomen), 2) maximum width of the thorax and 3) length of the second and 4) third tarsal segments (from the base of the leg where it attaches to the thorax to the base of the claw at the joint of the opposable claw) (Figure 4) (see Appendices A&B for measurements). Louse body size measurements were taken from males and females of at least 88 species. The crab louse (*Pthirus pubis*) was excluded from the analyses because its body shape is markedly different from that of the other species (Figure 3). Some louse body sizes were not measured due to damage to slide mounted specimen, which explains lack of measurements shown in Table 1.

In addition to louse body size, the lengths of the opening of the tibio-tarsal claws on the 1) second and 2) third legs were recorded. Each claw needed to be completely flattened and fully opened on the slide, for accurate and comparative measurements; thus, claws for several species of lice were deemed unsuitable and were excluded from the analyses. Claws were deemed open if the space between the claw and the tarsal apophysis was visible. The measurements were taken from the base of the claw to the greatest width enclosed by the tibio-tarsal opening (i.e., to the base of the tarsal apophysis) (Figure 5). The first leg was not measured because most sucking louse species have a simple (non-opposable) claw on this leg instead of a tarsal apophysis. Tibio-tarsal claw opening measurements were taken from at least 18 male and female louse species.

Measurement of Hosts

Mean body mass and body length (from the most anterior point to the end of the abdomen excluding the tail), of the principal host of each species of louse was taken from various sources of literature, including mammal field guides (e.g., Walker's Mammals of the World) and specialist journals (e.g., Mammalian Species) (see Appendix C). In most cases, the type host was used; this is the host species from which louse species was described (Durden and Musser 1994). If the type host was listed erroneously, the principal host was used. Listed are the louse species with the erroneous or atypical type hosts: *Antarctophthirus microchir, Enderleinellus kumadai, E. malaysianus, Microphthirus uncinatus, Haematopinus asini, Haematopinus bufali, H. tuberculatus, Haematopinoides squamosus, Hoplopleura biserata, H. brasiliensis, H. capensis, H. chippauxi, H. erratica, H. multilobata, H. neumanni, H. trispinosa, Linognathus africanus, Pedicinus hamadryas, P. mjobergi, Eulinognathus aculeatus, Fahrenholzia pinnata, Johnsonpthirus suahelicus, Lemurphthirus galagus, Neohaematopinus scirui, Polyplax alaskensis, P. asiatica, Polyplax expressa, Polyplax meridionalis, P. paradoxia, P. praecisa, P. smallwoodae, P. watersoni,* and *Scipio tripedatus* as listed by Durden and Musser (1994).

Measurement of Mammalian Hair

Host hairs were taken from dried museum specimens from: Smithsonian Institution National Museum of Natural History (Washington, District of Columbia), Georgia Southern University Mammal Collection (Statesboro, Georgia), University of Washington-Burke Museum (Seattle, Washington), Texas Cooperative Wildlife Collection (College Park, Texas), University of Michigan Museum of Zoology (Ann Arbor, Michigan), Michigan State University Museum (East Lansing, Michigan), University of Puget Sound Slater Museum (Tacoma, Washington), Cornell University Museum (Ithaca, New York), Museum of Comparative Zoology-Harvard (Cambridge, Massachusetts), University of Florida Natural History Museum (Gainesville, Florida).

Ten guard hairs and ten underfur hairs were taken from at least two specimens of each host species (if available) using microscissors. Specialized hairs such as spines or manes were excluded from the collection. For consistency, the hairs were removed from the same site for each host species, the dorsal anterior region (between the bases of the fore limbs). The hairs were excised by cutting, with microscissors, at skin level. The collected hairs were then placed into separate specimen vials using forceps and labeled appropriately with genus and species name, catalog number and country of origin. Hairs were later slide mounted using PVA mounting medium and measured using a compound microscope (National Optical, San Antonio, Texas) with the fitted calibrated eyepiece graticule (American Optical Company, Buffalo, New York). The hairs (guard and underfur) were measured at the maximum diameter as well as at the base of the hair (See Appendix D), above the follicle where the hair starts to taper (Figure 6).

Statistical Analysis

Mean measurements from 206 species of sucking lice were analyzed using pairwise correlations against host size (body length and mass). The statistical variables n, p, correlation coefficient (r) and the regression coefficient (r^2) were recorded (Table 1). Male and female lice were analyzed separately because females are larger than males.

In addition to raw data, Stearn's (1983) phylogenetic subtraction method was used to remove any variation in the data associated with common ancestry (Harvey and Pagel 1991). Phylogeny can account for a large percentage of variation among species (Harvey and Pagel 1991). This method is appropriate for this study because the current phylogeny for Anoplura (Kim 1988) is outdated and missing key information such as branch lengths, which are used in the more common, independent contrasts method analysis (Harvey and

Pagel 1991). Phylogenetic subtraction subtracts the mean sizes of a higher taxonomic level, from a lower taxonomic level (Harvey and Pagel 1991). The final data obtained after phylogenetic subtractions are independent of their phylogenetic associations and treated as independent data points (Harvey and Pagel 1991). For example, the mean size of the family Polyplacidae would be subtracted from the mean size of the species *Polyplax abyssinica* resulting in the phylogenetically independent residuals for that species. After phylogenetic subtraction, adult males of 161 species (7 families and 22 genera) and adult females of 200 species of sucking louse species (7 families and 26 genera) were obtained.

Analyses were conducted at the species level. For each louse species, male and female louse size (length, maximum thorax width and second and third tarsal length) residuals and the host mass and lengths were used in pairwise correlation analyses. In addition, the male and female second and third claw opening residuals and host hair diameters were used in pairwise correlation analyses. JMP 8.0 (SAS Institute 2008) was used to analyze the data.

The same pairwise correlation analyses were then performed for three families of sucking lice for the male and female datasets; Hoplopleuridae, Linognathidae and Polyplacidae. These families were chosen because they contained the largest number of louse species measured. To test for low power within the pairwise correlations, power analyses were then carried out, using JMP 8.0 (SAS Institute 2008), on analyses with low sample sizes. To increase the power of the analyses, the significance level that must be satisfied was increased from 0.05 to 0.1 (see Table 2).

RESULTS

The results of this study were based on a significance level alpha=α <0.1. The following are the significant results found; all results are listed in Table 1, which shows correlation analyses variables (n, p, r, r^2) for all tests. Here, significant correlation analyses are highlighted. Other significant correlations are found in Appendix E.

Raw Data Analyses

For the raw data on lice, all body size and hair size correlations were positively significant. The following body size correlations were significant: male and female louse body length and host body mass (Figures 7 & 8), male and female louse body length and host body length (Figures 9 & 10). Other significant raw data correlations are found in Appendix E, figures 1-12.

The following louse-hair size correlations were significant: male and female louse second claw opening and maximum guard hair diameter (Figures 11 & 12), male and female louse second claw opening and maximum underfur hair diameter (Figures 13 & 14), male and female louse second claw opening and base guard hair diameter (Figures 15 & 16), male and female louse second claw opening and base underfur hair diameter (Figure 17 & 18), male and female louse third claw opening and maximum underfur hair diameter (Figure 19 & 20), male and female louse third claw opening and base guard hair diameter (Figures 21 & 22), male and female louse third claw opening and base underfur hair diameter (Figures 23 & 24) and male louse third claw opening and maximum guard hair diameter (Figure 25).

Residual Data Analyses

Phylogenetically subtracted datasets using male and female lice were analyzed separately and are found in Appendix E, figures 13-15

Residual Data Analysis for the louse family Hoplopleuridae

Within the family Hoplopleuridae, female louse body length residual was negatively correlated with host body length (Figure 26). However, male and female louse body size indicators (thorax width, second and third tarsal segment lengths) were positively correlated to host body size (Appendix E, figures 16-25).

Residual Data Analysis for the louse family Linognathidae

Within the family Linognathidae, the significant correlation is found in Appendix E, figure 26.

Residual Data Analysis for the louse family Polyplacidae

Within the family Polyplacidae, the following body size correlations were significantly positive: male and female louse body length residual and host body length (Figures 27 & 28) and female louse third tarsal segment length residual and host body mass, louse body length residual and host body mass (Figure 29). Female louse body size indicators (thorax width, second and third tarsal segement lengths) were positively correlated to host body sizes, and male thorax width was positively correlated to hyost body length (Appendix E, figures 27-32).

DISCUSSION

Louse body size and Host body size

The raw data analyses in this study showed significant positive correlations between louse body size (body length, thorax width and tarsal length) and host body size (body length and mass). These results support Harrison's rule in that larger hosts generally had larger sucking lice and therefore, support the hypothesis that sucking louse body size is positively correlated with host size.

In addition to raw data analyses, phylogenetic subtraction was used to remove variation resulting from phylogeny. These residual results show that host body size is positively correlated with louse second tarsal segment length. These results are similar to those of previous studies of chewing lice, fleas, nematodes and parasitic rhizocephalan barnacles in that they conform to Harrison's rule (Kirchner et al. 1980, Harvey and Keymer 1991, Kirk 1991, Morand et al. 1996, 2000, Poulin and Hamilton 1997, Morand and Sorci 1998).

To further test host-louse body size correlations at a finer taxonomic scale, three louse families were analyzed separately to test for correlations, as Harvey and Keymer (1991), Kirk (1991) and Morand et al. (2000) did for different genera of chewing lice. One of the families with larger sample sizes in this study, Hoplopleuridae, showed that louse thorax width residuals were positively correlated with host body size (length and mass), second tarsal segment length residuals were positively correlated with host body length and third tarsal segment length residuals were positively correlated with host body size in males. In addition, thorax width residuals were positively correlated with host body length in Polyplacidae males and females. Additionally, thorax width residuals, second tarsal segment length residuals and third tarsal segment length residuals were positively correlated with host body size in Polyplacidae females. However, in the family Hoplopleuridae, female body length residuals were significantly negatively correlated with host body length. These data show that, for the families Hoplopleuridae and Polyplacidae, the correlations between host size and louse size was largely independent of louse phylogeny. The other families in the dataset were not analyzed because of small sample sizes (n<10). Data from other studies, in which higher taxonomic levels (genera) of chewing lice were analyzed, also supported Harrison's rule (Harvey and Keymer 1991, Kirk 1991, Morand et al. 2000). Harvey and Keymer (1991) and Morand et al. (2000) found that gopher species with larger body sizes had larger chewing lice. Also, Kirk (1991) found a significant positive relationship between the body size of a species of chewing louse, *Actornithophilus umbrinus*, and its host bird size.

Host body length and mass were used as proxies for host size in this study. There are host variables, other than host body mass and length, which could influence louse survival. These variables presumably include host skin thickness, coat depth, body temperature, sex, pheromone concentration, and grooming practices and habits (Murray 1960, Grossman 1989, Kirk 1991, Lehane 1991, Mooring et al. 2004 and Gorrell and Schulte-Hostedde 2008). Lehane (1991) found that tabanids locate thinner skin on their host to feed. Murray (1960) found that for the sheep foot louse, *Linognathus pedalis,* egg hatching was influenced by temperature. *Linognathus pedalis* has the highest hatching success rate at 36 °C and anything above or below this are not adequate temperatures for survival (Murray 1960). Therefore, *Linognathus pedalis* eggs are adapted for optimal survival only on sheep body sites that are at a temperature of 36°C. In addition, it has been previously documented that male hosts tend to be more heavily parasitized than females (Gorrell and Schulte-Hostedde 2008). This heavy parasitism in males might be because adult females have a stronger immune response (this is suppressed by testosterone in males), which could affect louse survival (Grossman 1989). Also, Mooring et al. (2004) found that some male hosts groom less than females, which could result in a higher rate of parasitism. As with fleas, coat depth could also affect the body size of lice. Kirk (1991) found that flea size is significantly correlated with host coat depth. For lice to survive long enough on the host to reproduce, they need to escape grooming responses by the host. The size of the lice could affect how well they move through the coat. The size and shape of a louse species on a particular host species may be adapted for easy escape from host grooming (Clay 1957, Clayton et al. 2003, Johnson and Clayton 2003). Clay (1957) and Johnson and Clayton (2003) found that particular groups of bird lice are morphologically different because of where they live on the host body. For example, lice found on the wings are flat for easy escape through feathers (Clay 1957). Clayton et al. (2003) found that feather lice could not escape from host grooming (preening) when that host was a different size than the native host. Ectoparasites are susceptible to selective pressures from the host, especially grooming and preening, and selectively adapt to avoid host defenses (Kethley and Johnston 1975, Ròsza 1993).

Louse claw size and Host hair diameter

There is a precedent that ectoparasites use structures to grasp host hairs. As with the combs of fleas (Humphries, 1966) and the head groove of chewing lice (Reed et al. 2000), sucking lice have a set of host-attachment structures, tibio-tarsal claws.

Correlating these claw opening sizes with host hair sizes has never been morphometrically tested until now. In this study, raw data analyses were used to test for a correlation between louse tibio-tarsal claw opening size and host hair diameter. Positive correlations were found in male lice between both (second and third) tibio-tarsal claw openings and host hair diameters. Interestingly, the claw openings were correlated with diameters at skin level as well as with the maximum hair diameter. However, in females, the third claw opening was not correlated with maximum guard hair diameter. It was expected that second claw opening diameters would correlate with hair diameter at skin level and third claw openings correlated with maximum hair diameter. This is because when lice feed, their heads are directed towards the skin and the second claw should therefore be closer to the skin surface than the third claw. Other research has been conducted with fleas, chewing lice, mites and hippoboscid flies that demonstrate the functional role of attachment organs for these ectoparasites (Humphries 1966, 1967, Taft 1973, Amin and Sewell 1977, Reed et at. 2000, Labryzycka 2006). Taft (1973) found that spacing between hooklets on the claws of avian and mammalian hippoboscid flies is correlated with the diameter of feather barbules or hairs of their hosts.

After phylogenetic subtraction, the data from this study showed no significant correlations between louse claw openings and host hair diameters. The raw results support the hypothesis that claw openings are dependent on host hair diameter but, after phylogenetic subtraction, it is not supported. These results signify that louse evolutionary lineage (phylogeny) accounts for more variation in louse claw size than host hair diameter does. However, the process of measuring louse claw openings was somewhat restricted. Many individuals could not be measured, thereby decreasing the sample sizes.

These small sample sizes allowed only a few analyses to be run, possibly making them unreliable. Also, sucking lice might use more than just their tibio-tarsal claws to stay attached to their hosts. Bush et al. (2006) found that chewing lice of birds use not only their head groove to attach to feathers, but also their mandibles to stay attached to the host. Although the mouthparts of sucking lice are haustellate and not mandibulate, other integumental structures (such as cephalic spines and hooks in some species) could help these lice to remain attached to their hosts. Kethley and Johnston (1975) found that certain ectoparasitic mites of birds have adaptive morphological mechanisms for clinging onto feathers so tightly that the bird would be forced to pull out its feathers to remove the mites. Like these mites, lice have evolved morphological traits for clinging to host hairs.

When each family was analyzed separately, significant correlations for the louse families Hoplopleuridae ad Polyplacidae were demonstrated between louse body size measurements and host body size. These data show that, for these two louse families, correlations between louse and host body sizes were independent of louse phylogeny. Conversely, there were no significant correlations between louse claw sizes and host hair diameters. Members of each these families have similar sized hosts, with different habitats, which could result in their sucking lice adapting to other host traits. For example, lice in the family Linognathidae are all parasites of large mammals of the families Bovidae (cattle, sheep, antelope, etc.), which are found in tropical and subtropical grasslands and savannas, Cervidae (deer), found in a wide range of habitats, from arctic tundra to tropical forests, Canidae (dogs, foxes, etc.), found on all continents except Antarctica and one species parasitizes a member of the Giraffidae, found in sub-Saharan Africa. Conversely, lice in the families Polyplacidae and Hoplopleuridae are all found on smaller mammals, mostly ground dwelling rodents, especially muroid rodents that are found on all continents except Antarctica (Durden and Musser, 1994).

Sources of error should always be considered within any experiment. Hairs in this experiment were taken from dried museum specimens; the drying process could have slightly altered the thickness of the hair from its natural state. Also, hairs on some mammal species change slightly by season (Ling 1970), and this was impossible to control because of limited museum resources. Lastly, host body mass and length averages were taken from the literature. These averages are not the actual measurements from each of the individual hosts from which measured louse specimens were taken.

Despite these potential sources of error, data from this study show clear trends for increased overall sucking lice body size with host body size and a correlation between host hair diameters and tibio-tarsal claw size openings. Overall, sucking lice have clearly tracked certain morphological traits of their hosts as demonstrated for the louse-host body size and louse claw-host hair correlations documented in this study, although, louse phylogeny also accounts for some of the observed trends.

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Table 1: Statistical variables for correlation analyses tested between host and sucking louse body sizes and host hair size and louse claw size. (significant p-values are in bold)

	N	p-value	r^2	r
Raw female louse body correlations				
Lice body length and Host body mass	147	**<0.01**	0.28	0.53
Lice body length and Host body length	157	**<0.01**	0.37	0.61
Louse thorax width and Host body mass	145	**<0.01**	0.14	0.37
Louse thorax width and Host body length	155	**<0.01**	0.20	0.44
Louse second tarsal length and Host body mass	121	**<0.01**	0.36	0.60
Louse second tarsal length and Host body length	123	**<0.01**	0.43	0.65
Louse third tarsal length and Host body mass	88	**<0.01**	0.27	0.52
Louse third tarsal length and Host body length	89	**<0.01**	0.35	0.59
Raw female louse claw correlations				
Louse second claw opening and Host maximum guard hair diameter	54	**<0.01**	0.15	0.38
Louse second claw opening and Host maximum underfur hair diameter	45	**<0.01**	0.41	0.64
Louse second claw opening and Host base guard hair diameter	54	**<0.01**	0.29	0.54
Louse second claw opening and Host base underfur hair diameter	45	**<0.01**	0.19	0.43
Louse third claw opening and Host maximum guard hair diameter	20	0.13	0.12	0.35
Louse third claw opening and Host maximum underfur hair diameter	18	**<0.01**	0.51	0.72
Louse third claw opening and Host base guard hair diameter	20	**0.01**	0.35	0.59
Louse third claw opening and Host base underfur hair diameter	18	**0.01**	0.34	0.58
Phylogenetically subtracted female louse body correlations				
Lice body length residual and Host body mass	142	1.00	<0.01	<0.01
Lice body length residual and Host body length	156	0.87	<0.01	0.01
Louse thorax width residual and Host body mass	141	0.45	<0.01	-0.06
Louse thorax width residual and Host body length	155	0.74	<0.01	0.03
Louse second tarsal length residual and Host body mass	114	**0.08**	0.03	0.17

Louse second tarsal length residual and Host body length	121	**0.01**	0.05	0.23
Louse third tarsal length residual and Host body mass	83	0.96	<0.01	-0.01
Louse third tarsal length residual and Host body length	84	0.93	<0.01	-0.01
Phylogenetically subtracted female louse claw correlations				
Louse second claw opening residual and Host maximum guard hair diameter	57	0.25	0.02	0.15
Louse second claw opening residual and Host maximum underfur hair diameter	47	0.27	0.03	0.16
Louse second claw opening residual and Host base guard hair diameter	57	0.12	0.04	0.21
Louse second claw opening residual and Host base underfur hair diameter	27	0.65	0.01	0.09
Louse third claw opening residual and Host maximum guard hair diameter	22	0.11	0.12	0.35
Louse third claw opening residual and Host maximum underfur hair diameter	20	0.19	0.09	0.30
Louse third claw opening residual and Host base guard hair diameter	22	0.50	0.02	0.15
Louse third claw opening residual and Host base underfur hair diameter	18	0.70	0.01	0.10
Female louse family correlations				
Hoplopleuridae				
Lice body length residual and Host body mass	39	0.55	0.01	-0.10
Lice body length residual and Host body length	52	**0.06**	0.07	-0.27
Louse thorax width residual and Host body mass	39	**0.01**	0.15	0.39
Louse thorax width residual and Host body length	52	**0.06**	0.07	0.26
Louse second tarsal length residual and Host body mass	32	0.33	0.03	0.18
Louse second tarsal length residual and Host body length	43	**0.09**	0.07	0.26
Louse third tarsal length residual and Host body mass	17	0.45	0.04	0.20
Louse third tarsal length residual and Host body length	22	0.51	0.02	-0.15
Louse second claw opening residual and Host maximum guard hair diameter	24	0.77	<0.01	0.06
Louse second claw opening residual and Host maximum underfur hair diameter	21	0.34	0.05	-0.22
Louse second claw opening residual and Host base guard hair diameter	24	0.43	0.03	0.17

Linognathidae				
Lice body length residual and Host body mass	15	0.70	0.01	0.11
Lice body length residual and Host body length	13	0.61	0.02	0.16
Louse thorax width residual and Host body mass	15	0.38	0.06	0.24
Louse thorax width residual and Host body length	13	0.10	0.22	0.47
Louse second tarsal length residual and Host body mass	13	0.54	0.03	0.19
Louse second tarsal length residual and Host body length	11	0.17	0.20	0.45
Louse third tarsal length residual and Host body mass	13	0.66	0.02	0.13
Louse third tarsal length residual and Host body length	11	**0.04**	0.40	0.63
Polyplacidae				
Lice body length residual and Host body mass	64	**<0.01**	0.13	0.37
Lice body length residual and Host body length	71	**<0.01**	0.13	0.37
Louse thorax width residual and Host body mass	64	**<0.01**	0.12	0.35
Louse thorax width residual and Host body length	71	**<0.01**	0.31	0.56
Louse second tarsal length residual and Host body mass	49	**<0.01**	0.21	0.45
Louse second tarsal length residual and Host body length	51	**<0.01**	0.20	0.44
Louse third tarsal length residual and Host body mass	35	**0.05**	0.11	0.33
Louse third tarsal length residual and Host body length	37	0.48	0.01	0.12
Louse second claw opening residual and Host maximum guard hair diameter	26	0.84	<0.01	0.04
Louse second claw opening residual and Host maximum underfur hair diameter	23	0.13	0.10	0.32
Louse second claw opening residual and Host base guard hair diameter	26	0.82	<0.01	-0.05
Louse second claw opening residual and Host base underfur hair diameter	23	0.97	<0.01	0.01
Louse third claw opening residual and Host maximum guard hair diameter	13	0.98	<0.01	0.01
Louse third claw opening residual and Host maximum underfur hair diameter	14	0.27	0.10	0.32
Louse third claw opening residual and Host base guard hair diameter	13	0.23	0.13	-0.36

Louse third claw opening residual and Host base underfur hair diameter	14	0.59	0.02	0.16
Raw male louse body correlations				
Lice body length and Host body mass	147	**<0.01**	0.28	0.53
Lice body length and Host body length	159	**<0.01**	0.43	0.66
Louse thorax width and Host body mass	146	**<0.01**	0.14	0.37
Louse thorax width and Host body length	158	**<0.01**	0.20	0.45
Louse second tarsal length and Host body mass	87	**<0.01**	0.27	0.52
Louse second tarsal length and Host body length	92	**<0.01**	0.22	0.47
Louse third tarsal length and Host body mass	73	**<0.01**	0.32	0.57
Louse third tarsal length and Host body length	69	**<0.01**	0.32	0.57
Raw male louse claw correlations				
Louse second claw opening and Host maximum guard hair diameter	39	**0.08**	0.08	0.28
Louse second claw opening and Host maximum underfur hair diameter	33	**<0.01**	0.45	0.67
Louse second claw opening and Host base guard hair diameter	39	**0.01**	0.19	0.44
Louse second claw opening and Host base underfur hair diameter	33	**0.01**	0.18	0.42
Louse third claw opening and Host maximum guard hair diameter	22	**<0.01**	0.35	0.60
Louse third claw opening and Host maximum underfur hair diameter	18	**0.01**	0.34	0.58
Louse third claw opening and Host base guard hair diameter	22	**0.02**	0.25	0.50
Louse third claw opening and Host base underfur hair diameter	18	**0.02**	0.30	0.55
Phylogenetically subtracted male louse body correlations				
Lice body length residual and Host body mass	118	0.56	<0.01	-0.05
Lice body length residual and Host body length	121	0.46	<0.01	0.07
Louse thorax width residual and Host body mass	117	0.12	0.02	-0.14
Louse thorax width residual and Host body length	120	**0.08**	0.03	-0.16
Louse second tarsal length residual and Host body mass	88	0.82	<0.01	0.02
Louse second tarsal length residual and Host body length	93	0.63	<0.01	0.05

