

ECTOPARASITIC INSECTS ON BIRDS AND MAMMALS OF THE KERMADEC ISLANDS

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ABSTRACT

Ectoparasitic insects of birds and mammals of Raoul and Meyer Islands, Kermadec Islands, are recorded. Included are 52 Phthiraptera, 4 Diptera and 4 Siphonaptera, of which 40 Phthiraptera, 2 Diptera (*Stomoxys calcitrans* and *Ornithoeca exilis*) and 1 Siphonapteron are new records for the islands. A simple key to the main groups of ectoparasites is given. Attention is drawn to the need for quarantine measures to prevent introductions of further pest species to the islands.

INTRODUCTION

During the Ornithological Society of New Zealand's Expedition of November 1966 - January 1967 to the Kermadec Islands (cf. Merton, 1970), the majority of bird species nesting on Raoul Island and Meyer Island were examined for ectoparasites. The results of this survey for ectoparasitic insects are presented below, and the records from the 1908 expedition of Oliver, and specimens collected by Sorensen in 1944, are also included. Ectoparasitic mites are at present being studied by my colleague, Dr. G. W. Ramsay, and will form the subject of a later paper. A tick, *Ornithodoros capensis*, has already been recorded (Ramsay, 1968).

Because some of the ectoparasites of mammals also attack birds, all mammalian ectoparasites are included. Only feral mammals (goats and rats) were examined, and other ectoparasites which were not recorded may occur on the farm animals (cattle, pigs, sheep, dogs and poultry).

Ectoparasites were collected from mammals which had been trapped or shot. Some bird ectoparasites were collected from dead specimens, but the majority were taken from living birds. This involved placing the bird (with its head projecting) in a polythene bag, together with a pad of cellulose wadding soaked in ethyl acetate, for 15 minutes. Larger birds had their feet tied. Following removal from the plastic bag, the bird was thoroughly ruffled over a large white plastic tray, untied, and released. The contents of the bag were then tipped onto the tray, and ectoparasites were picked up with a moist squirrel-hair brush, with the aid of a hand lens, and placed in 70% ethyl alcohol. This method of collection is efficient for ectoparasitic insects, but many mites are missed because of their small size.

Nests and burrow linings were collected after being abandoned, and their fauna was extracted with Tullgren funnels*. A few ectoparasitic insects were collected in pitfall traps, especially on Meyer Island, near nests and burrows. The flies were netted (*Stomoxys*, mosquitoes), or caught during "delousing" operations (Hippoboscidae).

* A Tullgren funnel is basically an enclosed metal funnel, in the upper part of which is an electric lamp. Heat and light and desiccation drive the Arthropoda and other small animals from the sample below the lamp, and they fall into a jar of 70% ethanol beneath the funnel.

Collections of Mallophaga from a few Procellariiformes and Charadriiformes are now reasonably adequate, but the same cannot be said of fleas and Hippoboscidae. Future visitors to the islands would do well to concentrate on the last two groups, but without neglecting Mallophaga.

Previous records of ectoparasites from the Kermadec Islands may be found in Johnston and Harrison (1912, Mallophaga), Edwards (1961, *Halipeurus*), Hilgendorf (1917, Siphonaptera), Smit (1965, Siphonaptera) and Belkin (1968, Culicidae). These earlier records are included below. Most of the species noted were recollected by the O.S.N.Z. Expedition, and many new records are added. All specimens listed from the O.S.N.Z. Expedition are in the Entomology Division collection (Nelson), apart from some duplicates not listed which are in the British Museum (Natural History), London. Most of the earlier collected material is in the Dominion Museum (Wellington — Oliver's collection of 1908) or in the Canterbury Museum (Christchurch — Sorenson's collection of 1944).

The terrestrial fauna of the Kermadecs is generally poor and fragmentary, many major groups represented on older islands being entirely absent. This is due mainly to the geological youth of the Kermadecs and their distance from faunal sources. Ectoparasites of birds are particularly suited for transport to such islands. Mallophaga are intimately associated with their hosts throughout their life cycle from egg to adult, and usually show a high level of host specificity, so their geographical distribution is generally that of their hosts. Other ectoparasites are less closely associated with their hosts, and usually show less host specificity, so their distribution is more similar to that of non-parasitic invertebrates than is the case of Mallophaga.

Some host species have, elsewhere in their ranges, ectoparasites which have not been found on Kermadec populations of the hosts. For example, Pukekos often harbour *Pseudomenopon concretum* in addition to *Rallicola lugens*. Elsewhere in various parts of its extensive range, the Sooty Tern is parasitised by *Actornithophilus incisus*, *A. piceus*, *Austromenopon atrofulvum* and *Saemundssonina petersi* in addition to *Quadriceps birostris*. Some of these apparent absences may reflect inadequate collecting, but this seems unlikely in the Starling, of which 18 specimens were examined. It is probable that Kermadec Starlings harbour only *Brueelia nebulosa*, *Menacanthus mutabilis* and *Sturnidoecus sturni*, and that other Mallophaga often or sometimes associated with this host (*Myrsidea cucullaris* and *Menacanthus spiniferus*) are absent.

