

Chewing Lice (Phthiraptera) Species Found on Turkish Shorebirds (Charadriiformes) ^[1]

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Summary

This study was carried out to determine chewing lice species of waders between September-October 2009 at Lake Kuyucuk Bird Ringing Station in Kars, eastern Turkey. Fourty-one birds belonging to two families (Scolopacidae and Sternidae), five genera and the following species were examined: *Chlidonias leucopterus*, *Gallinago gallinago*, *Tringa glareola*, *Calidris minuta*, *Calidris alpina*, *Calidris temminckii*, and *Philomachus pugnax*. Birds were caught in mistnets, ringed, examined for ectoparasites and released unharmed. To sample chewing lice, the feathers of each bird were carefully rubbed with a synthetic pyrethroid insecticide dust, over a white piece of paper. Thereafter, birds were placed in a breathable paper bag for 5 min. All lice were collected and placed in tubes with 70% alcohol. Lice specimens were cleared in 10% KOH, mounted in Canada balsam and identified under binocular light microscope. Thirty-six out of 41 birds examined (88%) were infested with at least one chewing louse species. All individuals of *Chlidonias leucopterus*, *Calidris minuta*, *C. alpina*, *C. temminckii* and *Philomachus pugnax* were infested, whereas 4 out of 9 (44.4%) *Gallinago gallinago* had chewing lice. A total of 20 lice species were found on birds. These were: *Austromenopon sp.*, *Austromenopon lutescens* (Burmeister, 1838), *A. durisetosum* (Blagoveshtchensky, 1948), *A. alpinum* Timmermann, 1954, *A. atrofulvum* (Piaget, 1880), *Actornithophilus totani* (Schränk, 1803), *A. pustulosus* (Piaget, 1880), *A. stictus* (Kellogg and Chapman, 1899), *A. umbrinus* (Burmeister, 1838), *Carduiceps scalaris* (Piaget, 1880), *C. zonarius* (Nitzsch, 1866), *C. meinertzhagani* Timmermann, 1954, *Quadriceps obscurus* (Burmeister, 1838), *Q. anagrapsus* (Nitzsch, 1866), *Lunaceps actophilus* (Kellogg and Chapman, 1899), *Lunaceps holophaeus* (Burmeister, 1838), *L. drosti* Timmermann, 1954, *L. incoensis* (Kellogg and Chapman, 1899), *Rhynonirmus scolopacis* (Denny, 1842), and *Saemundssonina lobaticeps* (Giebel, 1874). All louse species documented here are first records for Turkey, increasing the number of bird louse species known from Turkey by about 40%. *Austromenopon sp.* found on *Tringa glareola* belongs to a species probably new to science.