Louse third tarsal length residual and Host body mass	72	0.44	0.01	0.66
Louse third tarsal length residual and Host body length	68	0.86	0.01	0.02
Phylogenetically subtracted male louse claw correlations				
Louse second claw opening residual and Host maximum guard hair diameter	36	0.27	0.04	0.19
Louse second claw opening residual and Host maximum underfur hair diameter	30	0.31	0.04	0.19
Louse second claw opening residual and Host base guard hair diameter	36	0.63	0.01	0.08
Louse second claw opening residual and Host base underfur hair diameter	30	0.26	0.04	0.21
Louse third claw opening residual and Host maximum guard hair diameter	18	0.75	0.01	0.08
Louse third claw opening residual and Host maximum underfur hair diameter	14	0.51	0.04	0.19
Louse third claw opening residual and Host base guard hair diameter	18	0.25	0.08	0.29
Louse third claw opening residual and Host base underfur hair diameter	14	0.22	0.12	0.35
Male louse family correlations				
Hoplopleuridae				
Lice body length residual and Host body mass	33	0.78	<0.01	-0.05
Lice body length residual and Host body length	42	0.16	0.05	-0.22
Louse thorax width residual and Host body mass	33	**0.01**	0.18	0.42
Louse thorax width residual and Host body length	42	**0.01**	0.15	0.39
Louse second tarsal length residual and Host body mass	24	**0.03**	0.19	0.43
Louse second tarsal length residual and Host body length	33	**0.01**	0.21	0.46
Louse third tarsal length residual and Host body length	15	**0.03**	0.33	0.57
Louse third tarsal length residual and Host body mass	18	**0.10**	0.16	0.40
Louse second claw opening residual and Host maximum guard hair diameter	13	0.81	0.01	0.07
Louse second claw opening residual and Host maximum underfur hair diameter	11	0.68	0.02	0.14
Louse second claw opening residual and Host base guard hair diameter	13	0.82	<0.01	0.07
Louse second claw opening residual and Host base underfur hair diameter	11	0.65	0.02	0.16

Linognathidae				
Lice body length residual and Host body mass	13	0.87	<0.01	-0.05
Lice body length residual and Host body length	11	0.93	<0.01	-0.03
Louse thorax width residual and Host body mass	13	0.38	0.07	0.27
Louse thorax width residual and Host body length	11	0.68	0.02	0.14
Louse second tarsal length residual and Host body mass	12	0.68	0.02	0.13
Louse second tarsal length residual and Host body length	10	0.40	0.09	0.30
Louse third tarsal length residual and Host body mass	9	0.62	0.04	0.19
Louse third tarsal length residual and Host body length	8	0.81	0.01	0.10
Polyplacidae				
Lice body length residual and Host body mass	49	0.50	0.01	-0.10
Lice body length residual and Host body length	51	**<0.01**	0.34	0.58
Louse thorax width residual and Host body mass	49	0.75	<0.01	0.05
Louse thorax width residual and Host body length	51	**<0.01**	0.30	0.54
Louse second tarsal length residual and Host body mass	35	0.94	<0.01	0.01
Louse second tarsal length residual and Host body length	39	0.65	0.01	0.08
Louse third tarsal length residual and Host body mass	31	0.53	0.01	0.12
Louse third tarsal length residual and Host body length	31	0.58	0.01	0.10
Louse second claw opening residual and Host maximum guard hair diameter	18	0.29	0.07	0.27
Louse second claw opening residual and Host maximum underfur hair diameter	15	0.17	0.14	0.38
Louse second claw opening residual and Host base guard hair diameter	18	0.66	0.01	-0.11
Louse second claw opening residual and Host base underfur hair diameter	15	0.92	<0.01	-0.03
Louse third claw opening residual and Host maximum guard hair diameter	10	0.73	0.02	-0.12
Louse third claw opening residual and Host maximum underfur hair diameter	7	0.91	<0.01	-0.05
Louse third claw opening residual and Host base guard hair diameter	10	0.63	0.03	-0.17
Louse third claw opening residual and Host base underfur hair diameter	7	0.89	<0.01	0.07

Table 2: Power analyses comparisons between α=0.05 and α=0.10.

	Power α =0.05	**Power α =0.10**
Raw female louse body correlations		
Lice body length and Host body Mass	1.00	1.00
Lice body length and Host body Length	1.00	1.00
Louse thorax width and Host body mass	1.00	1.00
Louse thorax width and Host body length	1.00	1.00
Louse second tarsal length and Host body mass	1.00	1.00
Louse second tarsal length and Host body length	1.00	1.00
Louse third tarsal length and Host body mass	1.00	1.00
Louse third tarsal length and Host body length	1.00	1.00
Raw female louse claw correlations		
Louse second claw opening and Host maximum guard hair diameter	0.84	0.91
Louse second claw opening and Host maximum underfur hair diameter	1.00	1.00
Louse second claw opening and Host base guard hair diameter	1.00	1.00
Louse second claw opening and Host base underfur hair diameter	0.86	0.92
Louse third claw opening and Host maximum guard hair diameter	0.32	0.45
Louse third claw opening and Host maximum underfur hair diameter	0.97	0.99
Louse third claw opening and Host base guard hair diameter	0.83	0.91
Louse third claw opening and Host base underfur hair diameter	0.77	0.86
Phylogenetically subtracted female louse body correlations		
Lice body length residual and Host body Mass	0.05	0.10
Lice body length residual and Host body Length	0.05	0.10
Louse thorax width residual and Host body mass	0.12	0.20
Louse thorax width residual and Host body length	0.06	0.12
Louse second tarsal length residual and Host body mass	0.43	0.55
Louse second tarsal length residual and Host body length	0.72	0.81
Louse third tarsal length residual and Host body mass	0.05	0.10
Louse third tarsal length residual and Host body length	0.05	0.10

Phylogenetically subtracted female louse claw correlations		
Louse second claw opening residual and Host maximum guard hair diameter	0.20	0.31
Louse second claw opening residual and Host maximum underfur hair diameter	0.19	0.30
Louse second claw opening residual and Host base guard hair diameter	0.34	0.47
Louse second claw opening residual and Host base underfur hair diameter	0.07	0.13
Louse third claw opening residual and Host maximum guard hair diameter	0.35	0.49
Louse third claw opening residual and Host maximum underfur hair diameter	0.25	0.37
Louse third claw opening residual and Host base guard hair diameter	0.10	0.18
Louse third claw opening residual and Host base underfur hair diameter	0.07	0.12
Female louse family correlations		
Hoplopleuridae		
Lice body length residual and Host body Mass	0.09	0.16
Lice body length residualand Host body Length	0.48	0.61
Louse thorax width residual and Host body mass	0.71	0.81
Louse thorax width residual and Host body length	0.48	0.61
Louse second tarsal length residual and Host body mass	0.16	0.25
Louse second tarsal length residual and Host body length	0.39	0.52
Louse third tarsal length residual and Host body mass	0.11	0.19
Louse third tarsal length residual and host body length	0.10	0.17
Louse second claw opening residual and Host maximum guard hair diameter	0.06	0.11
Louse second claw opening residual and Host maximum underfur hair diameter	0.15	0.25
Louse second claw opening residual and Host base guard hair diameter	0.12	0.20

Linognathidae		
Lice body length residual and Host body Mass	0.07	0.12
Lice body length residualand Host body Length	0.08	0.14
Louse thorax width residual and Host body mass	0.13	0.22
Louse thorax width residual and Host body length	0.37	0.51
Louse second tarsal length residual and Host body mass	0.09	0.16
Louse second tarsal length residual and Host body length	0.27	0.40
Louse third tarsal length residual and Host body mass	0.27	0.40
Louse third tarsal length residual and Host body length	0.58	0.73
Polyplacidae		
Lice body length residual and Host body Mass	0.86	0.92
Lice body length residualand Host body Length	0.90	0.94
Louse thorax width residual and Host body mass	0.83	0.90
Louse thorax width residual and Host body length	1.00	1.00
Louse second tarsal length residual and Host body mass	0.93	0.96
Louse second tarsal length residual and Host body length	0.92	0.96
Louse third tarsal length residual and Host body mass	0.49	0.62
Louse third tarsal length residual and Host body length	0.11	0.18
Louse second claw opening residual and Host maximum guard hair diameter	0.05	0.11
Louse second claw opening residual and Host maximum underfur hair diameter	0.32	0.45
Louse second claw opening residual and Host base guard hair diameter	0.06	0.11
Louse second claw opening residual and Host base underfur hair diameter	0.05	0.10
Louse third claw opening residual and Host maximum guard hair diameter	0.05	0.10
Louse third claw opening residual and Host maximum underfur hair diameter	0.19	0.30
Louse third claw opening residual and Host base guard hair diameter	0.21	0.33
Louse third claw opening residual and Host base underfur hair diameter	0.08	0.14

Raw male louse body correlations		
Lice body length and Host body Mass	1.00	1.00
Lice body length and Host body Length	1.00	1.00
Louse thorax width and Host body mass	1.00	1.00
Louse thorax width and Host body length	1.00	1.00
Louse second tarsal length and Host body mass	1.00	1.00
Louse second tarsal length and Host body length	1.00	1.00
Louse third tarsal length and Host body mass	1.00	1.00
Louse third tarsal length and Host body length	1.00	1.00
Raw male louse claw correlations		
Louse second claw opening and Host maximum guard hair diameter	0.41	0.54
Louse second claw opening and Host maximum underfur hair diameter	1.00	1.00
Louse second claw opening and Host base guard hair diameter	0.82	0.90
Louse second claw opening and Host base underfur hair diameter	0.71	0.82
Louse third claw opening and Host maximum guard hair diameter	0.88	0.94
Louse third claw opening and Host maximum underfur hair diameter	0.77	0.87
Louse third claw opening and Host base guard hair diameter	0.68	0.79
Louse third claw opening and Host base underfur hair diameter	0.69	0.80
Phylogenetically subtracted male louse body correlations		
Lice body length residual and Host body Mass	0.09	0.16
Lice body length residual and Host body Length	0.11	0.19
Louse thorax width residual and Host body mass	0.34	0.47
Louse thorax width residual and Host body length	0.41	0.54
Louse second tarsal length residual and Host body mass	0.38	0.50
Louse second tarsal length residual and Host body length	0.62	0.73
Louse third tarsal length residual and Host body mass	0.06	0.11
Louse third tarsal length residual and Host body length	0.05	0.11

Phylogenetically subtracted male louse claw correlations		
Louse second claw opening residual and Host maximum guard hair diameter	0.20	0.30
Louse second claw opening residual and Host maximum underfur hair diameter	0.17	0.27
Louse second claw opening residual and Host base guard hair diameter	0.08	0.14
Louse second claw opening residual and Host base underfur hair diameter	0.20	0.30
Louse third claw opening residual and Host maximum guard hair diameter	0.06	0.12
Louse third claw opening residual and Host maximum underfur hair diameter	0.10	0.17
Louse third claw opening residual and Host base guard hair diameter	0.20	0.31
Louse third claw opening residual and Host base underfur hair diameter	0.22	0.34
Male louse family correlations		
Hoplopleuridae		
Lice body length residual and Host body Mass	0.06	0.11
Lice body length residualand Host body Length	0.29	0.41
Louse thorax width residual and Host body mass	0.71	0.82
Louse thorax width residual and Host body length	0.74	0.84
Louse second tarsal length residual and Host body mass	0.33	0.45
Louse second tarsal length residual and Host body length	0.98	0.99
Louse third tarsal length residual and Host body mass	0.41	0.55
Louse third tarsal length residual and Host body length	0.10	0.17
Louse second claw opening residual and Host maximum guard hair diameter	0.06	0.11
Louse second claw opening residual and Host maximum underfur hair diameter	0.07	0.13
Louse second claw opening residual and Host base guard hair diameter	0.06	0.11
Louse second claw opening residual and Host base underfur hair diameter	0.07	0.13

Linognathidae		
Lice body length residual and Host body Mass	0.05	0.10
Lice body length residualand Host body Length	0.05	0.10
Louse thorax width residual and Host body mass	0.13	0.22
Louse thorax width residual and Host body length	0.07	0.13
Louse second tarsal length residual and Host body mass	0.09	0.16
Louse second tarsal length residual and Host body length	0.27	0.40
Louse third tarsal length residual and Host body mass	0.06	0.11
Louse third tarsal length residual and Host body length	0.44	0.59
Polyplacidae		
Lice body length residual and Host body Mass	0.10	0.18
Lice body length residualand Host body Length	1.00	1.00
Louse thorax width residual and Host body mass	0.06	0.12
Louse thorax width residual and Host body length	0.99	1.00
Louse second tarsal length residual and Host body mass	0.05	0.10
Louse second tarsal length residual and Host body length	0.85	0.92
Louse third tarsal length residual and Host body mass	0.47	0.60
Louse third tarsal length residual and Host body length	0.09	0.16
Louse second claw opening residual and Host maximum guard hair diameter	0.18	0.28
Louse second claw opening residual and Host maximum underfur hair diameter	0.27	0.40
Louse second claw opening residual and Host base guard hair diameter	0.07	0.13
Louse second claw opening residual and Host base underfur hair diameter	0.05	0.10
Louse third claw opening residual and Host maximum guard hair diameter	0.06	0.12
Louse third claw opening residual and Host maximum underfur hair diameter	0.05	0.10
Louse third claw opening residual and Host base guard hair diameter	0.07	0.14
Louse third claw opening residual and Host base underfur hair diameter	0.05	0.10

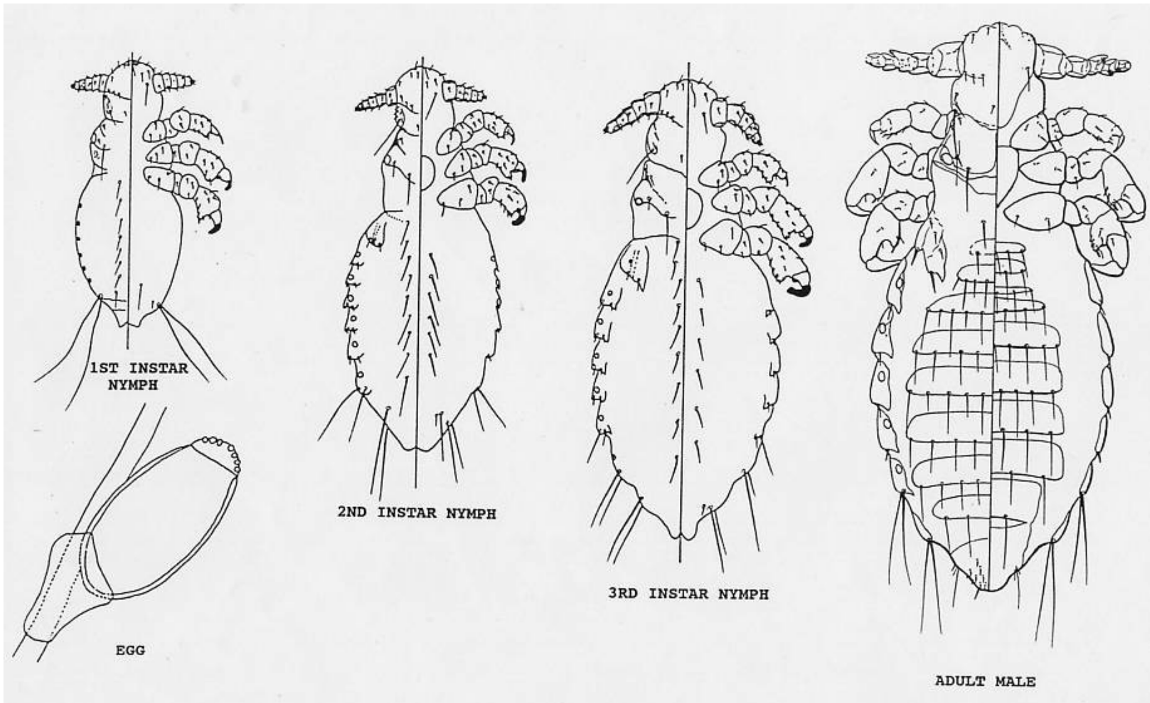

Figure 1: Life cycle of a representative sucking lice, the spined rat louse (*Polyplax spinulosa*). For nymphs and adults, dorsal morphology is shown to the left of the middle and ventral morphology to the right. (Adapted from Kim et al., 1986)

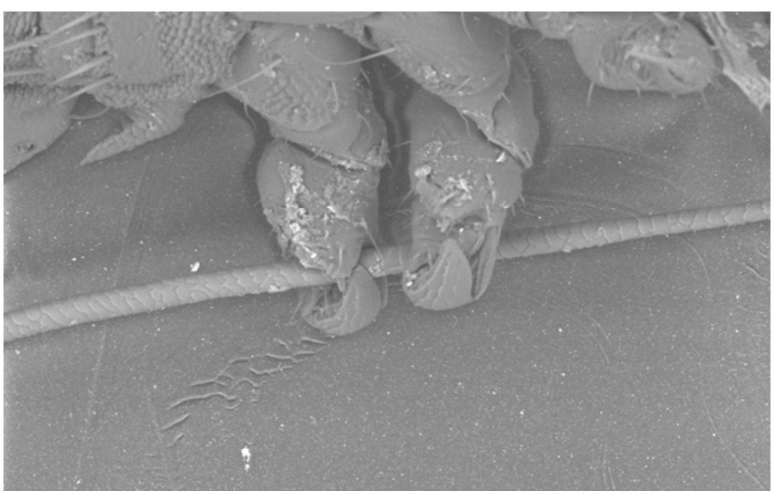

Figure 2: Tree shrew louse (*Sathrax durus*) tibio-tarsal claws (on the mesothoracic and metathoracic legs) grasping a hair shaft of the common tree shrew (*Tupaia glis*)

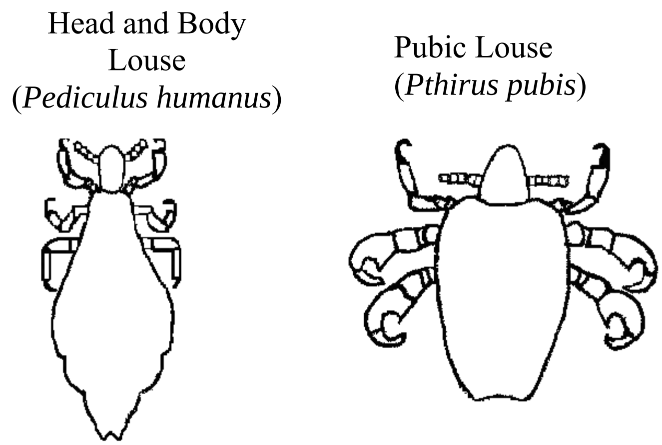

Figure 3: Human body and head louse body shape compared to crab louse body shape

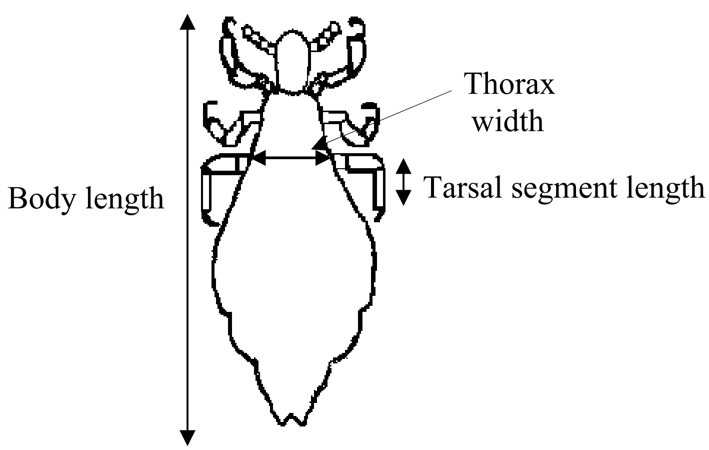

Figure 4: Louse body length measurements taken (body length, thorax width and second and third tarsal segment length)

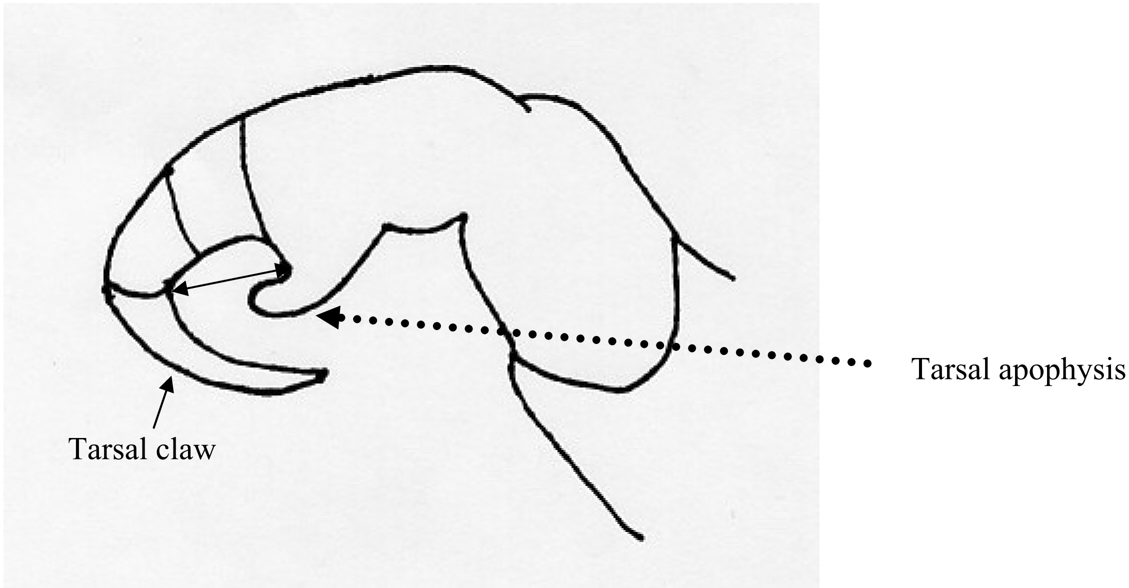

Figure 5: Diagram showing the measurement taken (solid line) for louse tibio-tarsal claw openings.

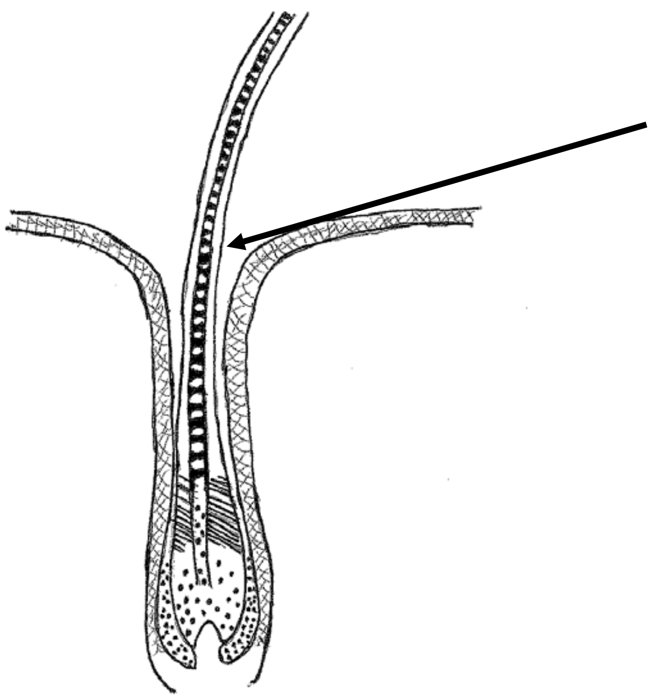

Figure 6: A longitudinal section of a mammalian hair. Base hair diameter was measured at the point shown (arrow) (i.e., where the hair enters the hair follicle) and maximum hair diameter was taken from the widest part of the hair.

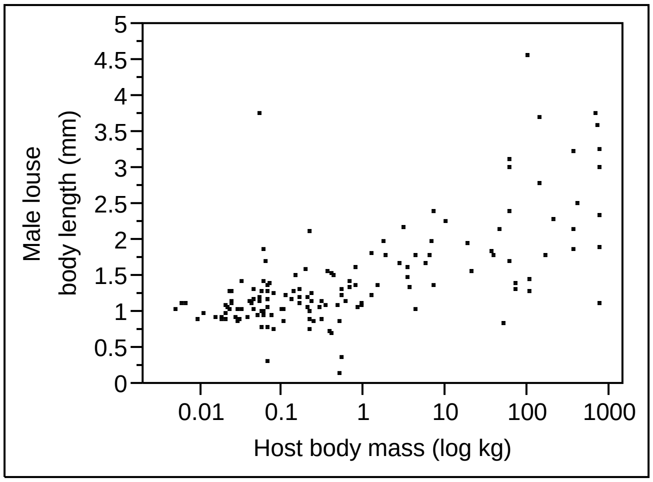

Figure 7: Positive correlation between male louse body length and host body mass (n=147, p<0.01, r=0.53).