Kermadec populations of land birds and non-migratory sea-birds have probably been founded by few individuals. These founders may have carried only part of the normal Mallophagan fauna occurring on the species in the source area.

Mallophaga normally have little effect on healthy adult hosts, who keep them fairly well controlled by preening, but they can cause irritation in young or sick birds, who may damage themselves by scratching. Fleas, Hippoboscids, mosquitoes and *Stomoxys* can cause extreme irritation by their bites, and may transmit various diseases or internal parasites from one host to another.

There are no previous published records of the Biting Fly *Stomoxys calcitrans* from the Kermadecs. As discussed in more detail below, it appears that this fly was probably introduced to Raoul from New Zealand in late 1963. The Biting Fly is a nuisance to stock and man, and it is important to ensure as far as possible by appropriate quarantine measures that no other pests are introduced to Raoul in future.

I wish to thank the Council of O.S.N.Z. for the opportunity to take part in the Kermadec Islands Expedition. Most members of the Expedition assisted with collecting ectoparasites, but particular mention must be made of the enthusiasm of Messrs. D. V. Merton, D. E. Crockett and C. R. Veitch. Mr. A. T. Blake, farm manager on Raoul from October, 1965, to October, 1967, provided information about *Stomoxys* and collected various Arthropoda. I am greatly indebted to the following specialists for identifying ectoparasitic insects: Dr. Theresa Clay (Phthiraptera), Mr. L. J. Dumbleton (Culicidae), Dr. T. C. Maa (Hippoboscidae) and Mr. F. G. A. M. Smit (Siphonaptera).

Dr. Clay, Professor R. L. C. Pilgrim, Mr. D. V. Merton and Dr. G. R. Williams kindly read and criticised a draft of this paper. Most of their suggestions have been incorporated. Professor Pilgrim tested the key and provided a list of the Mallophaga collected by J. H. Sorensen in 1944.

I thank Dr. D. F. Waterhouse and the Melbourne University Press for permission to reproduce Figs. 15 and 16 (from Insects of Australia), and Drs. H. K. Townes and J. N. Belkin for permission to reproduce Fig. 13.

A KEY TO ADULTS OF THE MAIN GROUPS OF ECTOPARASITES ON THE KERMADECS

Specific (and often generic) identification of ectoparasites is a matter for specialists. The following key is intended only as a guide for recognition of the main groups of ectoparasites in the field, and needs to be used with caution. Several Kermadec birds have not yet been examined adequately for ectoparasites, and it is possible that other genera of ectoparasites which have not yet been collected will be found later. In fleas, the genera *Ceratophyllus* (on domestic poultry) and *Ctenocephalides* (on dogs and cats) may have been overlooked in the past, or could be introduced in future, so they have been included in the key in square brackets []. Providing that the recorded host associations are borne in mind when using the key, few misidentifications should occur.

In the major divisions of the key, characters which can be seen with a hand lens, or at least with a stereoscopic microscope, have been used. In some of the generic separations it has been necessary to use characters which are only visible under fairly high magnifications, and may in a few cases require examination of slide-mounted, macerated specimens with a compound microscope. In almost all cases, however, host relationships will give a very strong clue to identity without recourse to microscopical examination. Note that most characters apply only to adults.

The Key to Mallophaga owes much to that of Blagoveshchenski (1967). The photographs of Mallophaga are of cleared, slide-mounted specimens.

1. With 8 legs. Body not divided into distinct head, thorax and abdomen (ticks and mites) Acarina
- With 6 legs. Body divided into distinct head, thorax and abdomen (insects) 2
2. Wings present (flies) Diptera — 3
- Wings absent 6
3. Relatively slender, long-legged flies with long, many segmented antennae (mosquitoes) Culicidae — 4
- Stouter, short-legged flies with short, 3-segmented antennae 5
4. Large, blackish-brown mosquitoes (Fig. 13). Usually on coast. *Opifex*
- Smaller, very slender, light-brown mosquitoes. Usually inland. *Culex*
5. Flattened, leathery flies ("louse flies" Fig. 14) Hippoboscidae
- Convex flies with fairly soft integument *Stomoxys* (Muscidae)
6. Body flattened laterally (fleas) Siphonaptera — 7
- Body flattened dorsoventrally (lice) Phthiraptera — 12
7. Comb present on posterior edge of pronotum 8
- Pronotal comb absent 10
8. With a comb on genal margin of head. On cats, dogs, straying to man [*Ctenocephalides*]
- Without comb on head 9
9. Front of head angled anterior to antennal insertions, with minute frontal tubercle. On domestic poultry, starlings, etc. [*Ceratophyllus*]
- Front of head evenly rounded, without frontal tubercle. On rats. *Pygiopsylla*
10. Front of head with a prominent trapezoid tubercle. In birds' nests *Parapsyllus*
- Front of head without tubercle 11
11. Mesothorax with a pleural rod. Head with a row of setae parallel to its posterior margin (Fig. 16). On rats *Xenopsylla*
- Mesothorax without a pleural rod. Head with a single seta on each side near posterior margin (Fig. 15). On man, dogs, pigs, etc. *Pulex*
12. Head relatively small, mandibles absent. On mammals (sucking lice) Anoplura
- Head relatively large, mandibles present. On birds; a few species on mammals (biting lice) Mallophaga — 13
13. Antennal grooves present, antennae usually concealed (Figs. 1-3). Third antennal segment wineglass-shaped. Maxillary palps present Amblycera, Menoponidae — 14
- Antennal grooves absent, antennae not concealed, projecting (Figs. 4-12). Third antennal segment not wineglass-shaped. Maxillary palps absent Ischnocera — 19
14. Head with ventral spine-like processes 15
- Head without ventral processes 16