Keywords: Chewing lice, Phthiraptera, Wader, Charadriiformes, Turkey

Türkiye’de Yağmur Kuşlarında Bulunan Bit Türleri

Özet

Bu araştırma Türkiye’deki Yağmur Kuşları’nda (Charadriiformes) görülen bit türlerini belirlemek amacıyla, Eylül-Ekim 2009 tarihleri arasında, Kars’ın Kuyucuk Gölü’nde yapılmıştır. İki ailede (Scolopacidae ve Sternidae) yer alan beş cinse ait (*Chlidonias*, *Gallinago*, *Tringa*, *Calidris* ve *Philomachus*) yedi türü içeren (*Chlidonias leucopterus*, *Gallinago gallinago*, *Tringa glareola*, *Calidris minuta*, *Calidris alpina*, *Calidris temminckii*, *Philomachus pugnax*) 41 kuş örneği incelenmiştir. Kuşlar ağlarla yakalandıktan sonra zarar verilmeden halkalanmış ve ektoparazitler yönünden incelenerek saliverilmişlerdir. Bitleri toplamak için her kuş örneği beyaz bir kağıt üzerinde sentetik piretroidli bir insektisitli dikkatli bir şekilde ilaçlanmıştır. Daha sonra kuşlar başları dışarda kalacak şekilde 5 dak. için karton bir kutu içerisinde tutulmuşlardır. Toplanan tüm bit örnekleri %70 alkol içerisinde konulmuş, %10 KOH solusyonunda saydamlaştırıldıktan ve alkol serilerinden geçirildikten sonra Kanada balsamla yapıştırılarak ve mikroskopta teşhis edilmişlerdir. İncelenen 41 kuş örneğinden 36’sının (%88) en azından bir adet bitle enfeste olduğu gözlenmiştir. Muayene edilen 9 adet *Gallinago gallinago*’nun 4’ünde bit saptanırken *Chlidonias leucopterus*, *Calidris minuta*, *C. alpina*, *C. temminckii* ve *Philomachus pugnax* örneklerinin tamamı bitlerle enfeste bulunmuştur. Kuşlarda *Austromenopon sp.*, *Austromenopon lutescens* (Burmeister, 1838), *A. durisetosum* (Blagoveshtchensky, 1948), *A. alpinum* Timmermann, 1954, *A. atrofulvum* (Piaget, 1880), *Actornithophilus totani* (Schränk, 1803), *A. pustulosus* (Piaget, 1880), *A. stictus* (Kellogg ve Chapman, 1899), *A. umbrinus* (Burmeister, 1838), *Carduiceps scalaris* (Piaget, 1880), *C. zonarius* (Nitzsch, 1866), *C. meinertzhagani* Timmermann, 1954, *Quadriceps obscurus* (Burmeister, 1838), *Q. anagrapsus* (Nitzsch, 1866), *Lunaceps actophilus* (Kellogg ve Chapman, 1899), *Lunaceps holophaeus* (Burmeister, 1838), *L. drosti* Timmermann, 1954, *L. incoensis* (Kellogg ve Chapman, 1899), *Rhynonirmus scolopacis* (Denny, 1842) ve *Saemundssonina lobaticeps* (Giebel, 1874) olmak üzere toplam 20 bit türü tespit edilmiştir. Belirtilen türlerin tamamına Türkiye’de ilk kez rastlanmıştır ve bu araştırma ile Türkiye’deki kuşlarda bilinen bit türü sayısı yaklaşık olarak %40 oranında artmıştır. *Tringa glareola*’da bulunan *Austromenopon sp.* muhtemelen yeni bir türdür.

Anahtar sözcükler: Çiğneyici bit, Phthiraptera, Yağmur kuşları, Charadriiformes, Türkiye



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INTRODUCTION

Approximately 4.500 species of lice have been so far described, with about 4.000 species seen on birds and with 3.000 species in the suborder Ischnocera¹. There are 465 bird species so far recorded in Turkey and the actual total is likely to exceed 500 species. However, the chewing lice fauna of these birds is almost unknown. Some recent studies on this subject have resulted in new findings²⁻¹⁰. Nevertheless, these few studies reported on only a handful of chewing louse species and there is a large potential for discovery.

These recent studies have focused on louse species of diurnal raptorial birds (Falconiformes)⁴⁻⁶, chukars (*Alectoris chukar*)², wild geese (*Anser spp.*)², white storks (*Ciconia ciconia*)⁷, white pelicans (*Pelecanus onocrotalus*)⁸ and starlings (*Sturnus vulgaris*)¹⁰. Other studies have examined a variety of bird species and have discovered new species for the bird louse fauna of Turkey^{5,9}, where approximately 50 louse species have been recorded on birds so far.

While approximately 50 bird species were examined in those studies, unfortunately only one Charadriiform bird species, a common tern (*Sterna hirundo*), was examined and no louse specimen was found on that bird. Consequently, this study was carried out to document chewing lice on shorebirds.

MATERIAL and METHODS

The field work was carried out between September-October 2009 at Lake Kuyucuk Bird Ringing Station in Kars, eastern Turkey (43°27' N, 40°45' E). The Kuyucuk Lake Wildlife Reserve is one of the most important wetlands of eastern Turkey where it is the only Ramsar wetland (www.kuyucuk.org). It is also a "Key Biodiversity Area (KBA)" and globally Important Bird Area (IBA), located at 37 kms northeast of Kars city centre, and 15 kms west of Akyaka town. Kuyucuk Lake is over 219 hectares and has an elevation of 1.627 meters. Surrounded by treeless steppe and a few *Phragmites* reed patches, the surrounding vegetation is mostly removed by sheep and cattle. Kuyucuk Lake is most important wetland in Kars for the birds. It hosts at least 214 bird species, some globally Endangered (White-headed Duck, Egyptian Vulture, Red-breasted Goose), and large raptor and waterfowl populations, sometimes exceeding 40.000 birds at once.