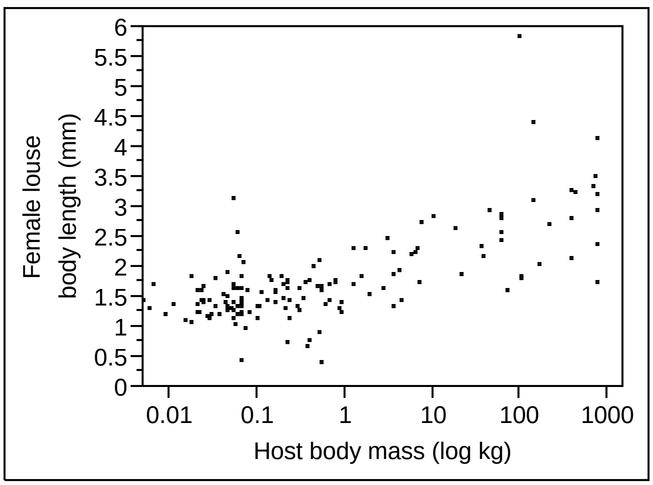

Figure 8: Positive correlation between female louse body length and host body mass (n=147, p<0.01, r=0.53).

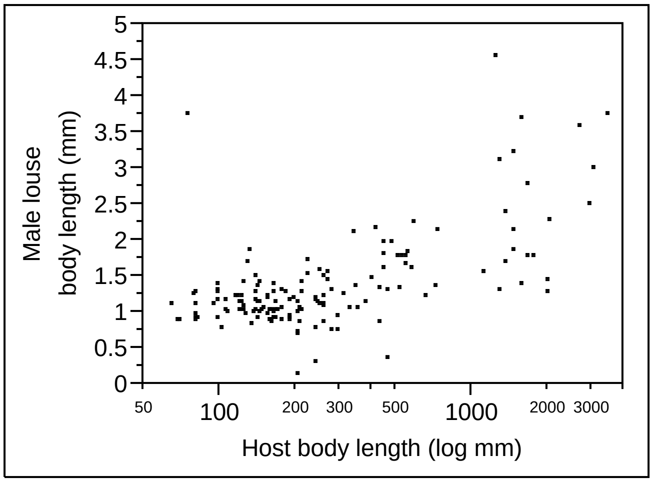

Figure 9: Positive correlation between male louse body length and host body length (n=159, p<0.01, r=0.66).

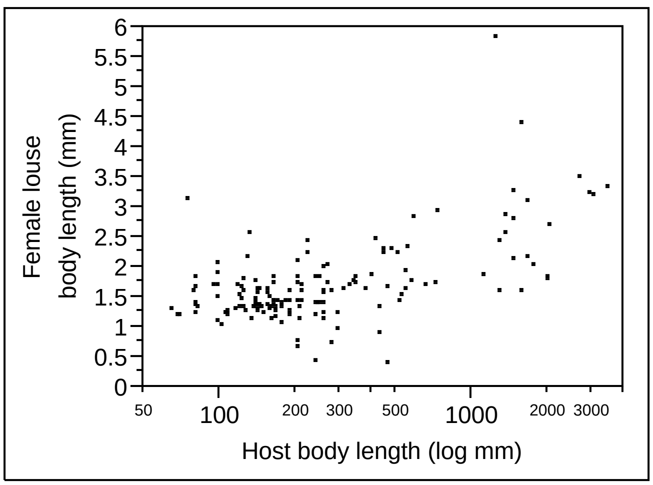

Figure 10: Positive correlation between female louse body length and host body length (n=157, p<0.01, r=0.61).

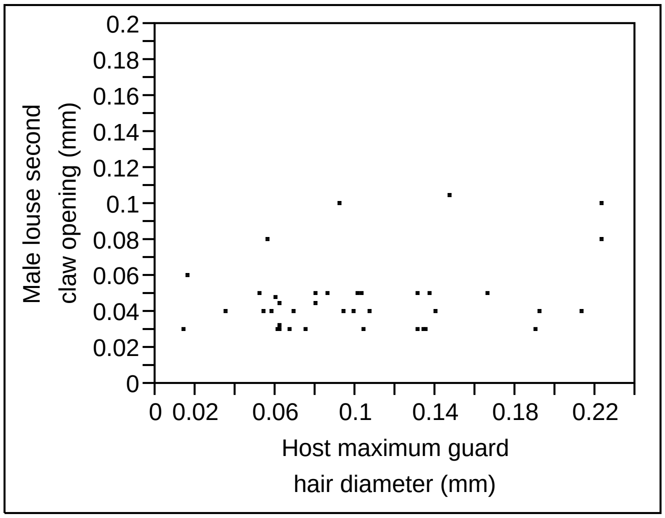

Figure 11: Positive correlation between male louse second claw opening and host maximum guard hair diameter (n=39, p=0.08, r=0.28).

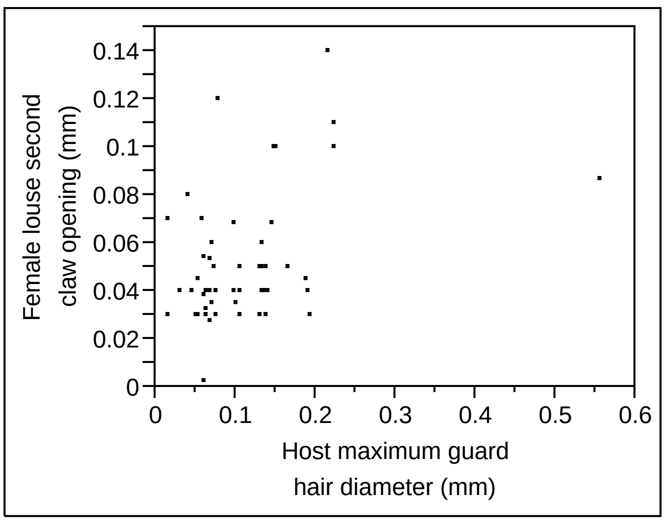

Figure 12: Positive correlation between female louse second claw opening and host maximum guard hair diameter (n=54, p<0.01, r=0.31).

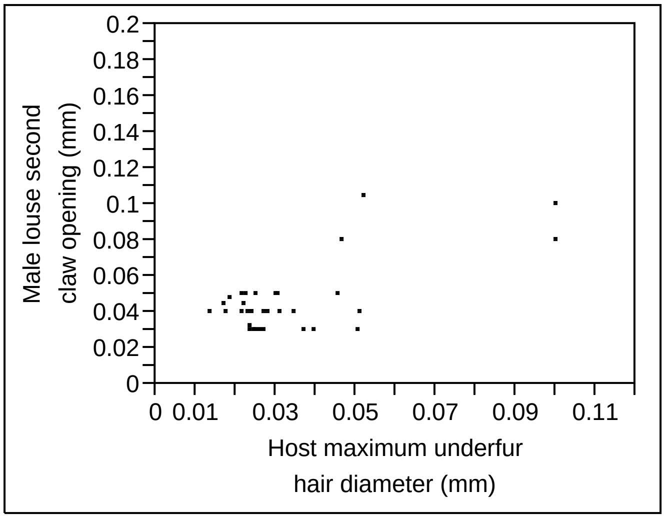

Figure 13: Positive correlation between male louse second claw opening and host maximum underfur hair diameter (n=33, p<0.01, r=0.67).

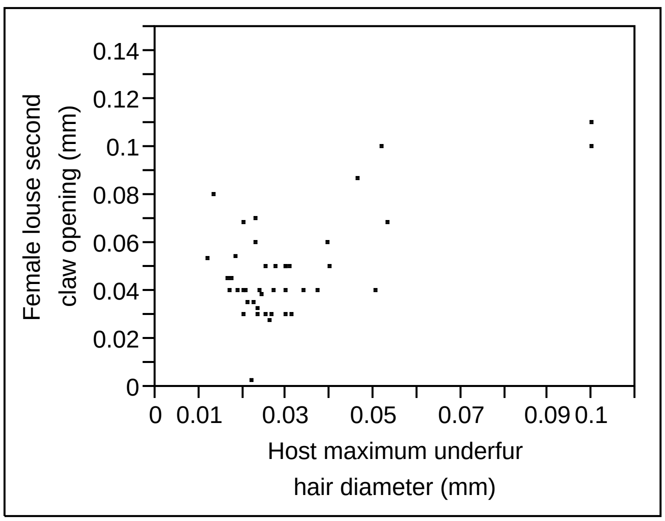

Figure 14: Positive correlation between female louse second claw opening and host maximum underfur hair diameter (n=45, p<0.01, r=0.64).

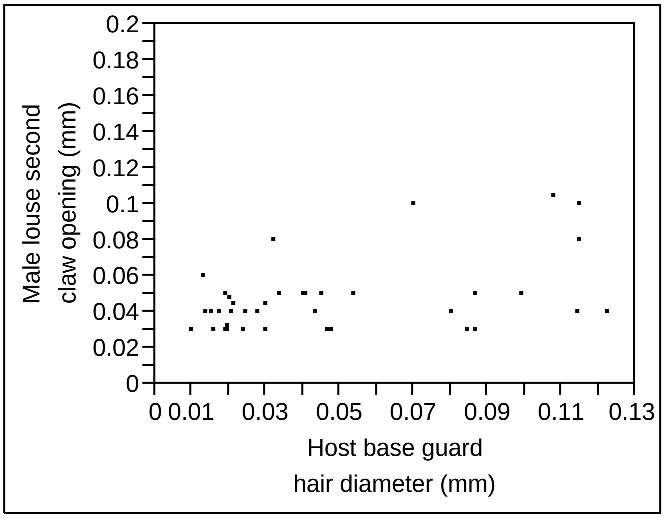

Figure 15: Positive correlation between male louse second claw opening and host base guard hair diameter (n=39, p=0.01, r=0.44).

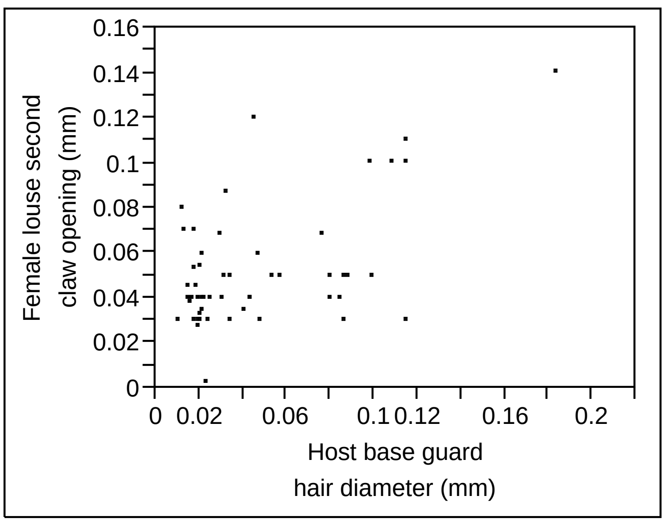

Figure 16: Positive correlation between female louse second claw opening and host base guard hair diameter (n=54, p<0.01, r=0.54).

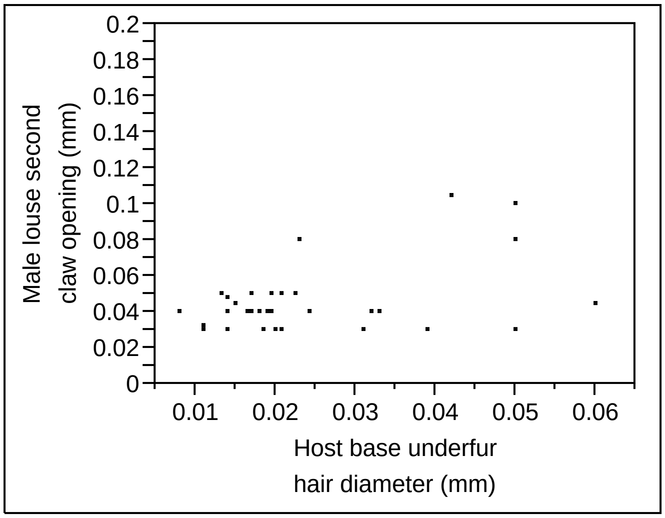

Figure 17: Positive correlation between male louse second claw opening and host base underfur hair diameter (n=33, p=0.01, r=0.42).

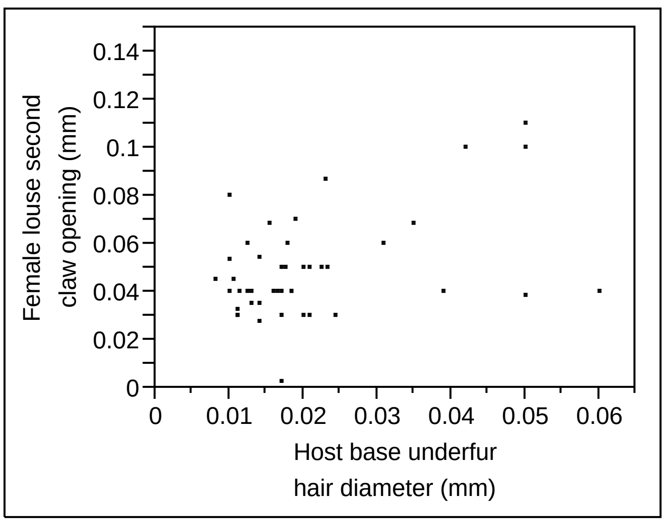

Figure 18: Positive correlation between female louse second claw opening and host base underfur hair diameter (n=45, $p<0.01$, r=0.43).

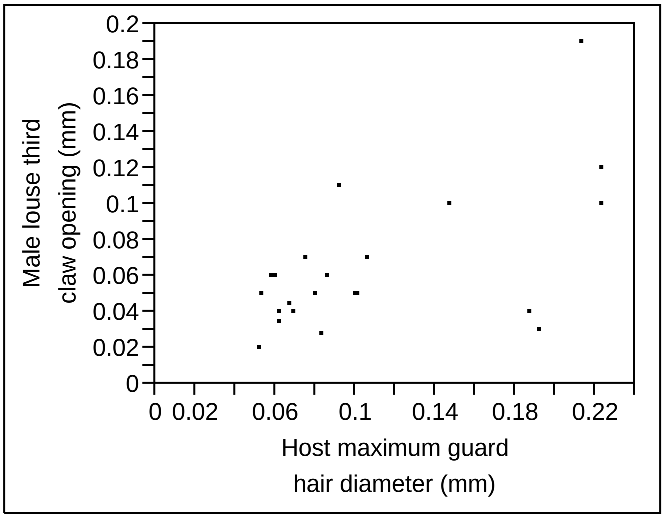

Figure 19: Positive correlation between male louse third claw opening and host maximum guard hair diameter (n=22, p<0.01, r=0.60).

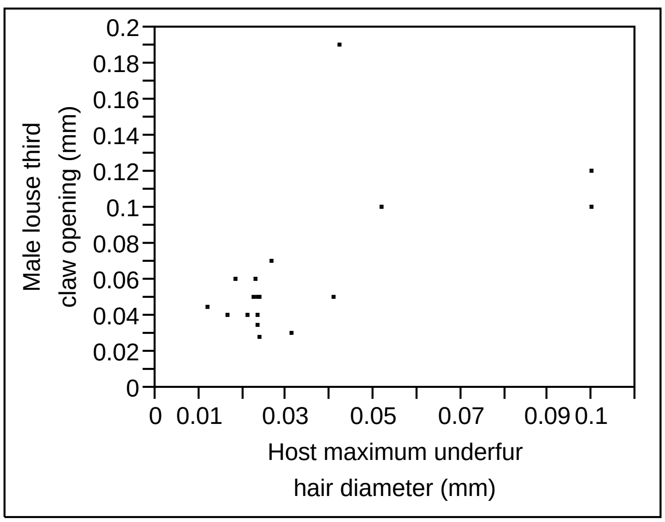

Figure 20: Positive correlation between male louse third claw opening and host maximum underfur hair diameter (n=18, p=0.01, r=0.58).

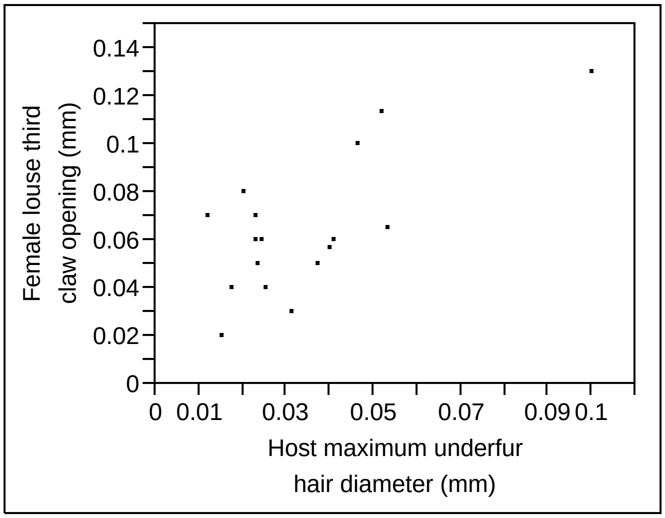

Figure 21: Positive correlation between female louse third claw opening and host maximum underfur hair diameter (n=18, p<0.01, r=0.72).

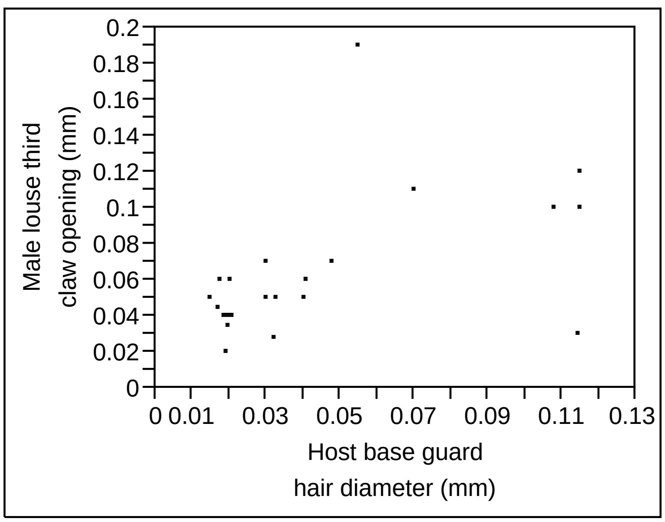

Figure 22: Positive correlation between male louse third claw opening and host base guard hair diameter (n=22, p=0.02, r=0.50).

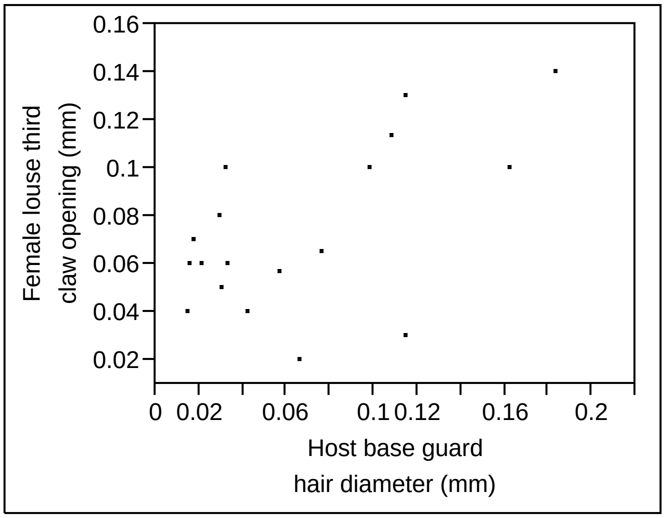

Figure 23: Positive correlation between female louse third claw opening and host base guard hair diameter (n=20, p=0.01, r=0.59).

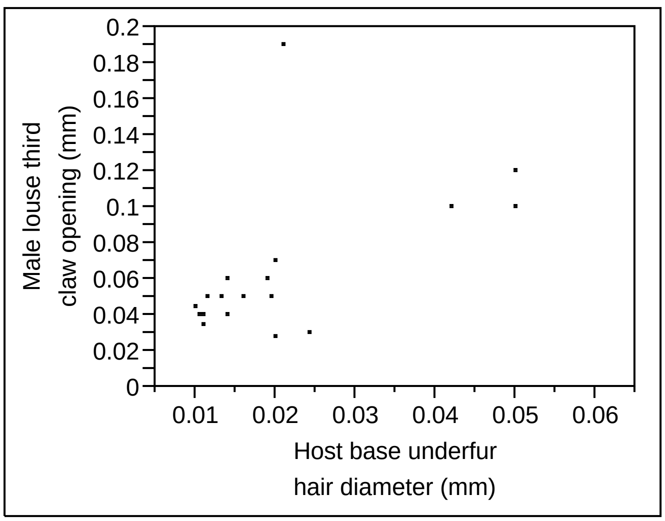

Figure 24: Positive correlation between male louse third claw opening and host base underfur hair diameter (n=18, p=0.02, r=0.55).

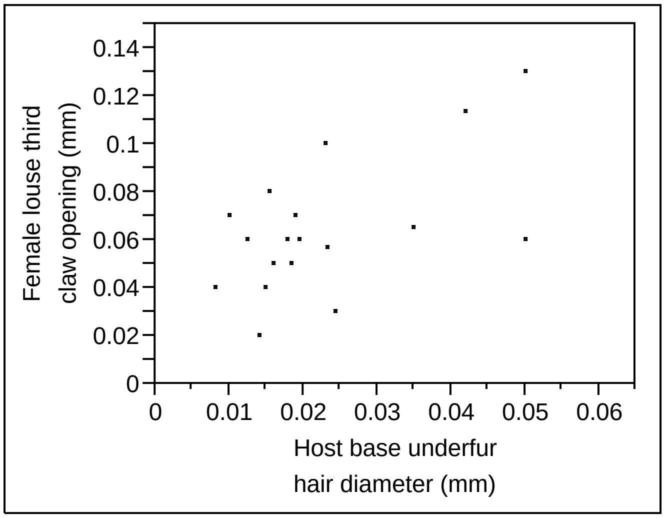

Figure 25: Positive correlation between female louse third claw opening and host base underfur hair diameter (n=18, p=0.01, r=0.58).

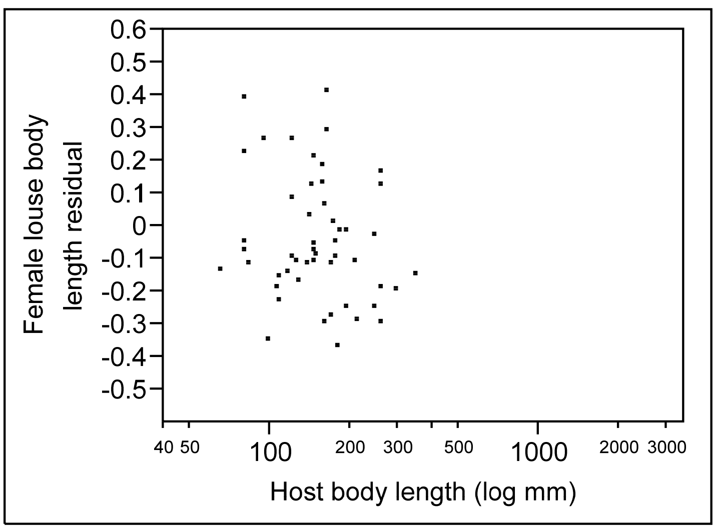

Figure 26: Negative correlation between female louse body length residual and host body length (n=52, p=0.06, r=-0.27).

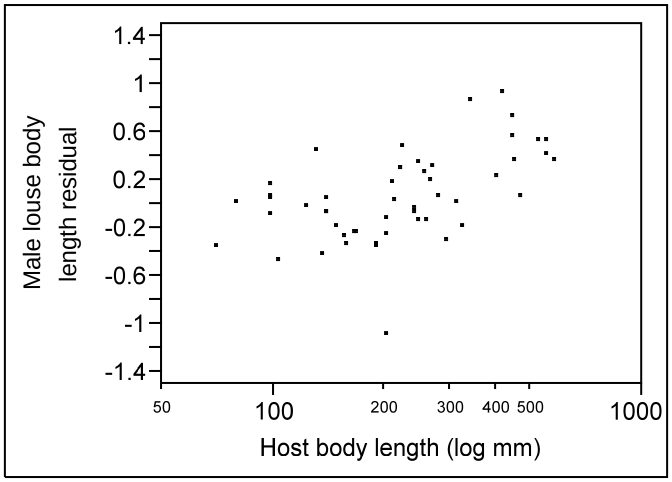

Figure 27: Positive correlation between Polyplacidae male louse body length residual and host body length (n=51, p<0.01, r=0.58).