- 15. Head with a pair of gular processes. On Procellariiformes.
 *Ancistrona*
 — Head without gular processes but with postpalpal processes.
 (Fig. 3). On Passeriformes *Menacanthus*
- 16. First two antennal segments with large expansions. On
 Anseriformes *Trinoton*
 — Antennae without large expansions 17
- 17. Head semilunar (Fig. 2). On Charadriiformes and Procellariiformes *Austromenopon*
 — Head trilobed 18
- 18. Side of head deeply emarginate (Fig. 1); head width/length not exceeding 1:3. Form elongate.
 On Charadriiformes *Actornithophilus*
 On Procellariiformes *Longimenopon*
 — Side of head weakly emarginate; head width/length about 1:8. Form broader. On Galliformes *Menopon*
- 19. Antennae 3-segmented (Fig. 4). One claw on each leg. On mammals Trichodectidae
 — Antennae 5-segmented (Figs. 5-12). Two claws on each leg. On birds Philopteridae — 20
- 20. Pterothorax (fused meso-and metathorax) rectangular with concave or straight approximately parallel lateral margins (Figs. 5, 6, 9). Body elongate. Usually on wing feathers 21
 — Pterothorax trapezoidal or pentagonal, with markedly diverging lateral margins (Figs. 7, 8, 10-12). Body less or not elongate. Rarely on wing feathers 25
- 21. Head without thick lateral setae on clypeus 22
 — Head with a thick lateral seta on each side of clypeus. On Anseriformes *Anaticola*
- 22. Form very elongate and slender, abdomen with sides fairly straight. (Fig. 5). On Procellariiformes *Halipeurus*
 — Form less elongate, abdomen with sides more strongly curved (Figs. 6, 9) 23
- 23. Lateral abdominal buttresses absent (Fig. 6). On Procellariiformes *Naubates*
 — Lateral abdominal buttresses present 24
- 24. Head scarcely longer than broad. Antennae strongly modified in ♂. On Pelecaniformes *Pectinopygus*
 — Head length/width exceeding 1:4. Antennae similar in both sexes (Fig. 9). On Charadriiformes some *Quadriceps*
- 25. Body relatively slender, short or oblong, usually with narrow head and narrow abdomen (Figs. 7, 8). Mainly on body plumage, sometimes on head and neck 26
 — Body short and broad, with broad head and broad abdomen (Figs. 10-12). Mainly on feathers of head and neck 30
- 26. Carina at anterior margin of head entire dorsally (Figs. 7, 8). On Passeriformes *Brueelia*
 — Carina at anterior margin of head interrupted dorsally 27

27. A movable projection (trabeculus) present on each side of head just in front of base of antenna.
 On Alcedinidae *Alcedoecus*
 On Charadriiformes *Carduiceps*
 — Trabeculi absent 28
28. Postgena with only one long seta on each side. Antennae much stouter in ♂ than in ♀. On Gruiformes *Rallicolla*
 — Postgena with more than one long seta on each side. Antennae similar in the two sexes 29
29. Clypeus with transparent anterior margin reaching only to carinae.
 On Charadriiformes some *Quadriceps*
 — Clypeus with transparent anterior margin reaching clypeal suture.
 On Charadriiformes *Luniceps*
30. A movable appendage (trabeculus) in addition to a fixed projection (conus) on each side of head, just in front of antennal insertions.
 On Passeriformes *Philopterus*
 — Trabeculi absent 31
31. Abdominal pleurites with ventral wedge-shaped processes. On Anseriformes *Anatoecus*
 — Abdominal pleurites without ventral processes 32
32. Tergites of abdomen entire. Head dorsally with 1-3 pairs of peg-like setae (Fig. 11). On Procellariiformes *Trabeculus*
 — Tergites of abdomen divided by median membranous areas. Head without peg-like setae 33
33. Frontal carina with a posterior transverse branch (Fig. 10).
 On Procellariiformes, Pelecaniformes, Charadriiformes
 *Saemundssonina*
 — Frontal carina with a posterior transverse branch (Fig. 12). On Passeriformes *Sturnidoecus*

ORDER PHTHIRAPTERA

Anoplura (sucking lice) are found only on mammals, and Mallophaga (biting lice) occur chiefly on birds. Mallophagan species are normally restricted to a single, or a few closely related host species, but may occur occasionally as stragglers on other birds. A genus of Mallophaga may exceptionally be confined to a single genus of birds (e.g. *Apterygon* on *Apteryx*), but usually is found on members of a family (e.g. *Alcedoecus* on Alcedinidae), an order (e.g. *Halipeurus* on Procellariiformes), or even several orders (e.g. *Saemundssonina*). As indicated in the preceding key, the body form of Mallophaga is related to the part of the host's plumage which they normally inhabit, as a result of differential selection pressures due to preening. (Short, stout lice can maintain themselves on neck and head, but would soon be eliminated from wings.)