We examined 41 birds of seven species in five genera (*Chlidonias leucopterus*, *Gallinago gallinago*, *Tringa glareola*, *Calidris minuta*, *Calidris alpina*, *Calidris temminckii*, *Philomachus pugnax*) and two families

(Scolopacidae and Sternidae). Birds were caught in mistnets, ringed, measured, examined for ectoparasites, and released unharmed. To sample chewing lice, the feathers of each bird were carefully rubbed, over a white piece of paper, with a synthetic pyrethroid dust harmless to vertebrates. Birds were then placed in breathable paper bags for five minutes. All lice were collected and placed in tubes with 70% alcohol. Lice specimens were cleared in 10% KOH, washed in distilled water, stored in consecutive days in increasing alcohol concentrations of 70%, 80%, 90%, and 99 %, mounted in Canada balsam on slides, and identified under a light microscope.

RESULTS

Of the birds examined, 36 out of 41 (88%) were infested with at least one chewing louse species (*Table 1*). All individuals of *Chlidonias leucopterus*, *Calidris minuta*, *C. alpina*, *C. temminckii* and *Philomachus pugnax* were infested whereas four out of nine (44.4%) *Gallinago gallinago* had chewing lice. A total of 20 lice species were found on the birds. These were *Austromenopon lutescens* (Burmeister, 1838) (*Fig. 2*), *Austromenopon sp.*, (*Fig. 5*) *A. durisetosum* (Blagoveshtchensky, 1948) (*Fig. 4*), *A. alpinum* Timmermann, 1954 (*Fig. 1*), *A. atrofulvum* (Piaget, 1880) (*Fig. 3*), *Actornithophilus totani* (Schrank, 1803) (*Fig. 9*), *A. pustulosus* (Piaget, 1880) (*Fig. 8*), *A. stictus* (Kellogg and Chapman, 1899) (*Fig. 7*), *A. umbrinus* (Burmeister, 1838) (*Fig. 6*), *Carduceps scalaris* (Piaget, 1880) (*Fig. 12*), *C. zonarius* (Nitzsch, 1866) (*Fig. 11*), *C. meinertzhagani* Timmermann, 1954 (*Fig. 10*), *Quadriceps obscurus* (Burmeister, 1838) (*Fig. 19*), *Q. anagrapsus* (Nitzsch, 1866) (*Fig. 18*), *Luniceps actophilus* Kellogg and

Table 1. Studied bird species and their infestation rates

Tablo 1. İncelenen kuş türleri ve enfestasyon oranları

| Bird Species | Number of Examined Birds | Number of Infested Birds (%) |
|--|--------------------------|------------------------------|
| Ruff (<i>Philomachus pugnax</i>) | 4 | 4 (100) |
| Wood Sandpiper (<i>Tringa glareola</i>) | 10 | 10 (100) |
| Common Snipe (<i>Gallinago gallinago</i>) | 9 | 4 (44.4) |
| Little Stint (<i>Calidris minuta</i>) | 10 | 10 (100) |
| Dunlin (<i>Calidris alpina</i>) | 4 | 4 (100) |
| Temminck's Stint (<i>Calidris temminckii</i>) | 1 | 1 (100) |
| White-winged Black Tern (<i>Chlidonias leucopterus</i>) | 3 | 3 (100) |

Chapman, 1899) (Fig. 13), *L. holophaeus* (Burmeister, 1838) (Fig. 16), *L. drosti* Timmermann, 1954 (Fig. 14), *L. incoensis* (Kellogg and Chapman, 1899) (Fig. 15), *Rhynonirmus scolopacis* (Denny, 1842), and *Saemundssonina lobaticeps* (Giebel, 1874) (Fig. 17) (Table 2). All of these species are reported for the first time in Turkey.