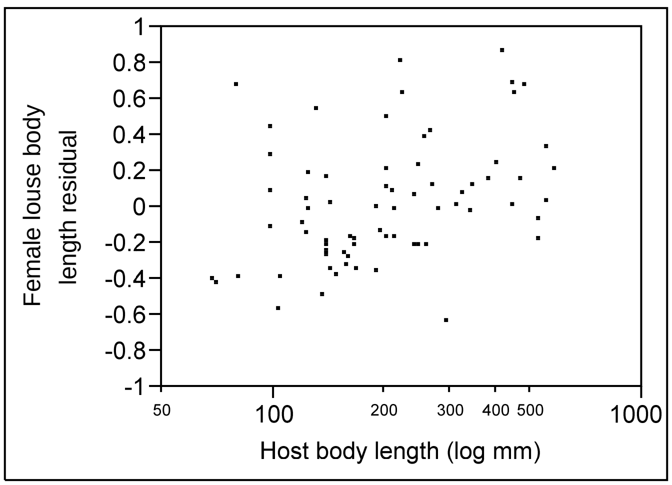

Figure 28: Positive correlation between Polyplacidae female louse body length residual and host body length (n=71, p<0.01, r=0.37).

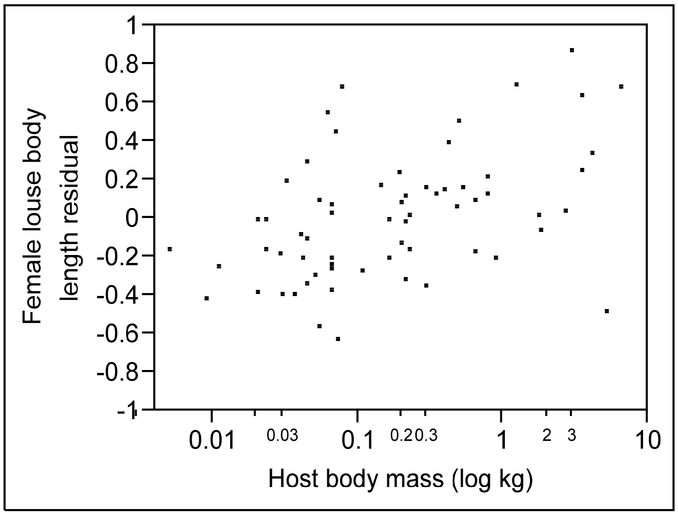

Figure 29: Positive correlation between Polyplacidae female louse body length residual and host body mass (n=64, p<0.01, r=0.37).

Appendix A: Sucking louse body size measurements used in correlation analyses.

Louse Family	Louse species	Sex	Body length (mm)	Thorax width (mm)	Second tarsal length (mm)	Third tarsal length (mm)
Echinophthiriidae	*Antarctophthirus callorhini*	M	2.27	0.80		0.38
		F	2.70	0.76	0.29	0.32
	Antarctophthirus trichechi	M	3.00	0.15	0.52	0.54
		F	3.20	0.13	0.51	0.54
	Enchinophthirius horridus	M	2.78	0.65		
		F	3.10	0.88	0.35	0.36
	Proechinophthirus calvus	M	1.36	0.27	0.14	
		F	1.84	0.30	0.15	0.17
	Proechinophthirus fluctus	M	2.51	0.49	0.25	
		F	3.24	0.63	0.26	0.30
Enderleinellidae	*Enderleinellus ferrisi*	M	0.75	0.16		
		F	0.75	0.16		
	Enderleinellus kumadai	M	0.70	0.13		0.04
		F	0.77	0.16	0.04	
	Enderleinellus longiceps	M	0.38	0.18		
		F	0.42	0.17	0.03	0.05
	Enderleinellus osborni	M	0.86	0.21		
		F	0.89	0.19		
	Enderleinellus venezuelae	M	0.73	0.16		
		F	0.68	0.18		
	Microphthirus uncinatus	M	0.31	0.35		
		F	0.43	0.45		

Haematopinidae	*Haematopinus asini*	M	3.22	0.62		0.35
		F	3.26	0.77	0.7	0.72
	Haematopinus bufali	M	3.74	1.01	0.76	0.77
		F	3.33		0.36	0.38
	Haematopinus eurysternus	M	2.32	0.71	0.40	0.43
		F	2.95	0.77	0.41	0.42
	Haematopinus minor	M	2.14	0.69	0.31	0.29
		F	2.80	0.64	0.35	0.36
	Haematopinus phacochoeri	M	4.55	1.03	1.00	1.00
		F	5.82	1.52	0.10	0.90
	Haematopinus quadripertusus	M	3.24	0.97	0.53	0.54
		F	4.14	1.10	0.57	0.58
	Haematopinus suis	M	3.70	1.04	0.78	0.80
		F	4.40	1.12	0.90	0.83
	Haematopinus tuberculatus	M	3.58	0.89	0.70	0.68
		F	3.50	1.02	0.70	0.65
Hamophthiriidae	*Hamopthirius galeopitheci*	M	1.82	0.36	0.13	0.14
		F	2.28	0.43	0.15	0.17
Hoplopleuridae	*Ancistroplax taiwanensis*	M	3.75	0.15		
		F	3.15	0.15	0.01	
	Ancistroplax crocidurae	M	1.11	0.16	0.01	
		F	1.70	0.16	0.01	
	Haematopinoides squamosus	M	1.20	0.20	0.13	
		F	1.62	0.22	0.13	
	Hoplopleura abeli	M	1.06	0.19		
		F	1.34	0.21	0.18	

Hoplopleura acanthopus	M	1.15	0.19	0.10	0.01
	F	1.32	0.20	0.10	0.12
Hoplopleura affinis	M	1.06	0.21	0.09	0.08
	F	1.24	0.20	0.09	
Hoplopleura aitkeni	M	1.00	0.22	0.10	
	F	1.21	0.20	0.08	
Hoplopleura angulata	M	1.14	0.24		
	F	1.36	0.27		0.14
Hoplopleura arboricola	M	0.75	0.16	0.07	0.12
	F	1.24	0.21		
Hoplopleura arizonesis	M	1.28	0.25	0.12	
	F	1.85	0.27	0.14	
Hoplopleura bidentata	M	1.05	0.23		
	F	1.29	0.24		
Hoplopleaura biseriata	M	1.16	0.28	0.11	0.16
	F	1.47	0.29	0.17	
Hoplopleura brasiliensis	M	1.43	0.24	0.08	
	F	1.65	0.25		0.14
Hoplopleura capensis	M	1.01	0.18	0.09	0.13
	F	1.28	0.21	0.09	0.14
Hoplopleura captiosa	M	0.88	0.16	0.08	
	F	1.36	0.19	0.08	0.12
Hoplopleura chilensis	M	0.85	0.18		0.11
	F	1.14	0.20		0.12
Hoplopleura chippauxi	M	1.23	0.27	0.13	0.18
	F	1.57	0.28	0.13	0.20

Hoplopleura chrysocomi	M	0.75	0.20	0.09	0.10
	F	1.00	0.20	0.09	
Hoplopleura colomydis	M	1.85	0.20	0.11	
	F	2.56	0.22	0.10	
Hoplopleura contigua	M	1.31	0.27	0.12	
	F	1.39	0.27		
Hoplopleura cricetula	M	0.97	0.23	0.11	
	F	1.40	0.23	0.11	
Hoplopleura diaphora	M	1.23	0.35	0.15	0.18
	F	1.75	0.38		0.19
Hoplopleura difficillis	M	0.88	0.17		
	F	1.07	0.17	0.07	
Hoplopleura dissicula	M	1.09	0.26		0.14
	F	1.46	0.27	0.11	
Hoplopleura emphereia	M	1.03	0.22	0.08	
	F	1.33	0.22	0.09	
Hoplopleura enormis	M	1.03	0.21	0.10	0.14
	F	1.34	0.23	0.10	0.15
Hoplopleura erratica	M	0.87	0.21	0.09	0.14
	F	1.14	0.23	0.11	0.15
Hoplopleura ferrisi	M	0.85	0.13	0.08	
	F	1.15	0.15		
Hoplopleura fonsecia	M	1.15	0.25	0.09	
	F	1.56	0.27		0.10
Hoplopleura n.sp.1	M	1.29	0.20		0.13
	F	1.66	0.21	0.10	0.14

Hoplopleura n.sp.2	M	0.98	0.22	0.10	0.14
	F	1.27	0.24	0.10	0.15
Hoplopleura hesperomydis	M	0.93	0.17	0.08	0.11
	F	1.16	0.17	0.08	0.10
Hoplopleura indiscreta	M	1.03	0.21		
	F	1.38	0.22	0.09	
Hoplopleura inexpectans	M	0.93	0.19	0.13	
	F	1.35	0.18	0.10	0.08
Hoplopleura intermedia	M	0.81	0.18		
	F	1.20	0.20		
Hoplopleura inusitata	M	1.10	0.23	0.13	0.16
	F	1.56	0.22	0.14	0.19
Hoplopleura irritans	M	1.17	0.26	0.13	
	F	1.42	0.27	0.12	
Hoplopleura johnsonae	M	0.92	0.19	0.09	
	F	1.83	0.20	0.09	
Hoplopleura kitti	M	1.01	0.26	0.12	0.13
	F	1.32	0.28	0.13	
Hoplopleura laticeps	M	1.23	0.25	0.11	0.11
	F	1.70	0.25	0.12	
Hoplopleura longula	M	1.10	0.17		
	F	1.30	0.18	0.07	
Hoplopleura malabarica	M	1.08	0.23	0.11	
	F	1.25	0.23	0.12	
Hoplopleura malaysiana	M	0.99	0.24	0.11	0.11
	F	1.26	0.25	0.13	

Hoplopleura maniculata	M	1.02	0.23	0.11	0.15
	F	1.35	0.25	0.12	0.15
Hoplopleura mendezi	M	1.01	0.23		
	F	1.33	0.24		
Hoplopleura mulleri	M	1.17	0.22	0.08	
	F	1.25	0.21	0.09	
Hoplopleura multilobata	M	1.14	0.26	0.10	0.13
	F	1.38	0.28	0.10	
Hoplopleura musseri	M	1.28	0.28	0.11	
	F	1.61	0.26	0.11	
Hoplopleura myomyis	M	0.85	0.20	0.08	0.12
	F	1.23	0.20	0.09	
Hoplopleura nasvikae	M	0.80	0.17	0.08	
	F	1.30	0.20	0.10	0.15
Hoplopleura nesoryzomydis	M	1.10	0.23	0.10	0.13
	F	1.55	0.27	0.10	0.09
Hoplopleura neumanni	M	1.28	0.28	0.11	
	F	1.42	0.28	0.12	
Hoplopleura oenomydis	M	1.04	0.25		
	F	1.50	0.20	0.12	
Hoplopleura oryzomydis	M	1.13	0.28	0.10	0.14
	F	1.41	0.23	0.10	0.15
Hoplopleura pacifica	M	0.95	0.21	0.10	0.12
	F	1.19	0.23	0.11	0.15
Hoplopleura patersoni	M	1.29	0.23	0.10	0.14
	F	1.75	0.23	0.11	

Hoplopleura pectinata	M	1.67	0.26	0.10	
	F	2.03	0.26	0.10	
Hoplopleura pelomydis	M	1.02	0.20	0.09	0.14
	F	1.45	0.23	0.11	0.15
Hoplopleura quadridentals	M	1.06	0.25		
Hoplopleura reithrodontomyis	F	1.33	0.26	0.11	0.13
	M	0.92	0.16	0.05	
Hoplopleura rimae	F	1.09	0.17	0.08	
	M	0.90	0.19		0.10
Hoplopleura rukenyae	F	1.29	0.20	0.08	
	M	1.11	0.18	0.07	
Hoplopleura scapteromydis	F	1.39	0.18	0.08	
	M	1.06	0.22	0.08	0.14
Hoplopleura sciuricola	F	1.34	0.23	0.11	0.15
	M	1.23	0.26	0.51	0.51
Hoplopleura scotinomydis	F	1.60	0.28	0.12	0.18
	M	0.91	0.17		0.11
Hoplopleura sembeli	F	1.32	0.18		
	M	0.96	0.24	0.1	0.14
Hoplopleura setzeri	F	1.22	0.25	0.1	0.15
	M	1.22	0.23	0.09	0.15
Hoplopleura sicata	F	1.30	0.21	0.09	0.15
	M	1.20	0.24	0.10	0.14
Hoplopleura similis	F	1.45	0.24	0.10	0.15
	M	1.41	0.27		0.15

	Hoplopleura somereni	F	1.71	0.28		
		M	1.40	0.31	0.13	
	Hoplopleura spiculifer	F	1.73	0.32	0.13	
		M	1.04	0.24	0.12	
	Hoplopleura tiptoni	F	1.52	0.26	0.13	0.17
		M	1.01	0.21	0.09	0.12
	Hoplopleura traubi	F	1.32	0.21		
		M	0.89	0.23	0.09	
	Hoplopleura travassosi	F	1.15	0.25	0.11	0.14
		M	0.97	0.21		
	Hoplopleura trispinosa	F	1.26	0.22	0.09	
		M	0.78	0.16		
	Schizophthirus graphiuri	F	1.19	0.20	0.09	0.10
		M	1.15	0.23		0.17
Hybophthiridae	*Hybophthirus notophallus*	F	1.45	0.26	0.19	
		M	3.12	1.11	0.09	0.08
Linognathidae	*Linognathus africanus*	F	2.43	1.22	0.10	
		M	1.70	0.31	0.24	0.23
	Linognathus breviceps	F	2.58	0.39	0.25	0.26
		M	1.37	0.30	0.19	0.21
	Linognathus fenneci	F	1.73	0.35	0.24	0.27
		M	1.21	0.28	0.11	
	Linognathus gorgonus	F	1.71	0.34	0.15	0.15
		M	1.77	0.44	0.26	0.26
	Linognathus pedalis	F	2.04	0.47	0.30	0.31
		M	1.84	0.36		

	Linognathus setosus	F	2.35	0.36	0.20	0.22
		M	1.78	0.37	0.18	0.18
	Linognathus stenopsis	F	2.17	0.44		
		M	2.39	0.37	0.25	0.28
	Linognathus tibialis	F	2.86	0.41	0.25	0.24
		M	1.39	0.26	0.18	0.20
	Linognathus vituli	F	1.59	0.33	0.22	0.24
		M	1.89	0.40	0.23	0.22
	Linognathus weisseri	F	2.38	0.42	0.26	0.27
		M	1.30	0.35	0.22	
	Prolinognathus leptocephalus	F	1.60	0.40	0.24	0.25
		M	1.33	0.35	0.16	
	Solenoptes binipilosus	F	1.33	0.39		0.21
		M	1.29	0.30	0.21	0.24
	Solenoptes capillatus	F	1.79	0.40	0.25	0.28
		M	1.11	0.33	0.20	
	Solenoptes ferrisi	F	1.73	0.45	0.23	0.23
		M	1.44	0.35	0.17	0.21
	Solenoptes muntiacus	F	1.83	0.37	0.21	
		M	1.55	0.39	0.25	0.28
Pedicinidae	*Pedicinus ancoratus*	F	1.86	0.45	0.27	0.29
		M	1.77	0.35	0.30	0.29
	Pedicinus eurygaster	F	2.23	0.41	0.32	0.31
		M	1.04	0.32	0.19	0.20
	Pedicinus hamadryas	F	1.44	0.40	0.20	0.22
		M	1.96	0.47	0.33	0.34

	Pedicinus obtusus	F	2.64	0.41	0.35	0.37
		M	1.68	0.39	0.24	0.24
	Pedicinus pictus	F	2.20	0.45	0.28	0.28
		M	2.24	.	0.31	0.31
Pediculidae	*Pediculus humanus*	F	2.85	.	0.34	0.36
		M	3.00	0.78	0.47	0.50
	Pediculus mjobergi	F	2.80	0.75	0.40	0.42
		M	2.38	0.71	0.47	0.44
	Pediculus schaeffi	F	2.72	0.80	0.37	0.42
		M	2.15	0.58		
Polyplacidae	*Eulinagnathus aculeatus*	F	2.92	0.68	0.46	0.44
		M	0.78	0.20	0.11	0.12
	Eulinognathus denticulatus	F	1.04	0.22	0.13	0.13
		M	1.48	0.51		
	Eulinognathus hesperius	F	1.86	0.57	0.21	0.22
		M	0.83	0.26	0.12	0.12
	Fahrenholzia fairchildi	F	1.12	0.29	0.13	
		M	1.37	0.23	0.22	0.2
	Fahrenholzia microcephala	F	1.63	0.27		0.24
		M	1.10	0.12		
	Fahrenholzia pinnata	F	1.40	0.22	0.15	0.15
		M	0.94	0.16	0.11	0.11
	Fahrenholzia reducta	F	0.98	0.16	0.11	0.11
		M	1.27	0.19		
	Fahrenholzia schwartzi	F	1.60	0.20	0.16	0.17
		M	0.92	0.17		

Fahrenholzia tribulosa	F	1.27	0.18		
	M	1.03	0.17		0.14
Haemodipsus brachylagi	F	1.45	0.19		0.17
	M	1.55	0.30		0.16
Haemodipsus lyriocephalus	F	1.73	0.36	0.18	0.18
	M	1.77	0.37	0.19	0.21
Haemodipsus setoni	F	1.94	0.41	0.22	0.23
	M	1.66	0.36	0.19	0.18
Haemodpsus ventricosus	F	1.65	0.38	0.16	0.17
	M	1.78	0.36	0.16	0.15
Johnsonpthirus heliosciuri	F	1.54	0.37	0.15	0.16
	M	1.13	0.27	0.13	0.14
Johnsonpthirus suahelicus	F	1.82	0.31	0.14	0.17
	M	0.99	0.22	0.10	0.13
Lemurphthirus galagus	F	1.72	0.28	0.11	
	M	1.59	0.39	0.12	0.13
Linognathoides cynomyis	F	1.85	0.40	0.13	0.13
	M	1.49	0.37		0.17
Linognathoides faurei	F	2.05	0.43		0.22
	M	1.44	0.49	0.3	0.30
Linognathoides laeviusculus	F	2.03	0.52	0.31	0.32
	M	1.36	0.30	0.13	0.15
Linognathoides marmotae	F	1.74	0.32		
	M	1.60	0.42	0.18	0.22
Linognathoides pectinifer	F	2.25	0.47	0.21	0.24
	M	1.52	0.41		0.24

Neohaematopinus appressus	F	1.76	0.65	0.27	0.27
	M	1.69	0.55	0.21	0.28
Neohaematopinus callosciuri	F	0.22	0.43	0.23	0.34
	M	0.15	0.35	0.19	0.17
Neohaematopinus capitaneus	F	2.12	0.54	0.16	
	M	1.72	0.42	0.16	0.19
Neohaematopinus citellinus	F	2.25	0.54	0.19	0.23
	M	1.31	0.34	0.16	0.18
Neohaematopinus cognatus	F	1.60	0.32	0.11	0.17
	M	1.20	0.21		
Neohaematopinus elbeli	F	1.76	0.41	0.17	0.18
	M	1.13	0.33	0.15	0.15
Neohaematopinus griseicolus	F	1.45	0.34	0.15	0.16
	M	1.50	0.34	0.14	0.15
Neohaematopinus inornatus	F	2.00	0.40	0.17	0.18
	M	1.32	0.25		0.12
Neohaematopinus pallidus	F	1.62	0.23		0.14
	M	2.11	0.42	0.16	0.18
Neohaematopinus pansus	F	1.77	0.45	0.18	0.20
	M	1.25	0.34	0.13	0.15
Neohaematopinus petauristae	F	1.60	0.40	0.14	0.18
	M	1.98	0.44	0.17	0.19
Neohaematopinus robustus	F	2.29	0.53	0.19	0.21
	M	1.80	0.43	0.17	0.18
Neohaematopinus rupestis	F	2.30	0.48	0.18	0.20
	M	1.54	0.35	0.17	

Neohaematopinus scuri	F	2.42	0.48	0.21	0.22
	M	1.30	0.35	0.14	0.16
Neohaematopinus sciurinus	F	1.68	0.36	0.16	0.17
	M	1.60	0.35	0.15	0.16
Neohaematopinus sciuropteri	F	1.77	0.38	0.15	0.18
	M	1.18	0.23		0.14
Neohaematopinus semifasciatus	F	1.82	0.30	0.13	0.15
	M	1.26	0.26		0.13
Neohaematopinus spilosmae	F	1.63	0.41	0.13	0.18
	M	1.20	0.26	0.14	0.16
Neohaematopinus sundasciuri	F	1.40	0.27	0.16	0.16
	M	1.24	0.31	0.15	
Neohaematopinus syriacus	F	1.57	0.36		0.15
	M	1.40	0.31	0.13	0.15
Polyplax abyssinica	F	1.56	0.34	0.14	0.16
	M	0.98	0.19	0.09	
Polyplax alaskensis	F	1.36	0.23	0.12	
	M	1.02	0.21	0.10	0.11
Polyplax arvicanthis	F	1.27	0.21	0.11	
	M	0.95	0.22	0.10	0.10
Polyplax asiatica	F	1.32	0.20	0.13	0.10
	M	1.10	0.22	0.12	
Polyplax auricularis	F	1.40	0.24	0.13	
	M	1.09	0.25		
Polyplax biseriata	F	1.60	0.30		
	M	1.05	0.21	0.10	

Polyplax borealis	F	1.23	0.42	0.12	
	M	1.02	0.20		
Polyplax brachyrrhyncha	F	1.42	0.20		0.13
	M	1.16	0.11		
Polyplax bullimae	F	1.5	0.16	0.12	
	M	1.00	0.23	0.18	
Polyplax cannomydis	F	1.60	0.31	0.16	
	M	1.42	0.29		
Polyplax cummingsi	F	1.70	0.32	0.16	
	M	0.92	0.19		
Polyplax expressa	F	1.45	0.20		
	M	0.91	0.22	0.11	
Polyplax gerbilli	F	1.61	0.21	0.12	0.13
	M	0.91	0.17	0.10	0.12
Polyplax guatemalensis	F	1.21	0.18	0.11	
	M	1.41	0.35		
Polyplax hoogstraali	F	1.80	0.36		
	M	1.29	0.18		0.13
Polyplax kaiseri	F	1.70	0.20	0.13	
	M	0.90	0.18		
Polyplax melasmothrixi	F	1.21	0.19		
	M	1.00	0.25		
Polyplax meridionalis	F	1.23	0.23	0.09	
	M	1.40	0.20	0.14	
Polyplax myotomydis	F	2.06	0.20	0.12	
	M	0.93	0.19		

Polyplax otomydis	F	1.43	0.22		
	M	1.00	0.18	0.90	
Polyplax oxyrrhyncha	F	1.40	0.20	0.09	
	M	1.30	0.16	0.12	
Polyplax paradoxa	F	1.90	0.19	0.14	
	M	1.04	0.19	0.11	
Polyplax phthisica	F	1.44	0.20	0.13	0.16
	M	1.14	0.19		
Polyplax plesia	F	1.47	0.19		
	M	1.03	0.21		
Polyplax praecisa	F	1.33	0.19		
	M	1.29	0.32	0.12	0.15
Polyplax praomydis	F	1.40	0.29	0.13	
	M	1.07	0.19		
Polyplax reclinata	F	1.67	0.23	0.12	
	M	0.89	0.18	0.11	
Polyplax rhizomydis	F	1.20	0.19	0.11	0.12
	M	2.17	0.44	0.19	
Polyplax roseinnesi	F	2.48	0.45	0.20	
	M	1.03	0.20		
Polyplax serrata	F	1.23	0.20		
	M	0.99	0.17		
Polyplax smallwoodae	F	1.22	0.18		
	M	1.22	0.17	0.11	
Polyplax spinulosa	F	1.66	0.19	0.12	
	M	0.89	0.22	0.11	0.11

	Polyplax stephensi	F	1.26	0.23	0.11	
		M	1.51	0.36		
	Polyplax subtaterae	F	1.78	0.34		
		M	1.18	0.28		
	Polyplax taterae	F	1.37	0.28	0.14	
		M	1.17	0.23	0.11	
	Polyplax vacillata	F	1.35	0.25	0.11	
		M	0.90	0.19		
	Polyplax wallacei	F	1.29	0.20	0.13	
		M	0.97	0.22	0.09	
	Polyplax watersoni	F	1.20	0.20	0.09	
		M	1.18	0.21	0.09	
	Polyplax werneri	F	1.57	0.22	0.11	
		M	1.13	0.20		
	Sathrax durus	F	1.52	0.24		
		M	1.20	0.31	0.12	
	Scipio aulacodi	F	1.48	0.36		0.13
		M	1.99	0.46	0.39	0.40
	Scipio tripedatus	F	2.29	0.60		
		M	1.05	0.25		
	Typhlomyophthirus bifoliatus	F	1.69	0.33	0.15	
		M	1.05	0.19		
Ratemidae	*Ratemia asiatica*	F	1.19	0.17		
		M	1.87	0.40	0.22	
		F	2.13	0.42	0.25	0.26

Appendix B: Sucking louse claw size measurements used in correlation analyses.