As the distribution of a louse is usually that of its host, localities have been omitted from the following list. All the lice were collected on Raoul I. and Meyer I. during December 1966 and January 1967, apart from some species recorded previously from the Kermadecs by Johnston and Harrison (1912) and others collected by J. H. Sorensen in 1944 (indicated by (S)), which are marked with an asterisk *. When the record is not the type host (i.e. the host

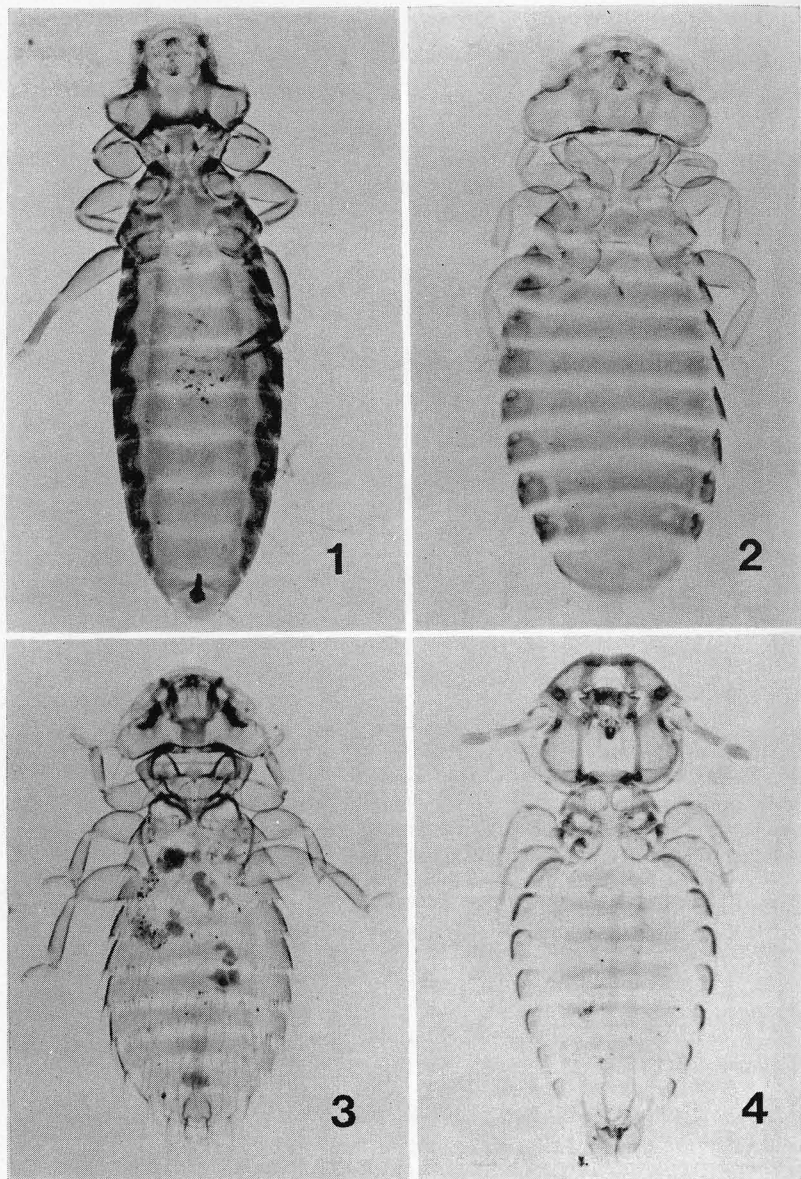
species from which the louse was originally described), the name of the type host is given in square brackets []. Johnston and Harrison's names have been brought up-to-date (cf Hopkins and Clay, 1952).