Among the species in the Ischnocera suborder, most specimens belonged to the *Lunaceps*, *Quadriceps* and *Carduiceps*, and only one species in each of the genera *Rhynonirmus* and *Saemundssonina* were found. While most species in this suborder were represented by males, females, and nymphs, only one nymph of *R. scolopacis* and two nymphs of *Lunaceps incoensis* were collected and no adults of these species were found. Table 2 shows the number of lice found on the bird species examined.

Nine louse species in two genera of the suborder Amblycera were recorded in relatively low numbers. Five species belonged to the genus *Austromenopon* and four species belonged to the genus *Actornithophilus*. Even though numbers of specimens per species were

mostly similar, only one female of *Actornithophilus stictus* was found. Although most louse species were specific to one host bird species examined, *Austromenopon lutescens* was collected from both *P. pugnax* and *C. minuta* (Table 2).

Austromenopon sp.

Female: Head triangular, rounded in anterior. Preocular and occipital nodi slightly developed. Antenna with four segments, last one clearly longer than the others. There are 3 setae on temporal margin. Gular plate broad, sub pentagonal, straight in anterior, rounded in posterior and has four setae on each side. Sitophore sclerite has two small holes; bifurcate in anterior. Prothorax is broad in anterior, ovate in posterior. Prosternal plate relatively wide, rounded in posterior and has a very small finger like prominent. It was narrowed and posterior prominent blunt in some specimens. Posterolateral margin of prothorax has 2 spines, 6 setae on each side. Posterior margin of metathorax has 14-16 setae, posterolateral margin with 3 spines. There are 18-20 spin on ventral of third femur. Abdomen oval, pleuratergal plates on segments I-VI well

Table 2. Distribution of louse species on host bird species, including louse numbers and mean louse intensity on infested hosts
Tablo 2. Konak türüne göre bit türlerinin dağılımları, konaklardan toplanan bit adedi ve ortalama bit yoğunluğu

| Louse Species | Bird Species | Louse Number | | | | Mean Intensity |
|------------------------------------|-------------------------------|--------------|----|----|-----|----------------|
| | | ♀ | ♂ | N | T | |
| <i>Actornithophilus pustulosus</i> | <i>Philomachus pugnax</i> | 8 | 3 | 8 | 19 | 4.75 |
| <i>Actornithophilus stictus</i> | <i>Gallinago gallinago</i> | 1 | - | - | 1 | 0.33 |
| <i>Actornithophilus totani</i> | <i>Tringa glareola</i> | 14 | 6 | 13 | 33 | 3.33 |
| <i>Actornithophilus umbrinus</i> | <i>Calidris minuta</i> | 1 | 1 | - | 2 | 0.20 |
| | <i>Calidris alpina</i> | 2 | 1 | - | 3 | 0.75 |
| <i>Austromenopon alpinum</i> | <i>Calidris alpina</i> | 2 | 2 | 1 | 5 | 1.25 |
| <i>Austromenopon atrofulvum</i> | <i>Chlidonias leucopterus</i> | 6 | 4 | 7 | 17 | 5.66 |
| <i>Austromenopon durisetosum</i> | <i>Gallinago gallinago</i> | 5 | - | 3 | 8 | 2.66 |
| <i>Austromenopon lutescens</i> | <i>Philomachus pugnax</i> | 4 | 3 | 3 | 10 | 2.50 |
| | <i>Calidris minuta</i> | 8 | - | 13 | 21 | 2.10 |
| <i>Austromenopon</i> sp. | <i>Tringa glareola</i> | 5 | 1 | 4 | 10 | 1.00 |
| <i>Carduiceps meinertzhagani</i> | <i>Calidris alpina</i> | 5 | 6 | - | 11 | 2.75 |
| <i>Carduiceps scalaris</i> | <i>Philomachus pugnax</i> | 12 | 9 | 10 | 31 | 7.77 |
| <i>Carduiceps zonarius</i> | <i>Calidris minuta</i> | 56 | 29 | 14 | 99 | 9.90 |
| <i>Lunaceps actophilus</i> | <i>Calidris alpina</i> | 26 | 16 | 19 | 71 | 17.50 |
| <i>Lunaceps holophaeus</i> | <i>Philomachus pugnax</i> | 31 | 40 | 13 | 84 | 21.00 |
| <i>Lunaceps drosti</i> | <i>Calidris minuta</i> | 31 | 21 | 27 | 79 | 7.9 |
| <i>Lunaceps incoensis</i> | <i>Calidris temminckii</i> | - | - | 2 | 2 | 2.00 |
| <i>Quadriceps anagrapsus</i> | <i>Chlidonias leucopterus</i> | 23 | 18 | 5 | 46 | 15.33 |
| <i>Quadriceps obscurus</i> | <i>Tringa glareola</i> | 57 | 45 | 12 | 114 | 11.40 |
| <i>Rhynonirmus scolopacis</i> | <i>Gallinago gallinago</i> | - | - | 1 | 1 | 0.33 |
| <i>Saemundssonina lobaticeps</i> | <i>Chlidonias leucopterus</i> | - | 1 | - | 1 | 1.33 |