Louse Family	Louse species	Sex	Second claw opening (mm)	Third claw opening (mm)
Echinophthiriidae	*Antarctophthirus callorhini*	F		0.10
	Antarctophthirus trichechi	M	0.25	0.25
		F	0.22	0.22
	Enchinophthirius horridus	M		0.19
Enderleinellidae	*Enderleinellus kumadai*	M		0.03
	Enderleinellus osborni	F		0.02
	Haematopinus asini	M		0.11
		F	0.21	0.27
Haematopinidae	*Haematopinus bufali*	F	0.11	
	Haematopinus eurysternus	M	0.12	0.11
		F		0.09
	Haematopinus minor	F	0.10	0.11
	Haematopinus phacochoeri	M	0.31	0.31
	Haematopinus suis	M	0.23	0.25
		F		0.30
	Ancistroplax taiwanensis	F	0.00	
Hoplopleuridae	*Haematopinoides squamosus*	M	0.03	
		F	0.03	
	Hoplopleura acanthopus	M	0.03	0.04
		F	0.03	
	Hoplopleura affinis	M		
		F	0.04	

Hoplopleura arboricola	M		0.05
	F	0.05	0.07
Hoplopleura arizonensis	M	0.05	
	F	0.05	
Hoplopleura captiosa	M	0.03	
	F	0.03	
Hoplopleura chippauxi	M	0.05	
	F	0.05	
Hoplopleura chrysocomi	M	0.03	0.04
	F	0.03	
Hoplopleura colomydis	F	0.04	
Hoplopleura contigua	M	0.05	
Hoplopleura cricetula	F	0.04	
Hoplopleura dissicula	F	0.04	
Hoplopleura emphereia	F	0.04	
Hoplopleura enormis	M	0.04	
Hoplopleura erratica	M		0.04
	F	0.05	
Hoplopleura ferrisi	M	0.04	
Hoplopleura hesperomydis	M	0.03	
	F	0.03	
Hoplopleura indiscreta	F	0.03	
Hoplopleura inexpectans	M	0.04	
Hoplopleura inusitata	M		0.06
	F	0.04	
Hoplopleura irritans	M	0.04	
	F	0.04	

Hoplopleura kitti	M	0.04	
Hoplopleura malaysiana	F	0.05	
Hoplopleura maniculata	M	0.05	0.06
	F	0.05	
Hoplopleura myomyis	F	0.03	
Hoplopleura nasvikae	F	0.03	
Hoplopleura nesoryzomydis	F	0.04	
Hoplopleura oenomydis	F	0.05	
Hoplopleura oryzomydis	M	0.04	
Hoplopleura pacifica	M	0.05	
	F	0.04	
Hoplopleura pelomydis	F	0.05	
Hoplopleura reithrodontomyis	F	0.03	
Hoplopleura rimae	F	0.03	
Hoplopleura sembeli	M	0.03	
	F	0.03	
Hoplopleura setzeri	M	0.04	
Hoplopleura sicata	M	0.04	
	F	0.04	
Hoplopleura similis	M		0.05
Hoplopleura somereni	M	0.05	
Hoplopleura spiculifer	M	0.04	
	F	0.05	
Hoplopleura trispinosa	F	0.08	
Schizophthirus graphiuri	M	0.06	
	F	0.07	

Hybophthiridae	*Hybophthirus notophallus*	M	4.30	3.50
		F	4.00	
Linognathidae	*Linognathus africanus*	F	0.10	0.13
	Linognathus fenneci	M	0.05	
		F	0.14	0.14
	Linognathus pedalis	F	0.10	0.10
	Linognathus setosus	M	0.06	0.07
	Linognathus stenopsis	M	0.10	0.12
	Linognathus vituli	M		0.09
		F	0.08	0.10
	Linognathus weisseri	F	0.12	0.12
	Solenoptes binipilosus	M	0.10	0.12
		F	0.11	0.13
	Solenopotes ferrisi	M	0.08	0.10
		F	0.10	
	Solenopotes muntiacus	M	0.11	0.10
		F	0.10	0.11
Pedicinidae	*Pedicinus ancoratus*	M	0.09	0.10
		F	0.10	0.10
	Pedicinus eurygaster	F	0.05	
	Pedicinus hamadryas	M	0.10	0.11
	Pedicinus obtusus	F	0.07	0.08
Pediculidae	*Pediculus humanus*	M	0.13	0.11
		F	0.08	0.01
	Pediculus mjobergi	M	0.12	
		F		0.13

Polyplacidae	*Fahrenholzia fairchildi*	M	0.08	0.13
		F	0.10	0.12
	Fahrenholzia microcephala	F		0.06
	Fahrenholzia pinnata	M	0.05	0.06
		F	0.06	
	Fahrenholzia reducta	F		0.08
	Fahrenholzia tribulosa	M		0.07
		F		0.06
	Haemodipsus brachylagi	F	0.06	0.06
	Haemodipsus lyriocephalus	M	0.06	0.07
		F	0.08	0.06
	Haemodipsus setoni	F		0.04
	Haemodipsus ventricosus	M	0.05	0.05
		F	0.04	
	Johnsonpthirus heliosciuri	M	0.04	0.06
		F	0.07	0.07
	Johnsonpthirus suahelicus	M	0.05	
		F	0.05	
	Lemurphthirus galagus	M	0.05	0.05
	Linognathoides cynomyis	M		0.07
		F		0.08
	Linognathoides faurei	M	0.14	0.15
		F	0.13	0.16
	Linognathoides laeviusculus	M	0.05	0.06
	Linognathoides marmotae	M	0.08	
		F	0.09	0.10

Neohaematopinus appressus	M	0.05	0.04
	F	0.05	0.05
Neohaematopinus callosciuri	M	0.06	0.07
	F		0.05
Neohaematopinus capitaneus	M	0.06	0.05
	F	0.08	0.07
Neohaematopinus citellinus	F	0.07	0.07
Neohaematopinus elbeli	F	0.06	0.06
Neohaematopinus griseicolus	F	0.07	0.08
Neohaematopinus inornatus	M		0.05
	F		0.05
Neohaematopinus petauristae	M	0.05	0.06
Neohaematopinus scuri	M		0.05
	F		0.06
Neohaematopinus sciurinus	F	0.06	0.06
Neohaematopinus spilosmae	F	0.05	0.06
Neohaematopinus syriacus	M	0.07	0.06
	F	0.07	0.07
Polyplax abyssinica	M	0.03	
	F	0.03	
Polyplax alaskensis	M	0.03	0.04
	F	0.03	
Polyplax arvicanthis	M	0.04	0.03
	F	0.03	0.03

Polyplax asiatica	M	0.03	0.03
	F	0.08	
Polyplax biseriata	M	0.03	
	F	0.03	
Polyplax brachyrrhyncha	F	0.03	
Polyplax bullimae	M	0.03	
	F	0.04	
Polyplax cannomydis	F	0.05	
Polyplax expressa	M	0.03	
	F	0.04	0.05
Polyplax gerbilli	M	0.05	0.02
	F	0.03	
Polyplax hoogstraali	M		0.07
	F	0.04	
Polyplax melasmothrixi	F	0.04	
Polyplax meridionalis	M	0.05	
	F	0.04	
Polyplax otomydis	M	0.03	
	F	0.03	
Polyplax oxyrrhyncha	M	0.05	
	F	0.05	
Polyplax paradoxa	M	0.03	
	F	0.04	0.06
Polyplax praecisa	M	0.03	0.07
	F	0.03	
Polyplax praomydis	F	0.04	

Polyplax reclinata	M	0.04	
	F	0.05	0.04
Polyplax rhizomydis	M	0.03	
	F	0.06	
Polyplax smallwoodae	M	0.04	
	F	0.04	
Polyplax spinulosa	M	0.04	0.04
	F	0.04	
Polyplax subtaterae	F	0.03	
Polyplax taterae	M	0.03	
	F	0.03	
Polyplax vacillata	F	0.04	
Polyplax wallacei	M	0.03	
	F	0.02	
Polyplax watersoni	M	0.03	
	F	0.03	
Scipio tripedatus	F	0.12	

Appendix C: Sucking louse-host associations and references used for host body sizes.

Louse Species	**Host species**	**References**
Ancistroplax crocidurae	*Crocidura horsfieldi*	Nowak, R.M. 1999. Walker's Mammals of the World sixth ed. Baltimore and London: The Johns Hopkins University Press, Baltimore.
Antarctophthirus callorhini	*Callorhinus ursinus*	Nowak, R.M. 1999. Walker's Mammals of the World sixth ed. Baltimore and London: The Johns Hopkins University Press, Baltimore.
Antarctophthirus trichechi	*Odobenus rosmarus*	Fay, F.H. 1985. *Odobenus rosmarus*. *Mammalian Species,* 238:1-7
Enderleinellus ferrisi	*Spermophilus citellus*	Nowak, R.M. 1999. Walker's Mammals of the World sixth ed. Baltimore and London: The Johns Hopkins University Press, Baltimore.
Enderleinellus kumadai	*Callosciurus prevostii*	Nowak, R.M. 1999. Walker's Mammals of the World sixth ed. Baltimore and London: The Johns Hopkins University Press, Baltimore.
Enderleinellus longiceps	*Sciurus carolinensis*	Koprowski, J.L. 1994. *Sciurus carolinensis*. *Mammalian Species,* 480:1-9
Enderleinellus osborni	*Spermophilus beecheyi*	Lima, M. 2003. "Spermophilus beecheyi" (On-line), Animal Diversity Web. Accessed October 09, 2009 at http://animaldiversity.ummz.umich.edu/site/accounts/information/Spermophilus_beecheyi.html.
Enderleinellus venezuelae	*Sciurus granatensis*	Nowak, R.M. 1999. Walker's Mammals of the World sixth ed. Baltimore and London: The Johns Hopkins University Press, Baltimore.

Eulinagnathus aculeatus	*Jaculus jaculus*	Keeley, T. and Myers, P. 2004. "Jaculus jaculus" (On-line), Animal Diversity Web. Accessed October 09, 2009 at http://animaldiversity.ummz.umich.edu/site/accounts/information/Jaculus_jaculus.html.
Eulinognathus denticulatus	*Pedetes capensis*	Jackson, A. 2000. "Pedetes capensis" (On-line), Animal Diversity Web. Accessed October 09, 2009 at http://animaldiversity.ummz.umich.edu/site/accounts/information/Pedetes_capensis.html.
Eulinognethus hesperius	*Allactaga tetradactyla*	Sims, K. 2000. "Allactaga tetradactyla" (On-line), Animal Diversity Web. Accessed October 09, 2009 at http://animaldiversity.ummz.umich.edu/site/accounts/information/Allactaga_tetradactyla.html.
Fahrenholzia fairchildi	*Heteromys desmerestianus*	Kuns, M.L. and Tashian, R.E. 1954. Notes on mammals from northern Chapias, Mexico. *Journal of Mammalogy*. 35:100-103
Fahrenholzia microcephala	*Liomys irritans*	Nowak, R.M. 1999. Walker's Mammals of the World sixth ed. Baltimore and London: The Johns Hopkins University Press, Baltimore.
Fahrenholzia pinnata	*Dipodomys heermanni*	Nowak, R.M. 1999. Walker's Mammals of the World sixth ed. Baltimore and London: The Johns Hopkins University Press, Baltimore.
Fahrenholzia reducta	*Chaetodipus formosus*	Eckhart, A. 2004. "Chaetodipus formosus" (On-line), Animal Diversity Web. Accessed October 09, 2009 at http://animaldiversity.ummz.umich.edu/site/accounts/information/Chaetodipus_formosus.html.
Fahrenholzia schwartzi	*Heteromys anomalus*	Walker, E. and Nowak, R. 1999. Walker's Mammals of the World sixth ed. Baltimore and London: The Johns Hopkins University Press, Baltimore.

Fahrenholzia tribulosa	*Chaetodipus californicus*	Johnson, M. 2001. "Chaetodipus californicus" (On-line), Animal Diversity Web. Accessed October 09, 2009 at http://animaldiversity.ummz.umich.edu/site/accounts/information/Chaetodipus_californicus.html.
Haematopinoides squamosus	*Parascalops breweri*	Hallett, J. 1978. *Parascalops breweri*. *Mammalian Species,* 98: 1-4
Haematopinus asini	*Equus caballus*	Bennet, D. and Hoffman, R.S. 1999. *Equus caballus*. *Mammalian Species,* 628:1-14
Haematopinus bufali	*Syncerus caffer*	Newell, T. 2000. "Syncerus caffer" (On-line), Animal Diversity Web. Accessed October 09, 2009 at http://animaldiversity.ummz.umich.edu/site/accounts/information/Syncerus_caffer.html.
Haematopinus eurysternus	*Bos taurus*	Dewey, T. and Ng, J. 2001. "Bos taurus" (On-line), Animal Diversity Web. Accessed October 09, 2009 at http://animaldiversity.ummz.umich.edu/site/accounts/information/Bos_taurus.html.
Haematopinus minor	*Equus caballus*	Bennet, D. and Hoffman, R.S. 1999. *Equus caballus*. *Mammalian Species,* 628:1-14
Haematopinus phacochoeri	*Phacochoerus africanus*	Nowak, R.M. 1999. Walker’s Mammals of the World sixth ed. Baltimore and London: The Johns Hopkins University Press, Baltimore.
Haematopinus quadripertusus	*Bos taurus*	Dewey, T. and Ng, J. 2001. "Bos taurus" (On-line), Animal Diversity Web. Accessed October 09, 2009 at http://animaldiversity.ummz.umich.edu/site/accounts/information/Bos_taurus.html.

Haematopinus suis	*Sus scrofa*	Dewey, T. and Hruby, J. 2002. "Sus scrofa" (On-line), Animal Diversity Web. Accessed October 09, 2009 at http://animaldiversity.ummz.umich.edu/site/accounts/information/Sus_scrofa.html.
Haematopinus tuberculatus	*Bubalus bubalus*	Roth, J. and Myers, P. 2004. "Bubalus bubalis" (On-line), Animal Diversity Web. Accessed October 09, 2009 at http://animaldiversity.ummz.umich.edu/site/accounts/information/Bubalus_bubalis.html.
Haemodipsus brachylagi	*Brachylagus idahoensis*	Green, J. and Flinders, J. 1980. *Brachylagus idahoensis*. *Mammalian Species,* 125: 1-4
Haemodipsus lyriocephalus	*Lepus timidus*	Angerbojorn, A. and Flux J. 1995. *Lepus timidus*. *Mammalian Species,* 495: 1-11
Haemodipsus setoni	*Lepus californicus*	Best, T.L. 1996. *Lepus californicus*. *Mammalian Species,* 530:1-10
Haemodpsus ventricosus	*Oryctolagus cuniculus*	Tislerics, A. 2000. "Oryctolagus cuniculus" (On-line), Animal Diversity Web. Accessed October 09, 2009 at http://animaldiversity.ummz.umich.edu/site/accounts/information/Oryctolagus_cuniculus.html.
Hoplopleura acanthopus	*Microtus pennsylvanicus*	Reich, L.M. 1981. *Microtus pennsylvanicus*. *Mammalian Species,* 159:1-8
Hoplopleura affinis	*Apodemus agrarius*	Nowak, R.M. 1999. Walker's Mammals of the World sixth ed. Baltimore and London: The Johns Hopkins University Press, Baltimore.
Hoplopleura aitkeni	*Akodon urichi*	Nowak, R.M. 1999. Walker's Mammals of the World sixth ed. Baltimore and London: The Johns Hopkins University Press, Baltimore.

Hoplopleura angulata	*Rhipidomys venezuelae*	Nowak, R.M. 1999. Walker's Mammals of the World sixth ed. Baltimore and London: The Johns Hopkins University Press, Baltimore.
Hoplopleura arboricola	*Tamias townsendii*	Sutton, D.A. 1993. *Tamias townsendii*. *Mammalian Species,* 435: 1-6
Hoplopleura arizonensis	*Sigmodon arizonae*	Nowak, R.M. 1999. Walker's Mammals of the World sixth ed. Baltimore and London: The Johns Hopkins University Press, Baltimore.
Hoplopleura bidentata	*Hydromys chrysogaster*	Lundrigan, B. and Pfotenhauer, K. 2003. "Hydromys chrysogaster" (On-line), Animal Diversity Web. Accessed October 09, 2009 at http://animaldiversity.ummz.umich.edu/site/accounts/information/Hydromys_chrysogaster.html.
Hoplopleura biseriata	*Tatera brantsii*	Nowak, R.M. 1999. Walker's Mammals of the World sixth ed. Baltimore and London: The Johns Hopkins University Press, Baltimore.
Hoplopleura brasiliensis	*Oryzomys capito*	Nowak, R.M. 1999. Walker's Mammals of the World sixth ed. Baltimore and London: The Johns Hopkins University Press, Baltimore.
Hoplopleura capensis	*Desmodillus auricularis*	Nowak, R.M. 1999. Walker's Mammals of the World sixth ed. Baltimore and London: The Johns Hopkins University Press, Baltimore.
Hoplopleura captiosa	*Mus musculus*	Ballenger, L. 1999. "Mus musculus" (On-line), Animal Diversity Web. Accessed October 09, 2009 at http://animaldiversity.ummz.umich.edu/site/accounts/information/Mus_musculus.html.
Hoplopleura chilensis	*Octodon degus*	Woods, C.A. and Boraker, D.K. 1975. *Octodon degus*. *Mammalian Species,* 67: 1-5

Hoplopleura chippauxi	*Arvicanthis niloticus*	Lundrigan, B., Biology of Mammals and St. John, J. 2005. "Arvicanthis niloticus" (On-line), Animal Diversity Web. Accessed October 09, 2009 at http://animaldiversity.ummz.umich.edu/site/accounts/information/Arvicanthis_niloticus.html.
Hoplopleura colomydis	*Colomys goslingi*	Nowak, R.M. 1999. Walker's Mammals of the World sixth ed. Baltimore and London: The Johns Hopkins University Press, Baltimore.
Hoplopleura contigua	*Holochilus sciureus*	Guillermo R.B. and Garcia-Rangel, S. 2005. *Holochilus sciureus*. *Mammalian Species,* 780:1-5
Hoplopleura difficilis	*Peromyscus crinitus*	Johnson, D.W. and Armstrong, D.M. 1987. *Peromyscus crinitus*. *Mammalian Species,* 287:1-8
Hoplopleura dissicula	*Sundamys muelleri*	Nowak, R.M. 1999. Walker's Mammals of the World sixth ed. Baltimore and London: The Johns Hopkins University Press, Baltimore.
Hoplopleura emphereia	*Peromyscus mexicanus*	Nowak, R.M. 1999. Walker's Mammals of the World sixth ed. Baltimore and London: The Johns Hopkins University Press, Baltimore.
Hoplopleura enormis	*Lemniscomys rosalia*	Nowak, R.M. 1999. Walker's Mammals of the World sixth ed. Baltimore and London: The Johns Hopkins University Press, Baltimore.
Hoplopleura erratica	*Tamias striatus*	Snyder, D.P. 1982. *Tamias striatus*. *Mammalian Species,* 168:1-8
Hoplopleura ferrisi	*Peromyscus boylii*	Boyett, W. 2002. "Peromyscus boylii" (On-line), Animal Diversity Web. Accessed October 09, 2009 at http://animaldiversity.ummz.umich.edu/site/accounts/information/Peromyscus_boylii.html.
Hoplopleura fonsecai	*Oxymycterus hispidus*	Nowak, R.M. 1999. Walker's Mammals of the World sixth ed. Baltimore and London: The Johns Hopkins University Press, Baltimore.

Hoplopleura n. sp. 1	*Mus shortridgei*	Nowak, R.M. 1999. Walker's Mammals of the World sixth ed. Baltimore and London: The Johns Hopkins University Press, Baltimore.
Holplopleura n. sp. 2	*Hapalomys longicaudatus*	Nowak, R.M. 1999. Walker's Mammals of the World sixth ed. Baltimore and London: The Johns Hopkins University Press, Baltimore.
Hoplopleura hesperomydis	*Peromyscus leucopus*	Lackey, J.A., Huckaby, D.G. and Ormiston, B.G. 1985. *Peromyscus leucopus*. *Mammalian Species,* 247:1-10
Holplopleura inuisitata	*Echimys semivillosus*	Adams, R. and Myers, P. 2004. "Echimys semivillosus" (On-line), Animal Diversity Web. Accessed October 09, 2009 at http://animaldiversity.ummz.umich.edu/site/accounts/information/Echimys_semivillosus.html.
Hoplopleura irritans	*Rattus fuscipes*	Taylor, M.J. and Calaby, J.H. 1988. *Rattus fuscipes*. *Mammalian Species,* 298:1-8
Hoplopleura johnsonae	*Mus cervicolor*	Nowak, R.M. 1999. Walker's Mammals of the World sixth ed. Baltimore and London: The Johns Hopkins University Press, Baltimore.
Hoplopleura laticeps	*Hybomys univittatus*	Nowak, R.M. 1999. Walker's Mammals of the World sixth ed. Baltimore and London: The Johns Hopkins University Press, Baltimore.
Hoplopleura longula	*Micromys minutus*	Ivaldi, F. 1999. "Micromys minutus" (On-line), Animal Diversity Web. Accessed October 09, 2009 at http://animaldiversity.ummz.umich.edu/site/accounts/information/Micromys_minutus.html.
Hoplopleura malabarica	*Bandicota indica*	Nowak, R.M. 1999. Walker's Mammals of the World sixth ed. Baltimore and London: The Johns Hopkins University Press, Baltimore.
Hoplopleura maniculata	*Funambulus palmarum*	Nowak, R.M. 1999. Walker's Mammals of the World sixth ed. Baltimore and London: The Johns Hopkins University Press, Baltimore.

Hoplopleura mendezi	*Oryzomys rhabdops*	Nowak, R.M. 1999. Walker's Mammals of the World sixth ed. Baltimore and London: The Johns Hopkins University Press, Baltimore.
Hoplopleura mulleri	*Gerbillurus paeba*	Perrin, M.R., Dempster, E.R. and Downs, C.T. 1999. *Gerbillus paeba*. *Mammalian Species,* 606:1-6
Hoplopleura multilobata	*Oryzomys albigularis*	Nowak, R.M. 1999. Walker's Mammals of the World sixth ed. Baltimore and London: The Johns Hopkins University Press, Baltimore.
Hoplopleura neumanni	*Tatera nigricauda*	Nowak, R.M. 1999. Walker's Mammals of the World sixth ed. Baltimore and London: The Johns Hopkins University Press, Baltimore.
Hoplopleura oenomydis	*Oenomys hypoxanthus*	Nowak, R.M. 1999. Walker's Mammals of the World sixth ed. Baltimore and London: The Johns Hopkins University Press, Baltimore.
Hoplopleura oryzomydis	*Oryzomys palustris*	Wolfe, J.L. 1982. *Oryzomys palustris*. *Mammalian Species,* 176:1-5
Hoplopleura pacifica	*Rattus exulans*	Warren, D. 2004. "Rattus exulans" (On-line), Animal Diversity Web. Accessed October 09, 2009 at http://animaldiversity.ummz.umich.edu/site/accounts/information/Rattus_exulans.html.
Hoplopleura pelomydis	*Pelomys fallax*	Nowak, R.M. 1999. Walker's Mammals of the World sixth ed. Baltimore and London: The Johns Hopkins University Press, Baltimore.
Hoplopleura quadridentata	*Nectomys squamipes*	Ernest, K.A. 1986. *Nectomys squamipes*. *Mammalian Species,* 265:1-5
Hoplopleura reithrodontomyis	*Reithrodontomys sumichrasti*	Nowak, R.M. 1999. Walker's Mammals of the World sixth ed. Baltimore and London: The Johns Hopkins University Press, Baltimore.