FAMILY MENOPONIDAE

- Actornithophilus ceruleus* (Timmermann, 1954). Fig. 1.
Procelsterna cerulea albivitta — ♀. [*P. c. cerulea*]
- **Actornithophilus limosae* (Kellogg, 1908) (S)
Limosa lapponica baueri
- **Actornithophilus timidus* (Kellogg, 1896)
Pluvialis dominica fulva
- Actornithophilus* sp.
Pterodroma hypoleuca nigripennis — ♀. "Certainly a straggler"
(T. Clay, in litt.).
- **Ancistrona procellariae* Westwood, 1874
Pelagodroma marina albiclunis. [*Daption capensis*]
- Ancistrona* sp.
Pterodroma hypoleuca nigripennis — nymph.
- Austromenopon atrofulvum* (Piaget, 1880)
Anous m. minutus — 2 ♀ ♀. [?]
- Austromenopon becki* (Kellogg, 1906). Fig. 2.
Phaethon rubricauda roseotincta — 2 ♀ ♀. [*P. aethereus mesonauta*]
- **Austromenopon meyeri* (Giebel, 1874)
Limosa lapponica baueri
- Austromenopon* sp.
Puffinus p. pacificus — ♀
- Austromenopon* sp.
Procelsterna cerulea albivitta — ♀
- Longimenopon* sp.
Pterodroma hypoleuca nigripennis — ♀
- Menacanthus mutabilis* Blagoveshchenskii, 1940. Fig. 3.
Sturnus v. vulgaris — 3 ♂ ♂, 5 ♀ ♀, 5 nymphs
- **Menacanthus stramineus* (Nitzsch, 1818) (S)
Gallus domesticus [*Meleagris gallopavo domestica*]
- Menacanthus* sp.
Prosthemadera n. novaeseelandiae — ♀
- Menacanthus* sp.
Turdus philomelos — ♀ nymph.
- Menacanthus* sp.
Turdus m. merula — ♀
- **Menopon gallinae* (Linnaeus, 1758) (S)
Gallus domesticus
- **Trinoton querquedulae* (Linnaeus, 1758) (S)
Anas s. superciliosa [*A. c. crecca*].

FAMILY TRICHODECTIDAE

- Damalinia caprae* (Gurlt, 1843). Fig. 4.
Capra hircus — many ♂ ♂, ♀ ♀, few nymphs.



[Photos by B. S. Eykel, D.S.I.R.]

FIGURE 1: *Actornithophilus ceruleus*, ♀ (length 2.1 mm) from Grey Ternlet.

FIGURE 2: *Austromenopon becki*, ♀ (length 2.4 mm) from Red-tailed Tropic Bird.

FIGURE 3: *Menacanthus mutabilis*, ♂ (length 1.5 mm) from Starling.

FIGURE 4: *Damalinia caprae*, ♂ (length 1.3 mm) from Goat.

FAMILY PHILOPTERIDAE

Alcedoecus sp.

Halcyon sancta vagans — 8 adults.

Anaticola crassicornis (Scopoli, 1763)

Anas s. superciliosa — 1 nymph. [*Anas p. platyrhynchos*]

**Anatoecus dentatus* (Scopoli, 1763) (S)

Anas s. superciliosa [*A. p. platyrhynchos*]

Brueelia merulensis (Denny, 1842). Fig. 8.

Turdus m. merula — 5 ♂♂, 3 ♀♀

Brueelia nebulosa (Burmeister, 1838) Fig. 7.

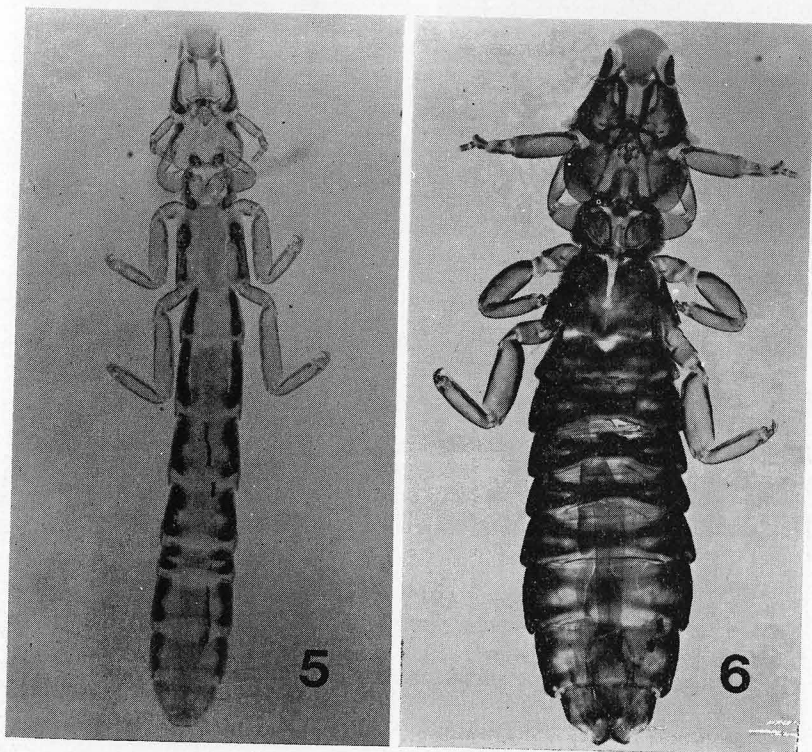
Sturnus v. vulgaris — many ♂♂, ♀♀, nymphs.

Brueelia sp. nov.

Prosthemadera n. novaeseelandiae — 5 adults.

Brueelia sp.

Turdus philomelos — nymph.



[Photos by B. S. Eykel, D.S.I.R.]

FIGURE 5: *Halipeurus kermadecensis*, ♂ (length 3.6 mm) from Kermadec Petrel.

FIGURE 6: *Naubates harrisoni*, ♂ (length 3.8 mm) from Wedge-tailed Shearwater.