N: Nymph; **T:** Total; **Mean intensity:** Louse number/infested bird number

developed. Tergocentral setae are; I, 22; II, 15-22; III, 14-22; IV, 16-22; V, 15-22; VI, 18; VII, 19; VIII, 14 (Fig. 5).

Male: Similar to the female, however some characters are different. Prosternal plate short and broad, not prominent on the posterior, on a specimen. It is narrowed and rounded in posterior in a other specimen. Segments I-VII have well developed pleuraltergal plates. There are eighteen setae on metasternal plate. Third femur has 8 spines on ventral side (Fig. 5).

Material examined: 1 ♀, Kuyucuk, Kars, 23.09.2009; 1 ♂, Kuyucuk, Kars, 25.09.2009; 1 ♀, 2 N, Kuyucuk, Kars, 30.09.2009; 1 N, Kuyucuk, Kars, 04.10.2009; 2 ♀, 1 ♂, 1 N, Kuyucuk, Kars, 05.10.2009.

Type host: *Tringa glareola*

Although Rekasi and Kiss¹¹ had collected one immature specimen of *Austromenopon* on *T. glareola* in North Dobruja, Romania, and reported as *Austromenopon sp.*, no *Austromenopon* species could be found on *T. glareola* on further reports. Clay¹² prepared a key to the species of *Austromenopon* found on Charadriiformes, but no louse species were reported from *T. glareola*. Two *Austromenopon* species, *A. sohni* (Ansari,¹³) from *Tringa ochropus*, and *A. decorosum* (Zlotorzycza,¹⁴) from *Tringa totanus* and *Tringa erythropus* had been described until now. However, morphological characters of *Austromenopon* specimens found on *T. glareola* in this study had some differences from *A. sohni*, including in the measurements of the specimens and in morphological characters such as spines on pleural plates and setae of gular plates. In a paper by Zlotorzycza¹⁴, *Austromenopon decorosum* was described from *Tringa totanus* and *T. erythropus*, but morphological characters were not provided in detail. Ledger¹⁵ reported that those features are not adequate to identify louse species on birds that belong to the genera *Philomachus*, *Calidris*, *Arenaria*, and *Tringa*. In this study, male genitalia were very similar to those of *A. decorosum*, but the hypopharyngeal sclerite in some specimens and the prosternal plate in general were different from the same features on that species.

DISCUSSION

We were unable to find any other studies of louse species on waders (Charadriiformes) in Turkey. Even though one recent article⁵ examined a common tern (*Sterna hirundo*) for louse, no specimen was found. In this study, 11 Ischnoceran species and 9 Amblyceran species of bird louse were collected. Ischnoceran species were seen to be more widespread on these birds than louse species in the suborder Amblycera, with 534 and 123 specimens collected respectively.