Hoplopleura rukenyae	*Mus triton*	Nowak, R.M. 1999. Walker's Mammals of the World sixth ed. Baltimore and London: The Johns Hopkins University Press, Baltimore.
Hoplopleura scapteromydis	*Scapteromys tumidus*	Nowak, R.M. 1999. Walker's Mammals of the World sixth ed. Baltimore and London: The Johns Hopkins University Press, Baltimore.
Hoplopleura sciuricola	*Sciurus carolinensis*	Koprowski, J.L. 1994. *Sciurus carolinensis*. *Mammalian Species,* 480:1-9
Hoplopleura scotinomydis	*Scotinomys xerampelinus*	Nowak, R.M. 1999. Walker's Mammals of the World sixth ed. Baltimore and London: The Johns Hopkins University Press, Baltimore.
Hoplopleura setzeri	*Grammomys macmillani*	Nowak, R.M. 1999. Walker's Mammals of the World sixth ed. Baltimore and London: The Johns Hopkins University Press, Baltimore.
Holplopleura somereni	*Dasymys incomtus*	Nowak, R.M. 1999. Walker's Mammals of the World sixth ed. Baltimore and London: The Johns Hopkins University Press, Baltimore.
Hoplopleura spiculifer	*Lemniscomys barbarus*	Nowak, R.M. 1999. Walker's Mammals of the World sixth ed. Baltimore and London: The Johns Hopkins University Press, Baltimore.
Hoplopleura tiptoni	*Thomasomys laniger*	Walker, E., R. Nowak. 1999. Walker's Mammals of the World sixth ed. Baltimore and London: The Johns Hopkins University Press, Baltimore.
Hoplopleura trispinosa	*Glaucomys volans*	Dolan, P.G. and Carter, D.C. 1977. *Glaucomys volans*. *Mammalian Species,* 78:1-6
Hybophthirus notophallus	*Orycteropus afer*	Shoshani, J., Goldman, C.A. and Thewissen, J.G.M. 1988. Orycteropus afer. *Mammalian Species,* 300:1-8

Johnsonpthirus heliosciuri	*Paraxerus palliatus*	Nowak, R.M. 1999. Walker's Mammals of the World sixth ed. Baltimore and London: The Johns Hopkins University Press, Baltimore.
Johnsonpthirus suahelicus	*Paraxerus cepapi*	Nowak, R.M. 1999. Walker's Mammals of the World sixth ed. Baltimore and London: The Johns Hopkins University Press, Baltimore.
Lemurphthirus galagus	*Galago senegalensis*	Ballenger, L. 2001. "Galago senegalensis" (On-line), Animal Diversity Web. Accessed October 17, 2009 at http://animaldiversity.ummz.umich.edu/site/accounts/information/Galago_senegalensis.html.
Linognathoides faurei	*Xerus inauris*	Richards, T. and Baker, S. 2009. "Xerus inauris" (On-line), Animal Diversity Web. Accessed October 17, 2009 at http://animaldiversity.ummz.umich.edu/site/accounts/information/Xerus_inauris.html.
Linognathoides laeviusculus	*Spermophilus parryii*	Brensike, J. 2000. "Spermophilus parryii" (On-line), Animal Diversity Web. Accessed October 09, 2009 at http://animaldiversity.ummz.umich.edu/site/accounts/information/Spermophilus_parryii.html.
Linognathoides marmotae	*Marmota flaviventris*	Frase, B.A. and Hoffman, R.S. 1980. *Marmota flaviventris*. *Mammalian Species,* 135:1-8
Linognathoides pectinifer	*Atlantoxerus getulus*	Nowak, R.M. 1999. Walker's Mammals of the World sixth ed. Baltimore and London: The Johns Hopkins University Press, Baltimore.
Linognathus africanus	*Capra hircus*	Mileski, A. and Myers, P. 2004. "Capra hircus" (On-line), Animal Diversity Web. Accessed October 09, 2009 at http://animaldiversity.ummz.umich.edu/site/accounts/information/Capra_hircus.html.
Linognathus breviceps	*Cephalophus maxwellii*	Ralls, K. 1973. *Cephalophus maxwellii*. *Mammalian Species,* 31: 1-4

Linognathus fenneci	*Vulpes zerda*	Lariviere, S. 2002. *Vulpes zerda*. *Mammalian Species,* 714:1-5
Linognathus gorgonus	*Connochaetes taurinus*	Newell, T. 1999. "Connochaetes taurinus" (On-line), Animal Diversity Web. Accessed October 09, 2009 at http://animaldiversity.ummz.umich.edu/site/accounts/information/Connochaetes_taurinus.html.
Linognathus pedalis	*Ovis aries*	Reavill, C. 2000. "Ovis aries" (On-line), Animal Diversity Web. Accessed October 09, 2009 at http://animaldiversity.ummz.umich.edu/site/accounts/information/Ovis_aries.html.
Linognathus setosus	*Canis lupus*	Mech, D.L. 1974. *Canis lupus*. *Mammalian Species,* 37:1-6
Linognathus stenopsis	*Capra hircus*	Mileski, A. and Myers, P. 2004. "Capra hircus" (On-line), Animal Diversity Web. Accessed October 09, 2009 at http://animaldiversity.ummz.umich.edu/site/accounts/information/Capra_hircus.html.
Linognathus tibialis	*Gazella dama*	Villarreal, L. and Myers, P. 2006. "Nanger dama" (On-line), Animal Diversity Web. Accessed October 09, 2009 at http://animaldiversity.ummz.umich.edu/site/accounts/information/Nanger_dama.html.
Linognathus vituli	*Bos taurus*	Dewey, T. and J. Ng. 2001. "Bos taurus" (On-line), Animal Diversity Web. Accessed October 09, 2009 at http://animaldiversity.ummz.umich.edu/site/accounts/information/Bos_taurus.html.
Linognathus weisseri	*Aepyceros melampus*	Lundrigan, B. and K. Sproull. 2000. "Aepyceros melampus" (On-line), Animal Diversity Web. Accessed October 09, 2009 at http://animaldiversity.ummz.umich.edu/site/accounts/information/Aepyceros_melampus.html.

Microphthirus uncinatus	*Glaucomys volans*	Dolan, P.G. and Carter, D.C. 1977. *Glaucomys volans*. *Mammalian Species,* 78:1-6
Neohaematopinus appressus	*Tamiops rodolphei*	Nowak, R.M. 1999. Walker's Mammals of the World sixth ed. Baltimore and London: The Johns Hopkins University Press, Baltimore.
Neohaematopinus callosciuri	*Callosciurus finlaysoni*	Nowak, R.M. 1999. Walker's Mammals of the World sixth ed. Baltimore and London: The Johns Hopkins University Press, Baltimore.
Neohaematopinus capitaneus	*Hylopetes phayrei*	Nowak, R.M. 1999. Walker's Mammals of the World sixth ed. Baltimore and London: The Johns Hopkins University Press, Baltimore.
Neohaematopinus citellinus	*Spermophilus tereticaudus*	Ernest, K.A. and Mares, M.A. 1987. *Spermophilus tereticaudus*. *Mammalian Species,* 274:1-9
Neohaematopinus elbeli	*Dremomys rufigenis*	Nowak, R.M. 1999. Walker's Mammals of the World sixth ed. Baltimore and London: The Johns Hopkins University Press, Baltimore.
Neohaematopinus griseicolus	*Sciurus griseus*	Carraway, L.N. and Verts, B.J. 1994. *Sciurus griseus*. *Mammalian Species,* 474:1-7
Neohaematopinus inornatus	*Neotoma cinerea*	Smith, F.A. 1997. *Neotoma cinera*. *Mammalian Species,* 564:1-8
Neohaematopinus pallidus	*Petaurista petaurista*	Newlin, S. and Bradshaw, J. 1999. "Petaurista petaurista" (On-line), Animal Diversity Web. Accessed October 09, 2009 at http://animaldiversity.ummz.umich.edu/site/accounts/information/Petaurista_petaurista.html.
Neohaematopinus pansus	*Petaurillus hosei*	Dewey, T. 2007. "Petaurillus hosei" (On-line), Animal Diversity Web. Accessed October 09, 2009 at http://animaldiversity.ummz.umich.edu/site/accounts/information/Petaurillus_hosei.html.

Neohaematopinus petauristae	*Petaurista petaurista*	Newlin, S. and Bradshaw, J. 1999. "Petaurista petaurista" (On-line), Animal Diversity Web. Accessed October 09, 2009 at http://animaldiversity.ummz.umich.edu/site/accounts/information/Petaurista_petaurista.html.
Neohaematopinus robustus	*Petaurista elegans*	Ryckman, E. 2004. "Petaurista elegans" (On-line), Animal Diversity Web. Accessed October 09, 2009 at http://animaldiversity.ummz.umich.edu/site/accounts/information/Petaurista_elegans.html.
Neohaematopinus rupestis	*Sciurotamias forresti*	Nowak, R.M. 1999. Walker's Mammals of the World sixth ed. Baltimore and London: The Johns Hopkins University Press, Baltimore.
Neohaematopinus sciuri	*Sciurus carolinensis*	Koprowski, J.L. 1994. *Sciurus carolinensis*. *Mammalian Species,* 480:1-9
Neohaematopinus sciurinus	*Sciurus niger*	Koprowski, J.L. 1994. *Sciurus niger*. *Mammalian Species,* 479:1-9
Neohaematopinus sciuropteri	*Glaucomys volans*	Dolan, P.G. and Carter, D.C. 1977. *Glaucomys volans*. *Mammalian Species,* 78:1-6
Neohaematopinus semifasciatus	*Tamiasciurus douglasii*	Steele, M.A. 1999. *Tamiasciurus douglasii*. *Mammalian Species,* 630:1-8
Neohaematopinus spilosmae	*Spermophilus spilosoma*	Streubel, D.P. and Fitzgerald, J.P. 1978. *Spermophilus spilosoma*. *Mammalian Species,* 101:1-4
Pedicinus ancoratus	*Trachypithecus cristatus*	Nowak, R.M. 1999. Walker's Mammals of the World sixth ed. Baltimore and London: The Johns Hopkins University Press, Baltimore.

Pedicinus eurygaster	*Macaca sinica*	Kanelos, M. and Myers, P. 2009. "Macaca sinica" (On-line), Animal Diversity Web. Accessed October 09, 2009 at http://animaldiversity.ummz.umich.edu/site/accounts/information/Macaca_sinica.html.
Pedicinus hamadryas	*Papio hamadryas*	Shefferly, N. 2004. "Papio hamadryas" (On-line), Animal Diversity Web. Accessed October 09, 2009 at http://animaldiversity.ummz.umich.edu/site/accounts/information/Papio_hamadryas.html.
Pedicinus obtusus	*Macaca maura*	Nowak, R.M. 1999. Walker's Mammals of the World sixth ed. Baltimore and London: The Johns Hopkins University Press, Baltimore.
Pedicinus pictus	*Colobus guereza*	Kim, K. 2002. "Colobus guereza" (On-line), Animal Diversity Web. Accessed October 09, 2009 at http://animaldiversity.ummz.umich.edu/site/accounts/information/Colobus_guereza.htm
Pediculus humanus	*Homo sapiens*	Nowak, R.M. 1999. Walker's Mammals of the World sixth ed. Baltimore and London: The Johns Hopkins University Press, Baltimore.
Pediculus mjobergi	*Ateles geoffroyi*	Gorog, A. 2002. "Ateles geoffroyi" (On-line), Animal Diversity Web. Accessed October 09, 2009 at http://animaldiversity.ummz.umich.edu/site/accounts/information/Ateles_geoffroyi.html.
Pediculus schaeffi	*Pan troglodytes*	Jones, C., Jones, C.A., Jones, J.K. and Wilson, D.E. 1996. *Pan troglodytes*. *Mammalian Species,* 529:1-9
Polyplax abyssinica	*Arvicanthis niloticus*	Nowak, R.M. 1999. Walker's Mammals of the World sixth ed. Baltimore and London: The Johns Hopkins University Press, Baltimore.
Polyplax alaskensis	*Microtus pennsylvannicus*	Reich, L.M. 1981. *Microtus pennsylvanicus*. *Mammalian Species,* 159:1-8

Polyplax arvicanthis	*Rhabdomys pumilio*	Nowak, R.M. 1999. Walker's Mammals of the World sixth ed. Baltimore and London: The Johns Hopkins University Press, Baltimore.
Polyplax asiatica	*Bandicota indica*	Nowak, R.M. 1999. Walker's Mammals of the World sixth ed. Baltimore and London: The Johns Hopkins University Press, Baltimore.
Polyplax auricularis	*Peromyscus maniculatus*	Bunker, A. 2001. "Peromyscus maniculatus" (On-line), Animal Diversity Web. Accessed October 09, 2009 at http://animaldiversity.ummz.umich.edu/site/accounts/information/Peromyscus_maniculatus.html.
Polyplax biseriata	*Tatera boehmi*	Nowak, R.M. 1999. Walker's Mammals of the World sixth ed. Baltimore and London: The Johns Hopkins University Press, Baltimore.
Polyplax borealis	*Clethrionomys gapperi*	Merritt, J.F. 1981. *Clethironomys gapperi*. *Mammalian Species,* 146:1-9
Polyplax brachyrrhyncha	*Acomys cahirinus*	Nowak, R.M. 1999. Walker's Mammals of the World sixth ed. Baltimore and London: The Johns Hopkins University Press, Baltimore.
Polyplax cannomydis	*Cannomys badius*	Frey, D. 2000. "Cannomys badius" (On-line), Animal Diversity Web. Accessed October 09, 2009 at http://animaldiversity.ummz.umich.edu/site/accounts/information/Cannomys_badius.html.
Polyplax cummingsi	*Dasymys incomtus*	Nowak, R.M. 1999. Walker's Mammals of the World sixth ed. Baltimore and London: The Johns Hopkins University Press, Baltimore.
Polyplax expressa	*Rattus everetti*	Nowak, R.M. 1999. Walker's Mammals of the World sixth ed. Baltimore and London: The Johns Hopkins University Press, Baltimore.

Polyplax gerbilli	*Gerbillus pyramidum*	Nowak, R.M. 1999. Walker's Mammals of the World sixth ed. Baltimore and London: The Johns Hopkins University Press, Baltimore.
Polyplax guatemalensis	*Peromyscus grandis*	Nowak, R.M. 1999. Walker's Mammals of the World sixth ed. Baltimore and London: The Johns Hopkins University Press, Baltimore.
Polyplax hoogstraali	*Acomys russatus*	Lee, T.E. Jr., Watkins, J.R. III and Cash, C.G. 1998. *Acomys russatus*. *Mammalian Species,* 590:1-4
Polyplax kaiseri	*Gerbillus gerbillus*	Nowak, R.M. 1999. Walker's Mammals of the World sixth ed. Baltimore and London: The Johns Hopkins University Press, Baltimore.
Polyplax melasmothrixi	*Melasmothrix naso*	Nowak, R.M. 1999. Walker's Mammals of the World sixth ed. Baltimore and London: The Johns Hopkins University Press, Baltimore.
Polyplax meridionalis	*Acomys spinosissimus*	Nowak, R.M. 1999. Walker's Mammals of the World sixth ed. Baltimore and London: The Johns Hopkins University Press, Baltimore.
Polyplax myotomydis	*Otomys unisulcatus*	Nowak, R.M. 1999. Walker's Mammals of the World sixth ed. Baltimore and London: The Johns Hopkins University Press, Baltimore.
Polyplax otomydis	*Otomys tropicalis*	Nowak, R.M. 1999. Walker's Mammals of the World sixth ed. Baltimore and London: The Johns Hopkins University Press, Baltimore.
Polyplax oxyrrhyncha	*Acomys cahirinus*	Nowak, R.M. 1999. Walker's Mammals of the World sixth ed. Baltimore and London: The Johns Hopkins University Press, Baltimore.
Polyplax paradoxa	*Meriones persicus*	Nowak, R.M. 1999. Walker's Mammals of the World sixth ed. Baltimore and London: The Johns Hopkins University Press, Baltimore.

Polyplax phthisica	*Lophuromys flavopunctatus*	Nowak, R.M. 1999. Walker's Mammals of the World sixth ed. Baltimore and London: The Johns Hopkins University Press, Baltimore.
Polyplax plesia	*Mystromys albicaudatus*	Maani, N. and Myers, P. 2004. "Mystromys albicaudatus" (On-line), Animal Diversity Web. Accessed October 09, 2009 at http://animaldiversity.ummz.umich.edu/site/accounts/information/Mystromys_albicaudatus.html.
Polyplax praecisa	*Tatera robusta*	Nowak, R.M. 1999. Walker's Mammals of the World sixth ed. Baltimore and London: The Johns Hopkins University Press, Baltimore.
Polyplax praomydis	*Aethomys namaquensis*	Nowak, R.M. 1999. Walker's Mammals of the World sixth ed. Baltimore and London: The Johns Hopkins University Press, Baltimore.
Polyplax reclinata	*Sorex araneus*	Taylor, M. 2002. "Sorex araneus" (On-line), Animal Diversity Web. Accessed October 09, 2009 at http://animaldiversity.ummz.umich.edu/site/accounts/information/Sorex_araneus.html.
Polyplax rhizomydis	*Rhizomys sumatrensis*	Nowak, R.M. 1999. Walker's Mammals of the World sixth ed. Baltimore and London: The Johns Hopkins University Press, Baltimore.
Polyplax roseinnesi	*Gerbillurus paeba*	Perrin, M.R., Dempster, E.R. and Downs, C.T. 1999. *Gerbillurus paeba*. *Mammalian Species,* 606:1-6
Polyplax serrata	*Mus musculus*	Ballenger, L. 1999. "Mus musculus" (On-line), Animal Diversity Web. Accessed October 09, 2009 at http://animaldiversity.ummz.umich.edu/site/accounts/information/Mus_musculus.html.
Polyplax smallwoodae	*Lophuromys woosnami*	Nowak, R.M. 1999. Walker's Mammals of the World sixth ed. Baltimore and London: The Johns Hopkins University Press, Baltimore.

Polyplax spinulosa	*Rattus norvegicus*	Myers, P. and Armitage, D. 2004. "Rattus norvegicus" (On-line), Animal Diversity Web. Accessed October 09, 2009 at http://animaldiversity.ummz.umich.edu/site/accounts/information/Rattus_norvegicus.html.
Polyplax stephensi	*Tatera indica*	Mott, S. 2004. "Tatera indica" (On-line), Animal Diversity Web. Accessed October 09, 2009 at http://animaldiversity.ummz.umich.edu/site/accounts/information/Tatera_indica.html.
Polyplax subtaterae	*Tatera valida*	Nowak, R.M. 1999. Walker's Mammals of the World sixth ed. Baltimore and London: The Johns Hopkins University Press, Baltimore.
Polyplax taterae	*Tatera robusta*	Nowak, R.M. 1999. Walker's Mammals of the World sixth ed. Baltimore and London: The Johns Hopkins University Press, Baltimore.
Polyplax vacillata	*Psammomys obesus*	Biagi, T. and Myers, P. 2004. "Psammomys obesus" (On-line), Animal Diversity Web. Accessed October 09, 2009 at http://animaldiversity.ummz.umich.edu/site/accounts/information/Psammomys_obesus.html.
Polyplax wallacei	*Bunomys chrysocomus*	Nowak, R.M. 1999. Walker's Mammals of the World sixth ed. Baltimore and London: The Johns Hopkins University Press, Baltimore.
Polyplax watersoni	*Mastomys natalensis*	Nowak, R.M. 1999. Walker's Mammals of the World sixth ed. Baltimore and London: The Johns Hopkins University Press, Baltimore.
Polyplax werneri	*Pachyuromys duprasi*	Barker, S. and C. Yahnke. 2004. "Pachyuromys duprasi" (On-line), Animal Diversity Web. Accessed October 09, 2009 at http://animaldiversity.ummz.umich.edu/site/accounts/information/Pachyuromys_duprasi.html.
Proechinophthirus fluctus	*Eumetopias jubatus*	Loughlin, T.R., Perez, M.A. and Merrick, R.L. 1987. *Eumetopias jubatus*. *Mammalian Species,* 283:1-7

Proechinophthirus calvus	*Cricetomys gambianus*	Joo, M. and Myers, P. 2004. "Cricetomys gambianus" (On-line), Animal Diversity Web. Accessed October 09, 2009 at http://animaldiversity.ummz.umich.edu/site/accounts/information/Cricetomys_gambianus.html.
Prolinognathus leptocephalus	*Procavia capensis*	Olds, N. and Shoshani, J. 1982. *Procavia capensis*. *Mammalian Species,* 171:1-7
Ratemia asiatica	*Equus caballus*	Bennet, D. and Hoffman, R.S. 1999. *Equus caballus*. *Mammalian Species,* 628:1-14
Sathrax durus	*Tupaia glis*	Lundrigan, B., Biology of Mammals and Cisneros, L.. 2005. "Tupaia glis" (On-line), Animal Diversity Web. Accessed October 09, 2009 at http://animaldiversity.ummz.umich.edu/site/accounts/information/Tupaia_glis.html.
Schozophthirus graphiuri	*Graphiurus murinus*	Nowak, R.M. 1999. Walker's Mammals of the World sixth ed. Baltimore and London: The Johns Hopkins University Press, Baltimore.
Scipio Aulacodi	*Thryonomys swinderianus*	Gochis, E. 2002. "Thryonomys swinderianus" (On-line), Animal Diversity Web. Accessed October 09, 2009 at http://animaldiversity.ummz.umich.edu/site/accounts/information/Thryonomys_swinderianus.htm
Scipio tripedatus	*Petromus typicus*	Santoro, K. and Myers, P. 2004. "Petromus typicus" (On-line), Animal Diversity Web. Accessed October 09, 2009 at http://animaldiversity.ummz.umich.edu/site/accounts/information/Petromus_typicus.html.
Solenopotes binipilosus	*Odocoileus virginianus*	Smith, W.P. 1991. *Odocoileus virginianus*. *Mammalian Species,* 388:1-13

Solenopotes capillatus	*Bos taurus*	Dewey, T. and J. Ng. 2001. "Bos taurus" (On-line), Animal Diversity Web. Accessed October 09, 2009 at http://animaldiversity.ummz.umich.edu/site/accounts/information/Bos_taurus.html.
Solenopotes ferrisi	*Odocoileus virginianus*	Smith, W.P. 1991. *Odocoileus virginianus*. *Mammalian Species,* 388:1-13
Solenopotes muntiacus	*Muntiacus muntjak*	Jackson, A. 2002. "Muntiacus muntjak" (On-line), Animal Diversity Web. Accessed October 09, 2009 at http://animaldiversity.ummz.umich.edu/site/accounts/information/Muntiacus_muntjak.html.

Appendix D: Host hair diameter measurements used in correlation analyses.