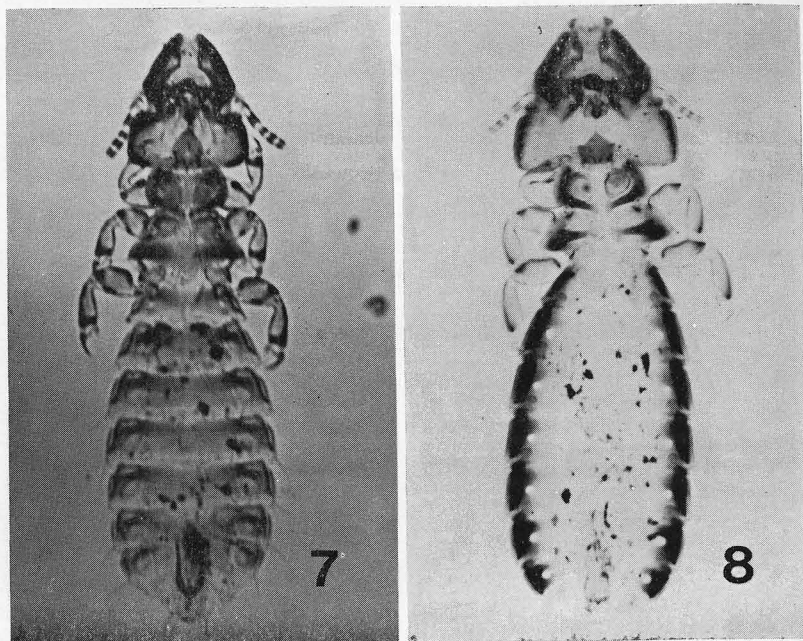


FIGURE 7: *Brueelia nebulosa*, ♂ (length 1.5 mm) from Starling.

FIGURE 8: *Brueelia merulensis*, ♂ (length 2.2 mm) from Blackbird.

**Carduceps cingulatus lapponicus* Emerson, 1953 (S)

Limosa lapponica baueri

Halipeurus kermadecensis (Johnston and Harrison, 1912). Fig. 5.

Pterodroma neglecta — many ♂♂, ♀♀, nymphs.

Halipeurus leucophryna Timmermann, 1960

Pterodroma hypoleuca nigripennis — many ♂♂, ♀♀, nymphs.
[*Pt. leucoptera masafueræ*]

Halipeurus mirabilis Thompson, 1940

Puffinus p. pacificus — 5 ♂♂, 11 ♀♀, 48 nymphs. [*P. p. chlororhynchus*].

**Halipeurus pelagicus* (Denny, 1842)

Pelagodroma marina albiclunis. [*Hydrobates pelagicus*].

**Halipeurus placodus* Edwards, 1961

Puffinus assimilis kermadecensis. [*Puffinus a. tunneyi*].
Recorded by Edwards (1961), not taken by O.S.N.Z., and apparently not yet represented in any New Zealand collection.

**Lunates phaeopi* (Denny, 1842)

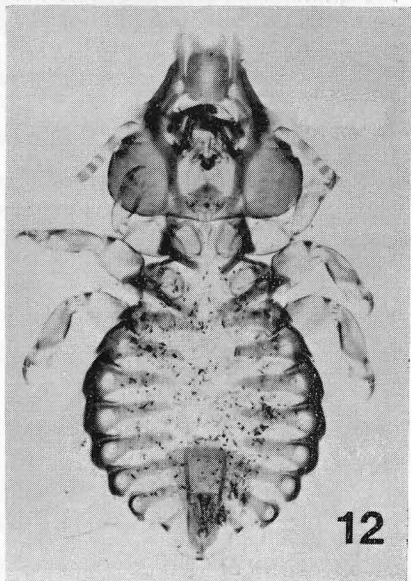
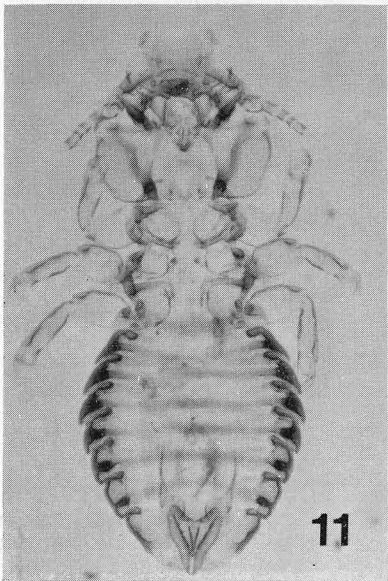
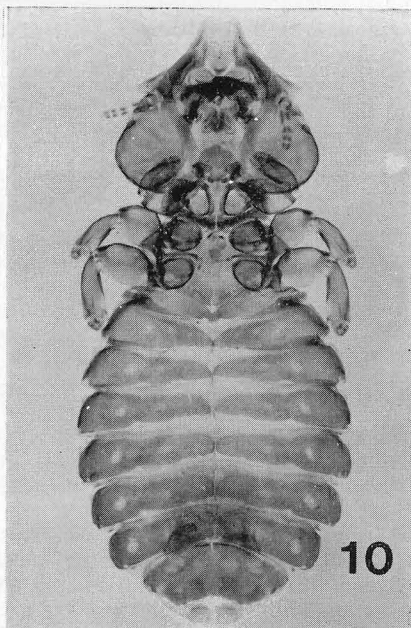
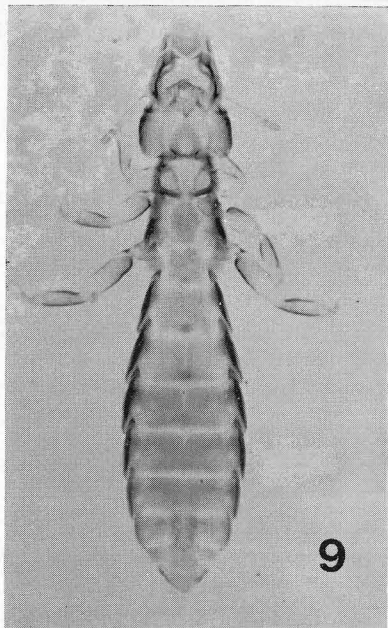
Numenius phaeopus variegatus