Indeed, most louse species recorded on birds generally belong to the suborder Ischnocera¹. In the first study to record on Charadriiformes the louse species in the ischnoceran genera *Lunaceps*, *Carduiceps*, and *Quadriceps*, Clay and Meinertzhagen¹⁶ have provided the morphological details of these genera and have published the identification keys for these genera and for the genus *Rhynonirmus*. Timmermann¹⁷⁻²⁰ has published many helpful papers on species in the genera *Quadriceps*, *Carduiceps*, *Lunaceps*, and *Saemundssonina*, and has also created identification keys that have examined the morphology of these genera in detail. In publications on the *Quadriceps* species found on the Tringinae subfamily of birds, Hopkins ve Timmermann²¹ have provided information on the morphological details of many *Quadriceps*, including *Q. obscurus*. In another publication, Timmermann²² has examined in detail the morphological characteristics of species in the genera *Quadriceps* and *Rhynonirmus* and has created identification keys for them. Timmermann¹⁸ has also provided detailed morphological information on *Carduiceps* species, including *C. scalaris* and *C. zonarius*, has described *C. meinertzhagani* from *C. alpina* (originally *Erolia a. alpina*), and later has provided the identification key for this species²². On the other hand, there are few publications on the genus *Lunaceps*. Timmermann²⁰ has also written the first detailed publication on this genus and has provided morphological details, some measurements, and illustrations of male genitalia.

In our study, the large majority of louse specimens collected belonged to 11 species in five genera in the suborder Ischnocera. We mostly recorded species in the genera *Lunaceps*, *Quadriceps*, and *Carduiceps*, and observed close overlap between the morphological characteristics of our specimens and those of species described in the literature detailed above¹⁷⁻²².

The number of species in the suborder Amblycera is only half those in the suborder Ischnocera and most amblyceran species belong to the family Menoponidae¹. In this study, all the species in the suborder Amblycera belonged to the genera *Austromenopon* (5 species) and *Actornithophilus* (4 species) in the family. The number of specimens were much lower than those collected from the suborder Ischnocera, with 71 specimens from *Austromenopon* and 52 specimens *Actornithophilus*. Even though most louse species were seen on only one host bird species, *Actornithophilus umbrinus* has seen on both *C. alpina* and *C. minuta*, and *Austromenopon lutescens* was seen on both *P. pugnax* and *C. minuta*.

On the other hand, specimens of *Austromenopon sp.* were found on five out of 10 *T. glareola* examined. Until this study, no *Austromenopon* species had been recorded

on *T. glareola* except the report of Rekasi and Kiss¹¹. Ledger¹⁵ had reported morphological similarities of *Austromenopon* species on Charadriiformes and therefore stated that he classified all *Austromenopon* specimens he collected as *A. lutescens*. Even though there is a number of publications on the genus *Austromenopon*^{14,16,23,24}, because of resemblance of the *Austromenopon* specimens collected from *T. glareola* to *A. decorosum* in some but not all characteristics, and as well as the differences among louse specimens, they have been identified as *Austromenopon sp.*

While the majority of birds examined were found to be infested with lice and most species showed 100% infestation rates, both the infestation rate on *G. gallinago* and the number of lice found on individual birds were lower when compared to other bird species. Among louse species, *L. holophaeus* had the highest density on host birds, followed by *L. actophilus*, *Q. anagrapsus*, and *Q. obscurus*.

In conclusion, in this study we recorded 20 bird louse species, all of which are recorded for the first time in Turkey, increasing the bird louse fauna of Turkey by approximately 40%. In addition, a louse species in the genus *Austromenopon* was recorded on *T. glareola* for the first time and this species is likely to be new to science. Our findings indicate that Turkey is an important frontier in phthirapteran research and many species likely remain to be discovered.

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Fig 1. *Austromenopon alpinum* ♂

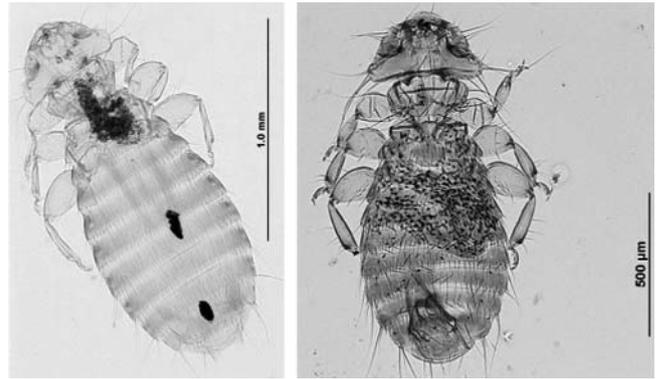


Fig 2. *Austromenopon lutescens* ♀ (at left) ♂ (at right)