Louse Species	**Host species** (**Museum Catalog #**)	**Maximum guard hair diameter (mm)**	**Maximum underfur hair diameter (mm)**	**Base guard hair diameter (mm)**	**Base underfur hair diameter (mm)**
Ancistroplax taiwanensis	*Soriculus fumidus* (MVZ 174867)	0.06	0.02	0.02	0.02
Antarctophthirus callorhini	*Callorhinus ursinus* (UWBM34309)	0.20		0.16	
Enderleinellus ferrisi	*Spermophilus citellus* (UMMZ55767)	0.13	0.02	0.08	0.02
Enderleinellus kumadai	*Callosciurus prevostii* (MCZ23791, MCZ28642)	0.08	0.02	0.03	0.02
Enderleinellus longiceps	*Sciurus carolinensis* (GSU5, GSUTEA8, GSUT30A)	0.10	0.04	0.03	0.02
Enderleinellus osborni	*Spermophilus beecheyi* (UF476, UF9233, UF4690)	0.19	0.02	0.07	0.01
Enderleinellus venezuelae	*Sciurus granatensis* (UF13539, UF13307)	0.08	0.02	0.03	0.02
Echinophthirius horridus	*Phoca vitulina* (UWBM30179, UWBM3425)	0.21	0.04	0.05	0.02
Eulinagnathus aculeatus	*Jaculus jaculus* (UMMZ101067, UMMZ101068)	0.02		0.02	
Fahrenholzia schwartzi	*Heteromys anomalus* (UF13318, UF23863)	0.26	0.04	0.03	0.03

Haemodipsus brachylagi	*Brachylagus idahoensis* (LAD3283, LAD3283)	0.07	0.02	0.02	0.01
Haemodipsus setoni	*Lepus californicus* (LSUMZ2753, LSUMZ2754)	0.13	0.03	0.04	0.02
Haemodipsus ventricosus	*Oryctolagus cuniculus* (MCZ22222, MCX22223)	0.10	0.02	0.04	0.01
Haematopinoides squamosus	*Parascalops breweri* (TCWC20666, TCWC6563)	0.01		0.01	
Hoplopleura acanthopus	*Microtus pennsylvanicus* (UF4156, UF3888, UF3885)	0.06	0.02	0.02	
Hoplopleura arboricola	*Tamias townsendii* (UF4962)	0.07	0.01	0.02	
Hoplopleura arizonensis	*Sigmodon arizonae* (MSU10553, MSU16531)	0.17	0.03	0.10	
Hoplopleura captiosa	*Mus musculus* (GSU3)	0.07	0.03	0.02	
Hoplopleura chippauxi	*Arvicanthis niloticus* (MSU31068, MSU31066)	0.13	0.03	0.09	
Hoplopleura colomydis	*Colomys goslingi* (LACM053161, LACM053159)	0.03	0.02	0.02	
Hoplopleura contigua	*Holochilus sciureus* (MVZ 190356)	0.08	0.02	0.03	
Hoplopleura cricetula	*Tscherskia triton* (UWBM77334, UWBM77335)	0.07	0.02	0.02	
Hoplopleura difficilis	*Peromyscus crinitus* (UF5397, UF5396, UF5394)	0.03	0.02	0.07	

Hoplopleura dissicula	*Sundamys muelleri* (UMMZ117177, UMMZ117176)	0.13	0.03	0.04
Hoplopleura emphereia	*Peromyscus mexicanus* (UF23931, UF23933, UF3184)	0.05	0.02	0.01
Hoplopleura erratica	*Tamias striatus* (GSU1, GSU22)	0.19	0.02	0.02
Hoplopleura ferrisi	*Peromyscus boylii* (UF4671, UF13243)	0.04	0.01	0.01
Hoplopleura irritans	*Rattus fuscipes* (LACM068893, LACM068894)	0.10	0.03	0.04
Hoplopleura kitti	*Berylmys berdmorei* (NMNH533364, NMNH533365)	0.21	0.05	0.12
Hoplopleura malaysiana	*Leopoldamys sabanus* (TCWC47484)	0.13		0.08
Hoplopleura maniculata	*Funambulus palmarum* (LACM 014308, LACM014309)	0.06	0.02	0.02
Hoplopleura multilobata	*Oryzomys albigularis* (UMMZ123381, UMMZ123382)	0.11	0.02	0.03
Hoplopleura nesoryzomydis	*Nesoryzomys narboroughi* (MCZ27035)	0.07	0.03	0.02
Hoplopleura oenomydis	*Oenomys hypoxanthus* (LACM035611, LASM035612)	0.11	0.03	0.03
Hoplopleura oryzomydis	*Oryzomys palustris* (LAD1)	0.11	0.03	0.02
Hoplopleura pacifica	*Rattus exulans* (UF30103, UF30104)	0.15	0.03	0.02

Hoplopleura patersoni	*Aethomys chrysophilus* (MSU14345, MSU14346)	0.09	0.02	0.03	
Hoplopleura pelomydis	*Pelomys fallax* (MSU15332, MSU15331)	0.13	0.03	0.09	
Hoplopleura quadridentata	Nectomys *squamipes* (MCZ25769, MCZ25770)	0.11	0.04	0.03	
Hoplopleura reithrodontomyis	*Reithrodontomys sumichrasti* (UF6064, UF7886, UF6062)	0.05	0.02	0.02	
Hoplopleura sciuricola	*Sciurus carolinensis* (GSU5, GSUTEA8, GSUT30A)	0.10	0.04	0.03	
Hoplopleura scotinomydis	*Scotinomys xerampelinus* (UF31098)	0.06	0.01	0.02	
Hoplopleura setzeri	*Grammomys macmillani* (NMNH299738, NMNH299737)	0.09	0.03	0.03	
Hoplopleura sicata	*Niviventer cremoriventer* (UMMZ117168, UMMZ117169)	0.14	0.02	0.08	
Hoplopleura similis	*Oligoryzomys fulvescens* (UWBM72275, UWBM72277)	0.08	0.02	0.01	
Hoplopleura tiptoni	*Thomasomys laniger* (NMNH579469, NMNH579470)	0.05	0.02	0.01	
Hoplopleura travassosi	*Oligoryzomys flavescens* (UWBM72275, UWBM72277)	0.08	0.02	0.01	
Hoplopleura trispinosa	*Glaucomys volans* (GSU8, GSU2)	0.04	0.01	0.01	
Johnsonpthirus heliosciuri	*Paraxerus palliates* (LACM053499, LACM042931)	0.06	0.02	0.02	0.02

Linognathoides marmotae	*Marmota flaviventris* (UF12739, UF12750)	0.06	0.05	0.03	0.02
Linognathus fenneci	*Vulpes zerda* (MSU17366, MSU17365)	0.08	0.02	0.05	0.02
Linognathus gorgonus	*Connochaetes taurinus* (NMNH21648, NMNH470193)	0.22		0.18	
Linognathus setosus	*Canis lupus* (UWBM34178, UWBM39461)	0.15		0.10	
Microphthirus uncinatus	*Glaucomys volans* (GSU8, GSU2)	0.04	0.01	0.01	0.01
Neohaematopinus citellinus	*Spermophilus tereticaudus* (UF 4664, UF4665, UF4663)	0.14	0.05	0.08	0.04
Neohaematopinus elbeli	*Dremomys rufigenis* (UMMZ117143, UMMZ117144)		0.02		0.02
Neohaematopinus griseicolus	*Sciurus griseus* (LSUZ7032, LSUMZ10474)	0.10	0.02	0.03	0.02
Neohaematopinus inornatus	*Neotoma cinerea* (UF8173, UF8171, UF3166)	0.05	0.02	0.03	0.02
Neohaematopinus pallidus	*Petaurista petaurista* (UMMZ 117156, UMMZ117157)	0.09		0.04	
Neohaematopinus pansus	*Petaurista petaurista* (UMMZ 117156, UMMZ117157)	0.09		0.04	
Neohaematopinus sciuri	*Sciurus carolinensis* (GSU5, GSUTEA8, GSUT30A)	0.10	0.04	0.03	
Neohaematopinus sciuropteri	*Glaucomys volans* (GSU8, GSU2)	0.04	0.01	0.01	0.02

Neohaematopinus semifasciatus	*Tamiasciurus douglasii* (NMNH204825, NMNH231817)	0.08	0.02	0.04	0.01
Neohaematopinus spilosmae	*Spermophilus spilosoma* (UF7909, UF46675, UF20902)	0.13	0.04	0.06	0.02
Pedicinus hamadryas	*Papio hamadryas* (LACM042384, LACM010026)	0.09		0.07	
Pediculus humanus	*Homo sapiens* (GSUSC2)	0.10			
Pedicinus eurygaster	*Macaca sinica* (MCZ34787, MCZ34788)	0.07		0.05	
Pediculus schaeffi	*Pan troglodytes* (UF9702)	0.09		0.07	
Polyplax abyssinica	*Arvicanthis niloticus* (MSU31068, MSU31066)	0.13	0.03	0.09	0.02
Polyplax alaskensis	*Microtus pennsylvannicus* (UF4156, UF3888, UF3885)	0.06	0.02	0.02	0.02
Polyplax arvicanthis	*Rhabdomys pumilio* (MSU24155, MSU24148)	0.19	0.03	0.11	0.01
Polyplax auricularis	*Peromyscus maniculatus* (UF2121, UF5446, UF1621)	0.03	0.01	0.01	0.02
Polyplax borealis	*Clethrionomys gapperi* (UF3846, UF3843, UF2993)	0.06	0.01	0.02	0.01
Polyplax brachyrrhyncha	*Acomys cahirinus* (UF14576, UF15224, UF15232)	0.14	0.03	0.03	0.01
Polyplax bullimae	*Bullimus bagobus* (NMNH462208, NMNH462207)	0.19	0.05	0.08	0.02

Polyplax cummingsi	*Dasymys incomtus* (CU13621, CU13622)	0.10	0.05	0.05	0.04
Polyplax expressa	*Rattus everetti* (UF30020, UF30076)	0.14	0.04	0.03	0.02
Polyplax gerbilli	*Gerbillus pyramidum* (TCWC20914)	0.05		0.02	0.02
Polyplax hoogstraali	*Acomys russatus* (TCWC56193, TCWC56697)	0.11		0.03	
Polyplax kaiseri	*Gerbillus gerbillus* (MCZ15808, MCZ15809)	0.04	0.02	0.02	
Polyplax meridionalis	*Acomys spinosissimus* (MVZ 220923)	0.06	0.02	0.02	0.05
Polyplax otomydis	*Otomys tropicalis* (UWBM36197, UWBM36195)			0.02	0.06
Polyplax oxyrrhyncha	*Acomys cahirinus* (UF14576, UF15224, UF15232)	0.14	0.03	0.03	
Polyplax paradoxa	*Meriones persicus* (UF14599, UF14589)	0.06	0.02	0.02	0.02
Polyplax phthisica	*Lophuromys flavopunctatus* (LACM050408, LACM045577)	0.10	0.02	0.06	0.05
Polyplax plesia	*Mystromys albicaudatus* (NMNH452307, NMNH452308)	0.02		0.01	0.02
Polyplax praecisa	*Tatera robusta* (MSU15593, MSU15594)	0.08	0.03	0.05	
Polyplax praomydis	*Aethomys namaquensis* (TCWC56849, TCWC56847)	0.08	0.03	0.02	0.02

Polyplax reclinata	*Sorex araneus* (TCWC25657, TCWC25658)	0.05	0.02	0.02	0.02
Polyplax rhizomydis	*Rhizomys sumatrensis* (NMNH488712, NMNH488713)	0.13	0.04	0.05	0.01
Polyplax serrata	*Mus musculus* (GSU3)	0.07	0.03	0.02	0.03
Polyplax spinulosa	*Rattus norvegicus* (GSU001, GSUT53A)	0.07	0.02	0.02	0.01
Polyplax stephensi	*Tatera indica* (UF14600, UF14591, UF15094)	0.07	0.02	0.03	0.01
Polyplax taterae	*Tatera robusta* (MSU15593, MSU15594)	0.08	0.03	0.05	0.03
Proechinophthirus fluctus	*Cricetomys gambianus* (UF20544)	0.13	0.03	0.03	0.02
Schizophthirus graphiuri	*Graphiurus murinus* (TCWC27895, TCWC27896)	0.02		0.01	
Scipio tripedatus	*Petromus typicus* (LACM040861, LACM058335)	0.08		0.05	0.02
Solenopotes binipilosus	*Odocoileus virginianus* (GSUSC1)	0.22	0.10	0.12	0.05
Solenopotes ferrisi	*Odocoileus virginianus* (GSUSC1)	0.22	0.10	0.12	0.05
Solenopotes muntiacus	*Muntiacus muntjak* (MSUJT-71, MSU5890)	0.15	0.05	0.11	0.04

Appendix E: Additional significant correlation graphs mentioned in the results.

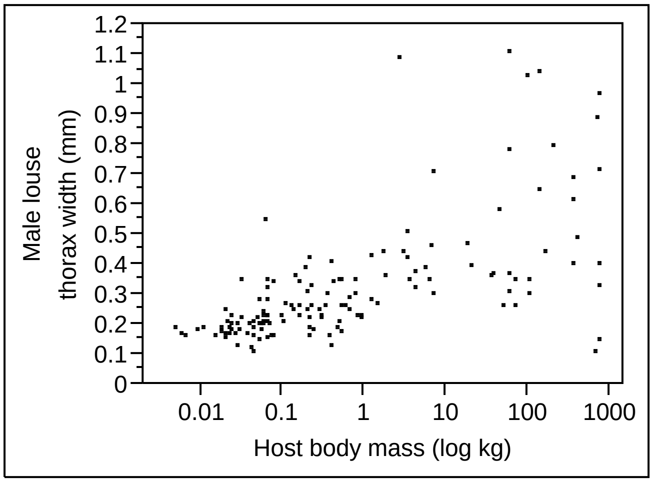

Figure E.1: Positive correlation between male thorax width and host body mass (n=146, p<0.01, r=0.37).

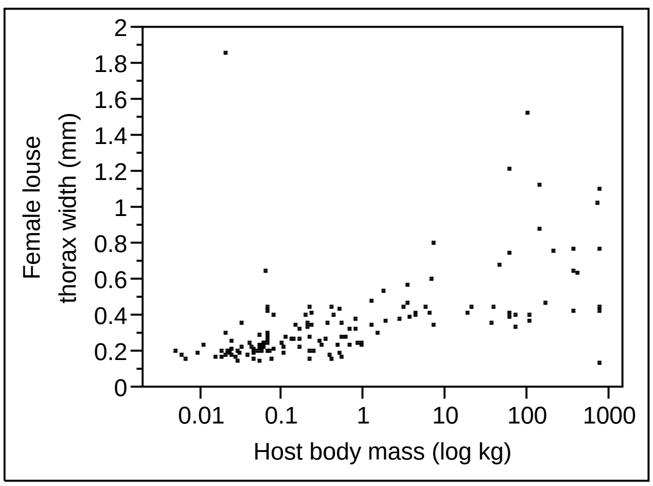

Figure E.2: Positive correlation between female thorax width and host body mass (n=145, p<0.01, 0.37).

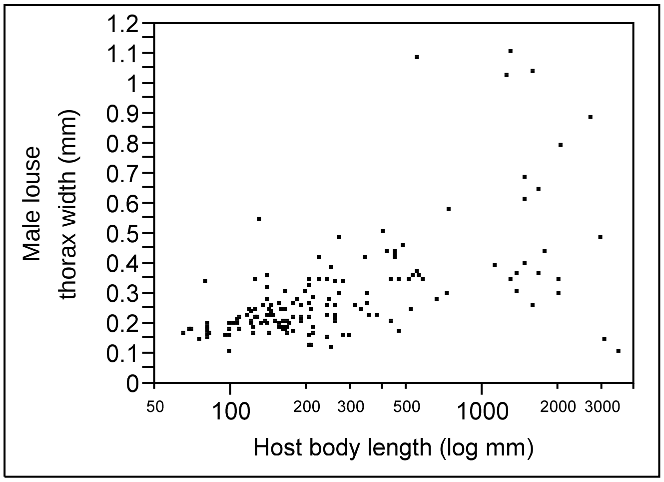

Figure E.3: Positive correlation between male louse thorax width and host body length (n=158, $p<0.01$, r=0.45).

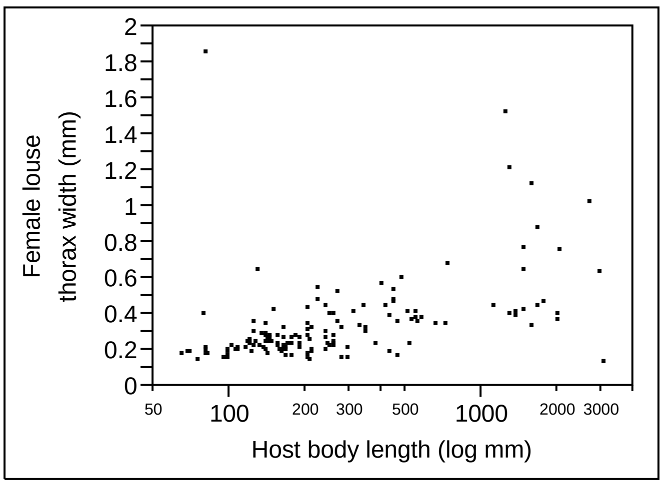

Figure E.4: Positive correlation between female louse thorax width and host body length (n=155, $p<0.01$, r=0.44).

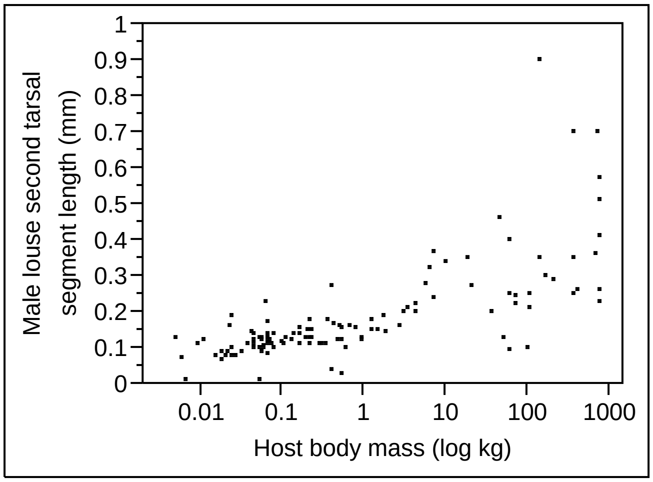

Figure E.5: Positive correlation between male louse second tarsal segment length and host body mass (n=87, p<0.01, r=0.52).

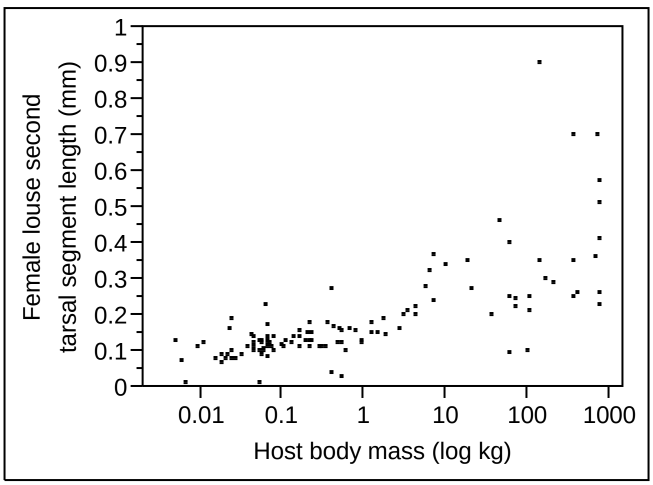

Figure E.6: Positive correlation between female louse second tarsal segment length and host body mass n=121, p<0.01, r=0.60).

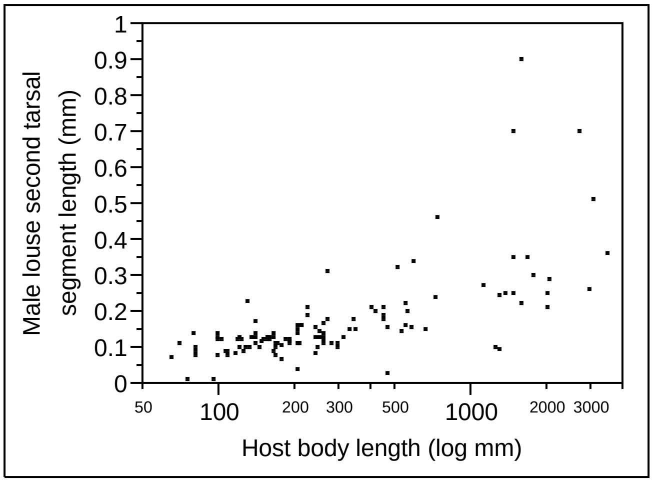

Figure E.7: Positive correlation between male louse second tarsal segment length and host body length (n=92, p<0.01, r=0.47).

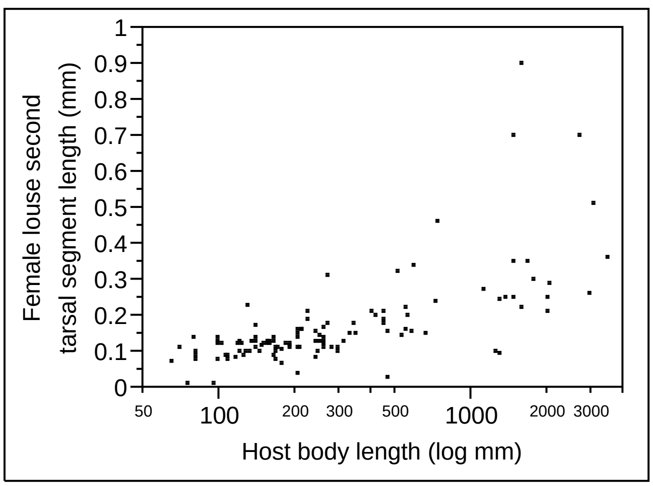

Figure E.8: Positive correlation between female louse second tarsal segment length and host body length (n=123, p<0.01, r=0.65).

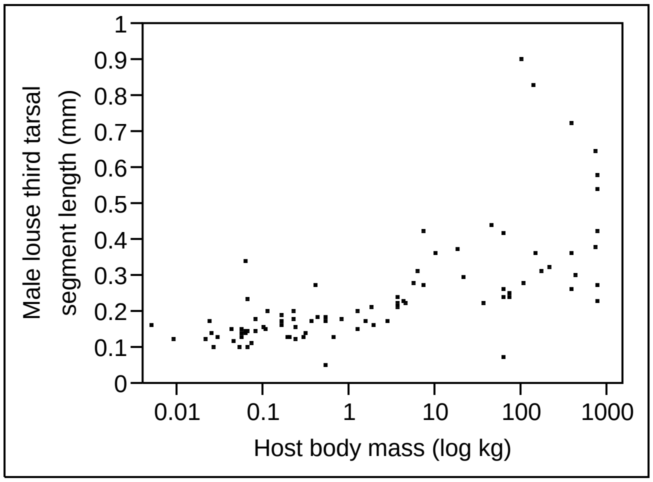

Figure E.9: Positive correlation between male louse third tarsal segment length and host body mass (n=73, p<0.01, r=0.57).

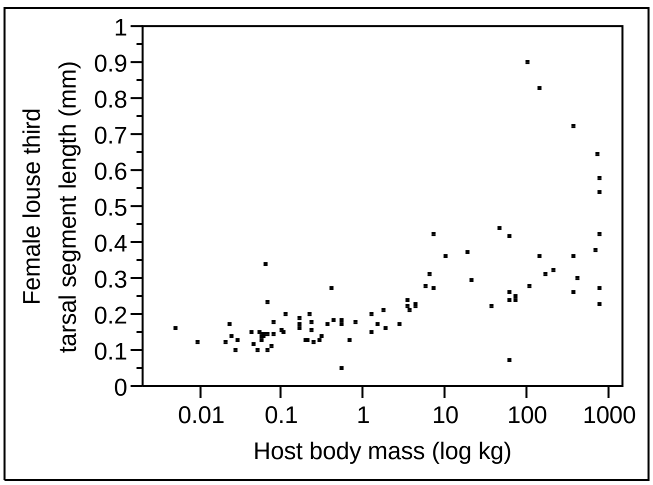

Figure E.10: Positive correlation between female louse third tarsal segment length and host body mass (n=88, p<0.01, r=0.52).

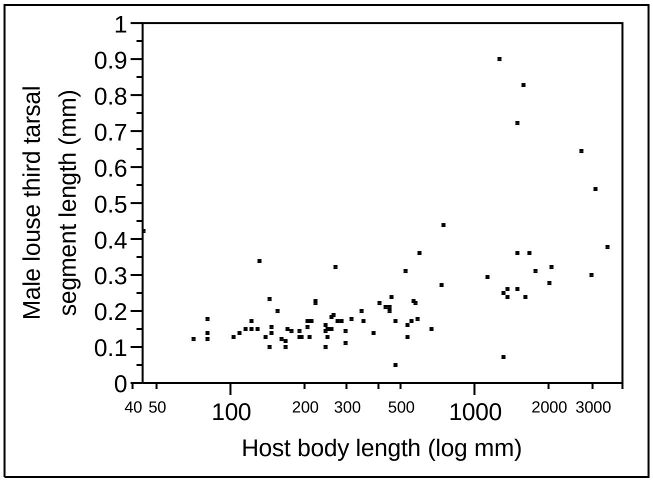

Figure E.11: Positive correlation between male louse third tarsal segment length and host body length n=69, p<0.01, r=0.57).