Naubates harrisoni Bedford, 1930. Fig 6.

Puffinus p. pacificus — 3 ♂♂, 2 ♀♀, 9 nymphs [*P. gravis*].

**Pectinopygus annulatus* (Piaget, 1880) (S)

Sula dactylatra personata [*Sula leucogaster*]



[Photos by B. S. Eykel, D.S.I.R.]

FIGURE 9: *Quadriceps hopkinsi apophoretus*, ♂ (length 1.7 mm) from Grey Ternlet.

FIGURE 10: *Saemundssonsonia hexagona*, ♀ (length 3.2 mm) from Red-tailed Tropic Bird.

FIGURE 11: *Trabeculus fuscoclypeatus*, ♂ (length 1.3 mm) from Kermadec Petrel.

FIGURE 12: *Sturnidoecus sturni*, ♂ (length 1.5 mm) from Starling.

- Philopterus turdi* (Denny, 1842)
Turdus philomelos — ♀
- Quadriceps birostris* (Giebel, 1874)
Sterna fuscata — 17 ♂♂, 19 ♀♀
- Quadriceps h. hopkinsi* Timmermann, 1952
Anous m. minutus — 12 ♂♂, 18 ♀♀, nymph ["*Anous minutus melanogenys*"]
- Quadriceps hopkinsi apophoretus* Timmermann, 1969. Fig. 9.
Procelsterna cerulea albivitta — holotype ♂, allotype ♀, 4 ♂♂, 4 ♀♀ paratypes.
- Rallicola lugens* (Giebel, 1874)
Porphyrio porphyrio melanotus — 34 adults, 1 nymph [P. *poliocephalus*].
- **Saemundssonina hawaiiensis* (Kellogg and Chapman, 1902)
Pluvialis dominica fulva
- Saemundssonina hexagona* (Giebel, 1874). Fig. 10.
Phaethon rubricauda roseotincta — ♀
- **Saemundssonina limosae* (Denny, 1842) (S)
Limosa lapponica baueri
- **Saemundssonina numeniicola* (Johnston and Harrison, 1912)
Numenius phaeopus variegatus
- Saemundssonina puellula* Timmermann, 1965
Puffinus p. pacificus — ♂, ♀
- **Saemundssonina scolopacisphaeopodi* (Schrank, 1803)
Numenius phaeopus variegatus
- Saemundssonina* sp.
Pterodroma hypoleuca nigripennis — 4 nymphs
- Sturnidoecus sturni* (Schrank, 1776). Fig. 12.
Sturnus v. vulgaris — many ♂♂, ♀♀, nymphs.
- Sturnidoecus* sp.
Prothemadera n. novaeseelandiae — 4 nymphs
- Trabeculus fuscoclypeatus* (Johnston and Harrison, 1912). Fig. 11.
Pterodroma neglecta — many ♂♂, ♀♀, nymphs.
- Trabeculus hexacon* (Waterson, 1914) sens. lat.
Puffinus p. pacificus — many ♂♂, ♀♀ nymphs; *Pterodroma hypoleuca nigripennis* — 5 ♂♂, 8 ♀♀. [*Procellaria aequinoctialis*]

SUBORDER ANOPLURA (SIPHUNCULATA)

FAMILY HOPLOPLEURIDAE

- Polyplax spinulosa* (Burmeister, 1839)
Rattus norvegicus — 6 ♂♂, 7 ♀♀

ORDER DIPTERA

The Kermadecs are free from many of the common groups of biting flies such as sandflies (or blackflies: Simuliidae), biting midges (Ceratopogonidae) and horseflies (Tabanidae).

FAMILY CULICIDAE

Adult mosquitoes bite almost all terrestrial vertebrates, although most species seem to have preferred hosts. The natural hosts of all species occurring originally in New Zealand are probably birds, but several native mosquitoes frequently attack man and introduced

mammals. Some native mosquitoes transmit avian virus diseases. Both species recorded here were known previously from the Kermadecs (Belkin, 1968).

Culex pervigilans Bergroth, 1889

A few larvae were collected from a cattle trough and Tui Lake (Raoul I.) in December, and adults emerged in January. This species is the dominant and most widespread mosquito of the New Zealand area. It can be a serious nocturnal domestic pest on the mainland, but apparently does not readily attack man out of doors. It was not observed feeding on Raoul. According to Belkin, Kermadec specimens (both adults and larvae) differ substantially from New Zealand populations, but material is very limited. Thus it would be desirable to collect more specimens from Raoul.