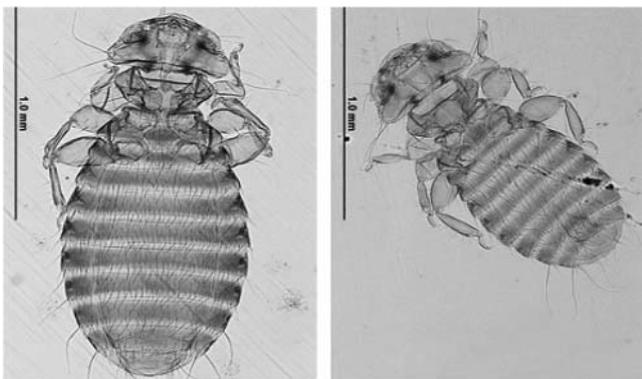


Fig 3. *Austromenopon atrofulvum* ♀ (at left) ♂ (at right)

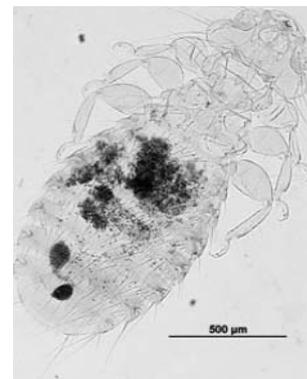


Fig 4. *Austromenopon durisetosum* ♀

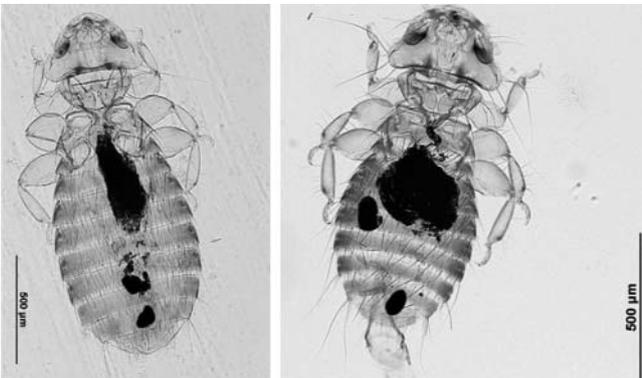


Fig 5. *Austromenopon* sp. ♀ (at left) ♂ (at right)



Fig 6. *Actornithophilus umbrinus* ♂

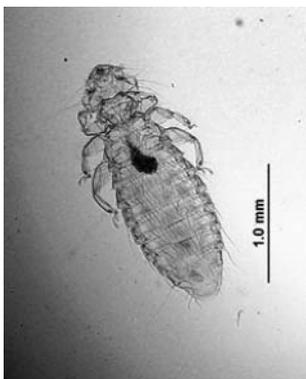


Fig 7. *Actornithophilus stictus* ♀

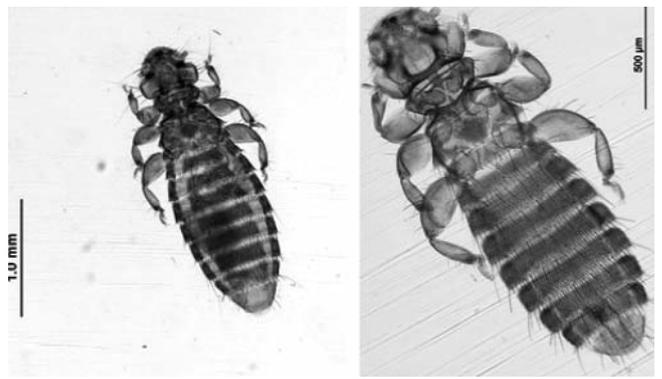


Fig 8. *Actornithophilus pustulosus* ♀ (at left) ♂ (at right)



Fig 9. *Actornithophilus totani* ♀ (at left) ♂ (at right)