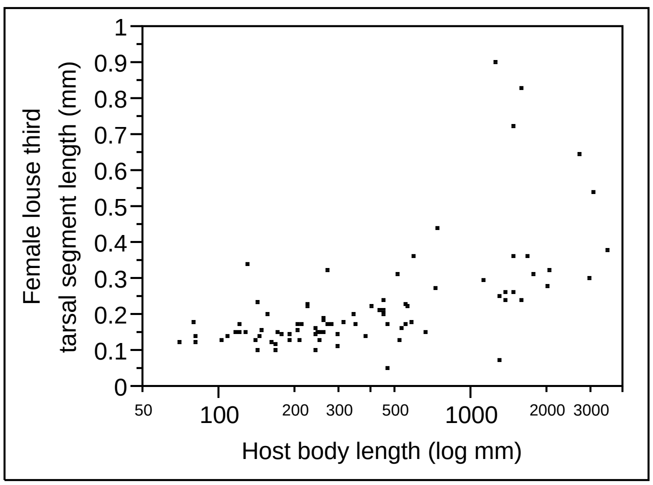

Figure E.12: Positive correlation between female louse third tarsal segment length is positively correlated on host body length (n=89, p<0.01, r=0.59).

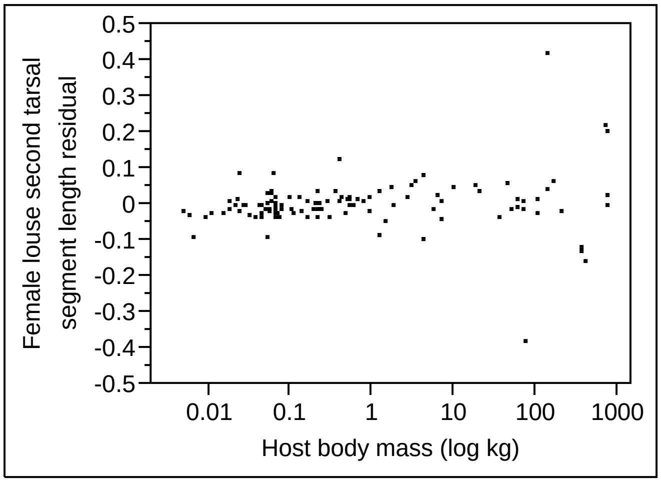

Figure E.13: Positive correlation between female louse second tarsal segment length residual and host body mass (n=114, p=0.08, r=0.17).

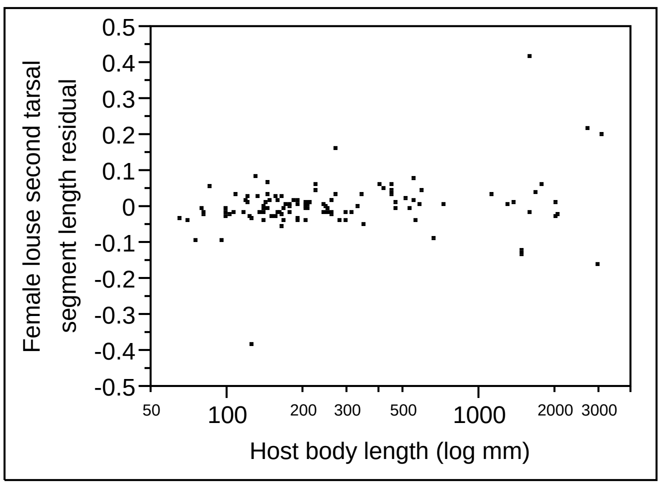

Figure E.14: Positive correlation between female louse second tarsal segment length residual and host body length (n=121, p=0.01, r=0.23).

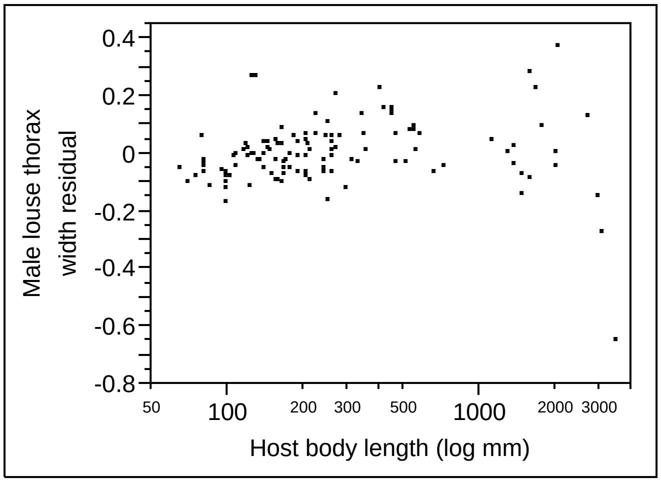

Figure E.15: Negative correlation between male thorax width residual and host body length (n=120, p=0.08, r=-0.16).

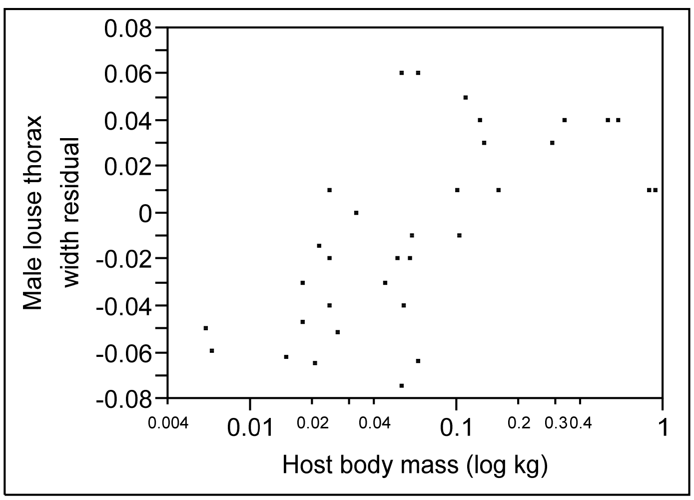

Figure E.16: Positive correlation between Hoplopleuridae male louse thorax width residual and host body mass (n=33, p=0.01, r=0.42).

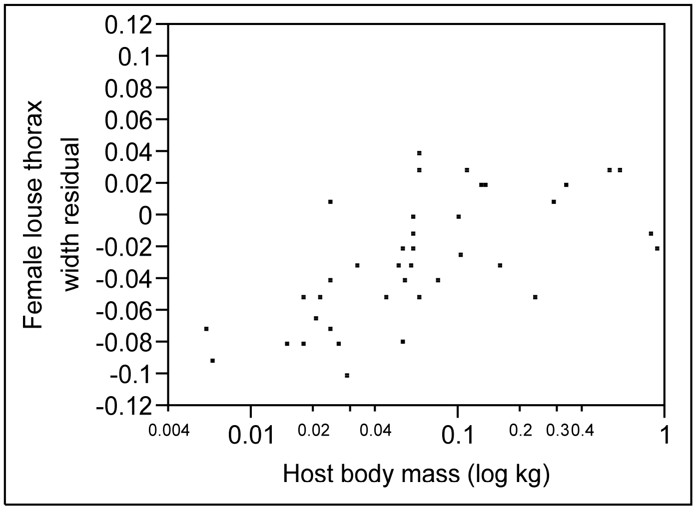

Figure E.17: Positive correlation between Hoplopleuridae female louse thorax with residual and host body mass (n=39, p=0.01, r=0.39).

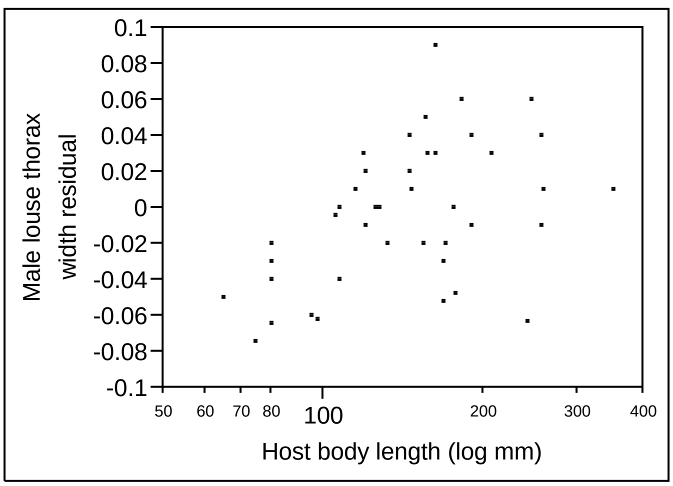

Figure E.18: Positive correlation between Hoplopleuridae male louse thorax width residual and host body length (n=42, p=0.01, r=0.39).

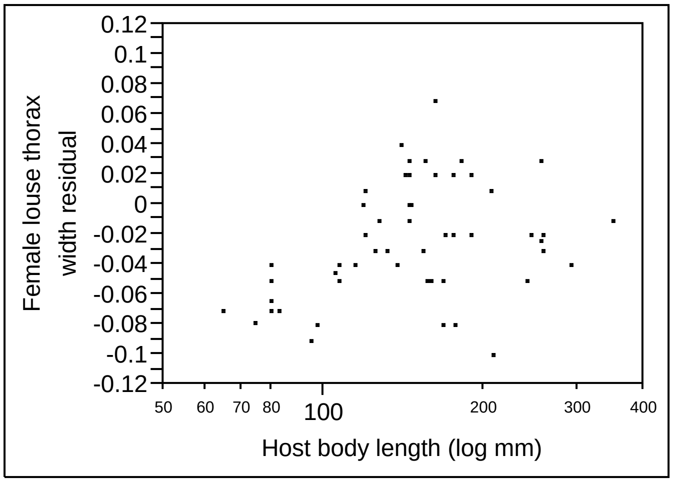

Figure E.19: Positive correlation between Hoplopleuridae female louse thorax width residual and host body length (n=52, p=0.06, r=0.26).

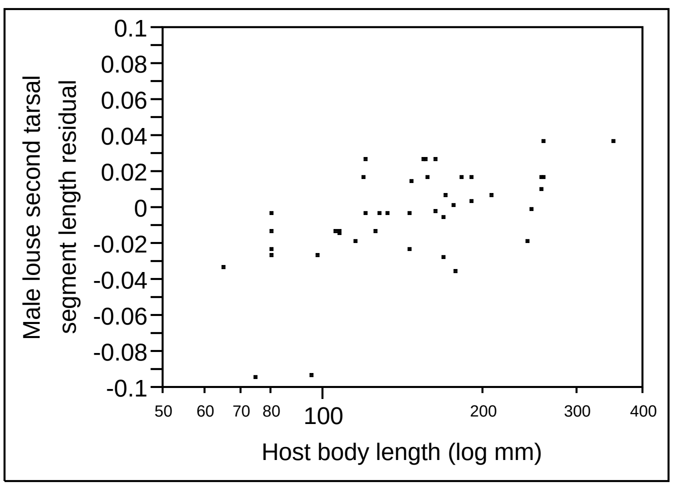

Figure E.20: Positive correlation between Hoplopleuridae male louse second tarsal segment length residual and host body length (n=33, p=0.01, r=0.46).

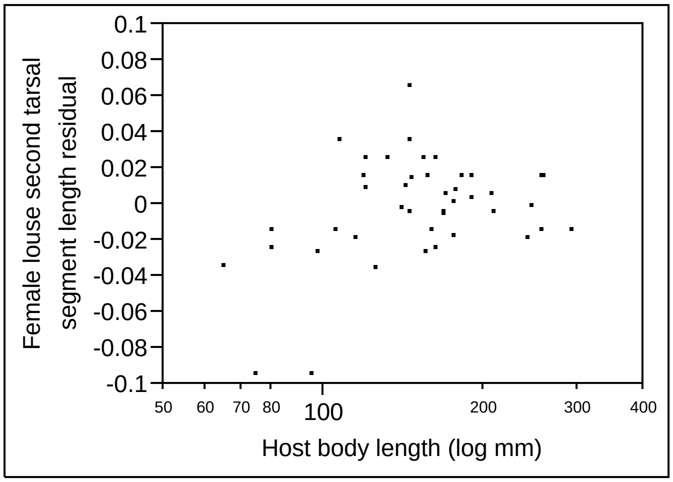

Figure E.21: Positive correlation between Hoplopleuridae female louse second tarsal segment length residual and host body length (n=43, p=0.09, r=0.26).

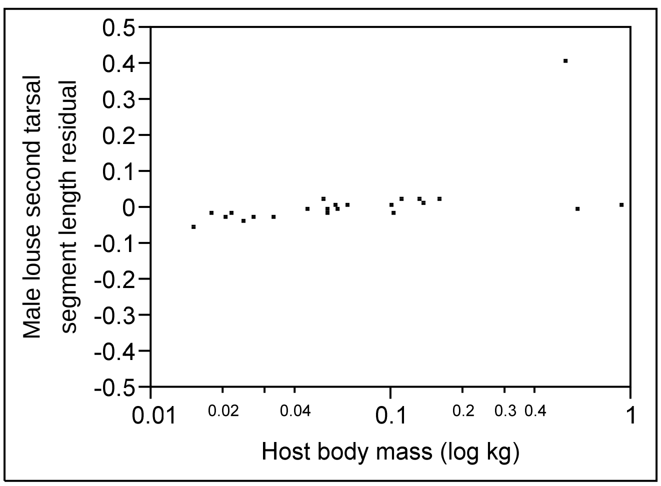

Figure E.22: Positive correlation between Hoplopleuridae male louse second tarsal segment length residual and host body mass (n=24, p=0.03, r=0.43).

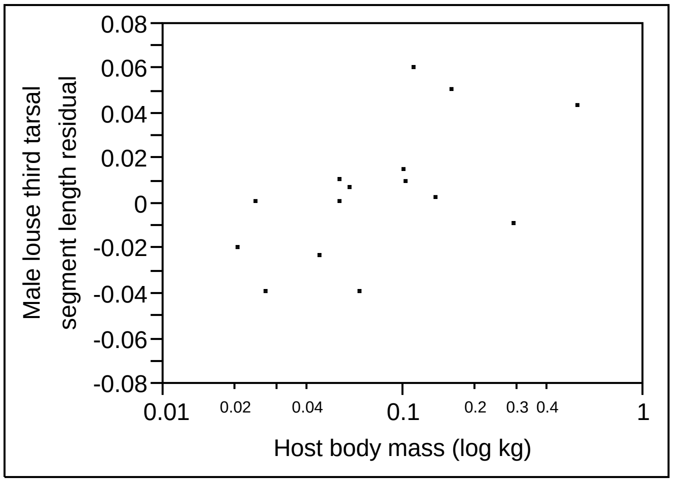

Figure E.23: Positive correlation between Hoplopleuridae male louse third tarsal segment length residual and host body mass (n=15, p=0.03, r=0.57).

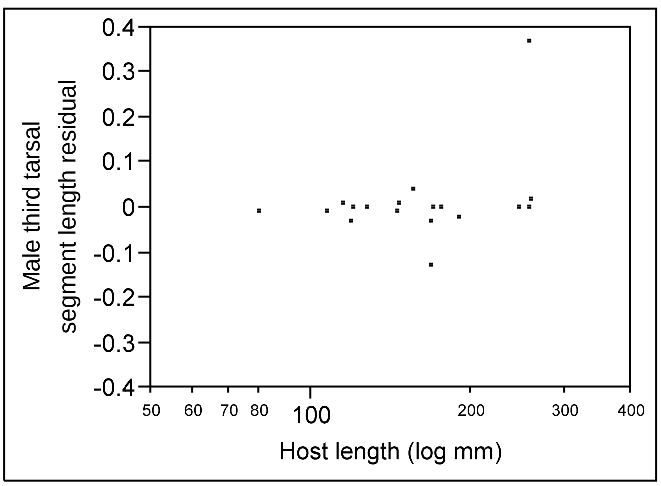

Figure E.24: Positive correlation between Hoplopleuridae male louse third tarsal segment length residual and host body length (n=18, p=0.10, r=0.40).

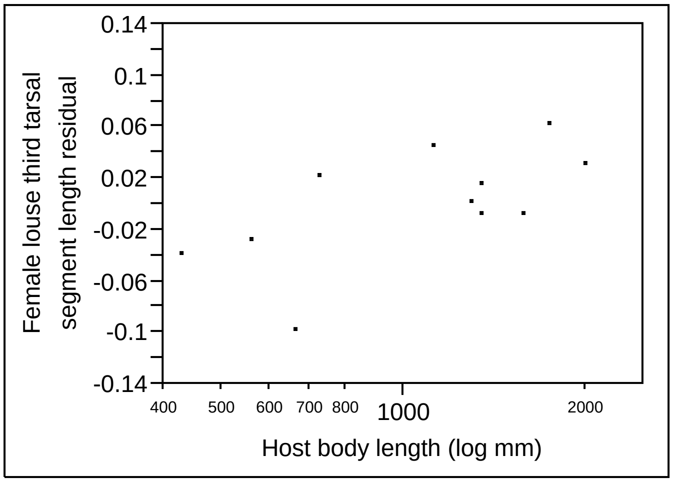

Figure E.25: Positive correlation between Linognathidae female louse third tarsal segment length residual and host body length (n=11, p=0.04, r=0.63).

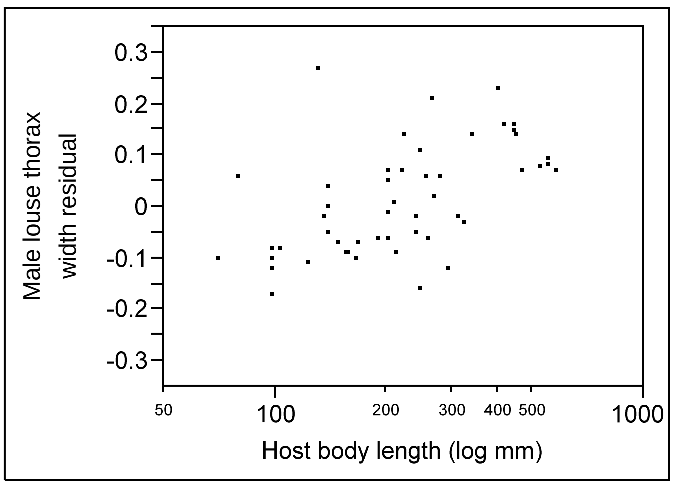

Figure E.26: Positive correlation between Polyplacidae male louse thorax width residual and host body length (n=51, p<0.01, r=0.54).

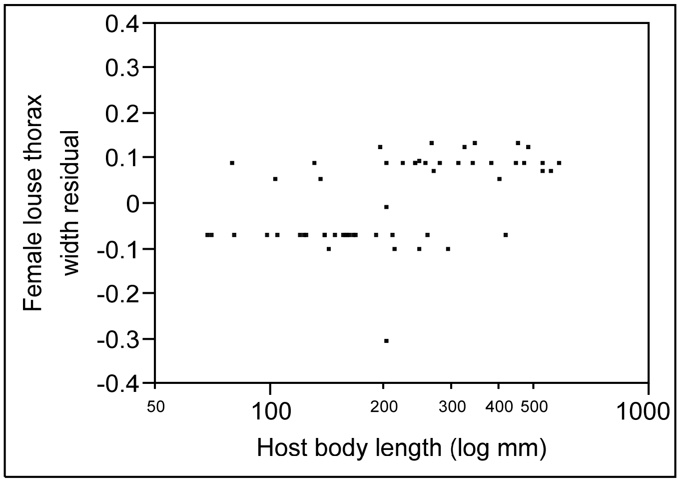

Figure E.27: Positive correlation between Polyplacidae female louse thorax width residual and host body length (n=71, p<0.01, r=0.56).

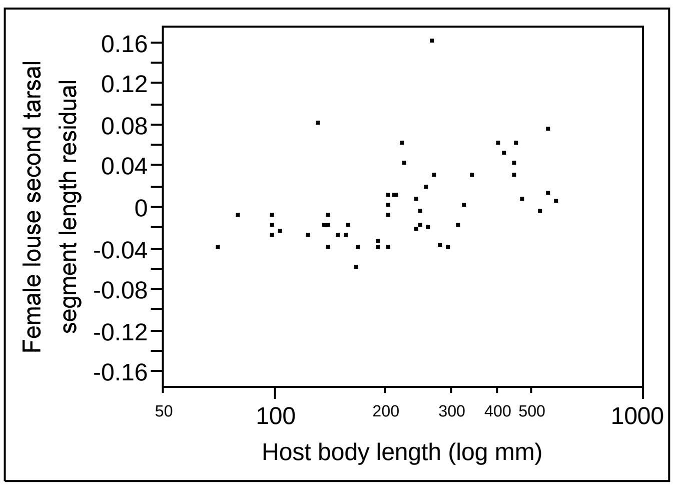

Figure E.28: Positive correlation between Polyplacidae female louse second tarsal segment length residual and host body length (n=51, p<0.01, r=0.44).

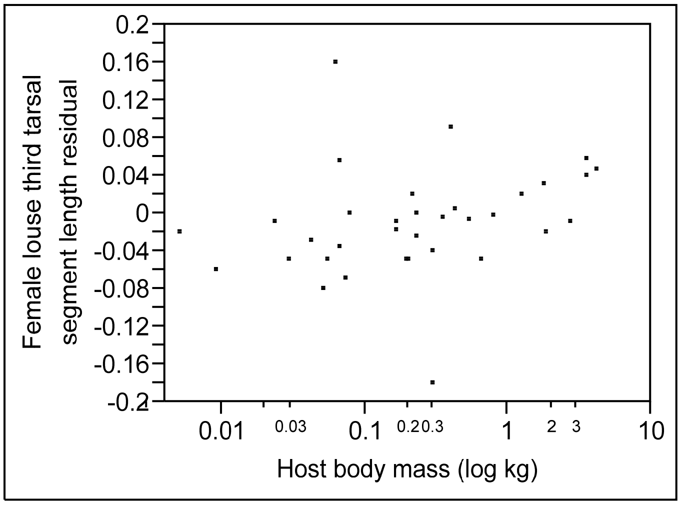

Figure E.29: Positive correlation between Polyplacidae female louse third tarsal segment length residual and host body mass (n=35, p=0.05, r=0.33).

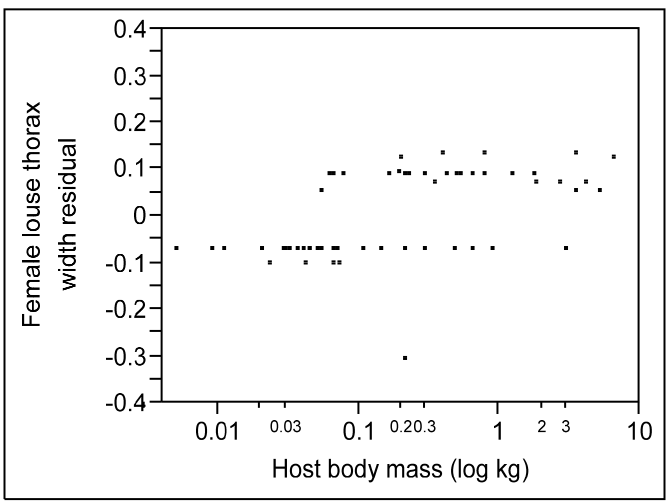

Figure E.30: Positive correlation between Polyplacidae female louse thorax width residual and host body mass (n=64, p<0.01, r=0.35).

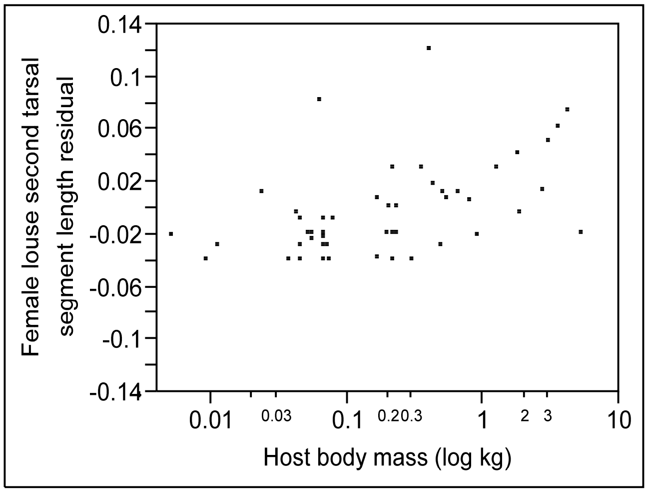

Figure E.31: Positive correlation between Polyplacidae female louse second tarsal segment length residual and host body mass (n=49, p<0.01, r=0.45).