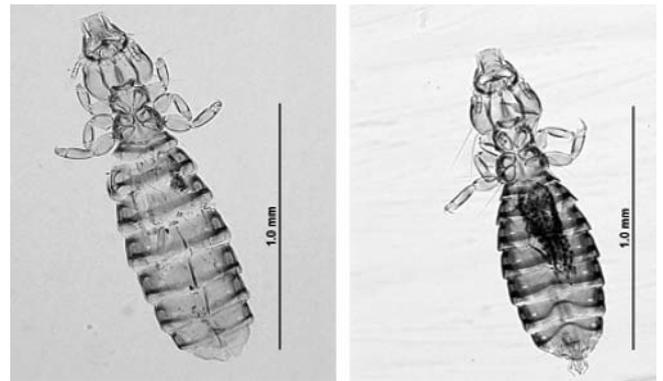


Fig 10. *Carduiceps meinertzhagani* ♀ (at left) ♂ (at right)

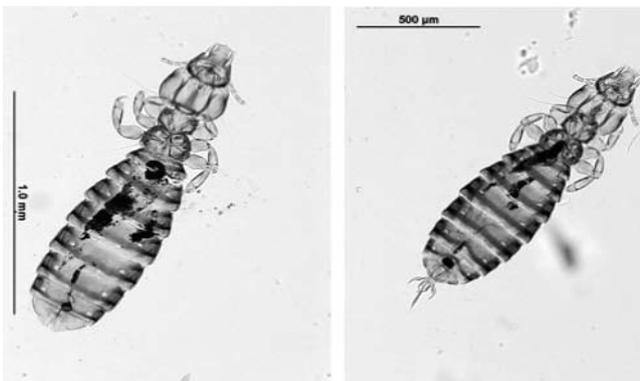


Fig 11. *Carduiceps zonarius* ♀ (at left) ♂ (at right)



Fig 12. *Carduiceps scalaris* ♀ (at left) ♂ (at right)

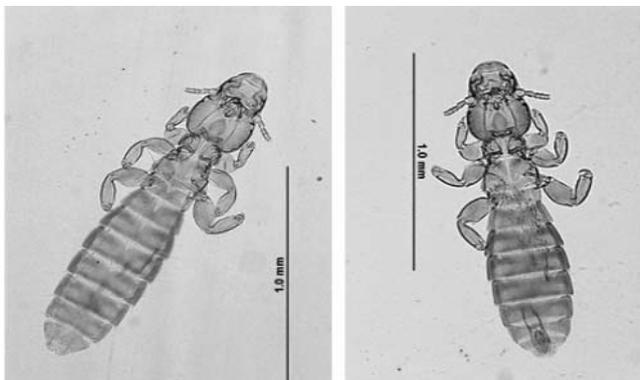


Fig 13. *Lunaceps actophilus* ♀ (at left) ♂ (at right)



Fig 14. *Lunaceps drosti* ♀ (at left) ♂ (at right)

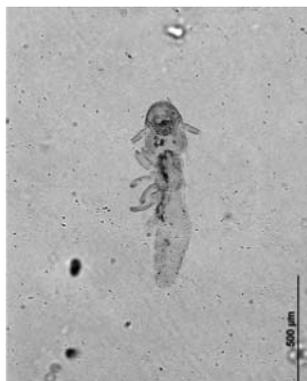


Fig 15. *Lunaceps incoensis* Nymph



Fig 16. *Lunaceps holophaeus* (at left) ♂ (at right)



Fig 17. *Saemundssonina lobaticeps* ♂



Fig 18. *Quadriceps anagrapsus* ♀ (at left) ♂ (at right)

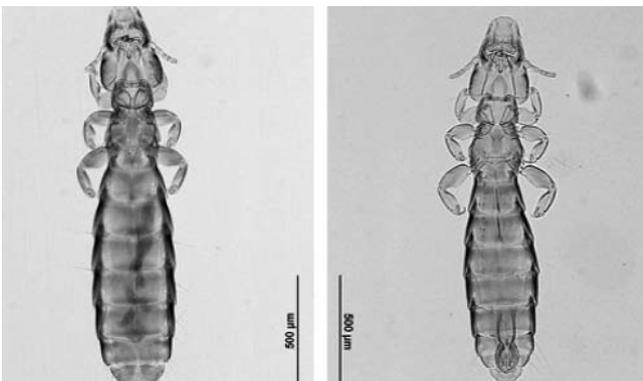


Fig 19. *Quadriceps obscurus* ♀ (at left) ♂ (at right)