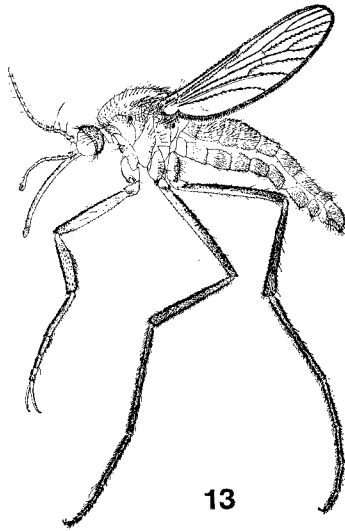


FIGURE 13: *Opifex fuscus*, ♂ (length about 5 mm) (after Belkin, 1968).

Opifex fuscus Hutton, 1902. Fig. 13.

Larvae were common to abundant in saline pools in the splash zone above HWM on Raoul and Meyer Islands. Adults were observed feeding on birds (Kermadec Petrel and Sooty Tern) on Meyer Island, and on man (frequently and painfully) at Fishing Rock and on Meyer Island.

Opifex adults rarely leave the shore, but on two occasions during warm moist nights they came to light in fair numbers at our camp on Low Flat. This species is the common coastal "Saltwater Mosquito" of New Zealand.

FAMILY MUSCIDAE

Stomoxys calcitrans (Linnaeus, 1758)

This species is commonly known as the Biting Fly in New Zealand, and as the Stable Fly in some overseas countries. Larvae breed in decaying vegetable matter of all kinds, including silage and compost heaps. Adults are vicious biters of domestic mammals, particularly cattle (in which they can cause substantial lowering of beef or milk production), and man. They can transmit mechanically various diseases and internal parasites. On Raoul, Biting Flies were common in the vicinity of the farm, on Low Flat and at Denham Bay, and occurred elsewhere in clearings and on the coast. Two were observed (biting) on North Meyer Island. They caused considerable annoyance to both man and cattle. They were also observed biting feral goats, but not birds.

Stomoxys was not observed on Raoul until early in 1965 (A. T. Blake, pers. comm.), and was thought to have been introduced with straw in the crate of a bull taken to Raoul from New Zealand in November, 1963. The crate was taken ashore with the bull in it, and was cleaned out on land before being returned to the ship.

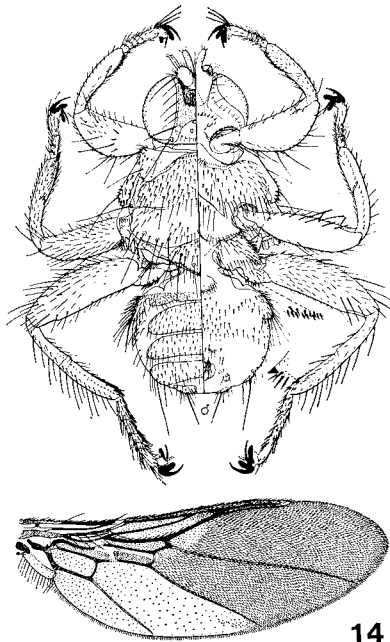


FIGURE 14: *Ornithoica exilis* (length about 3 mm) (after Ferris, 1927).
Top left: dorsal view. Top right: ventral view (wings removed in both). Bottom: right wing.

FAMILY HIPPOBOSCIDAE

This family includes flattened leathery flies which parasitise birds or mammals. Females give birth, one at a time, to full-grown larvae which pupate almost immediately in nest material or in a protected place. Previous New Zealand records (cf. Maa, 1969) are *Ornithomyia opposita* Walker, 1849 (on Psittaciformes and Ploceidae), and *Melophagus ovinus* (Linnaeus, 1758) (the Sheep Ked). Other genera and species occur, but need further study.

Ornithoica exilis (Walker, 1861). Fig. 14.

Meyer I., on *Cyanoramphus novaezelandiae cyanurus*, 19 Jan. 1967, D. V. Merton — ♀; Raoul I., 9 Jan. 1967, on *Rattus norvegicus*, C. R. Veitch — ♀.

These are the first records of this species from the New Zealand area. It is widely distributed in the Oriental region, Indonesia, Micronesia, Australia, Solomon Islands, New Hebrides, Loyalty Is., Fiji and Samoa. It has been recorded from many groups of birds, including 11 other genera of parrots, but does not normally parasitise rats, and apparently the specimen on *Rattus* was a straggler. Dr. Maa writes (*in litt.*) that these are unusually small, and one of the southernmost records of *O. exilis*.

ORDER SIPHONAPTERA

Fleas are not normally as specific in their host associations as lice. Their larvae live in debris in nests, regular resting places, etc., and only the adults are parasitic. The life cycle of bird fleas is usually closely correlated with the nesting cycle of the host, but mammal fleas have a less sharply defined breeding season. The known flea fauna of the New Zealand area has been recorded by Smit (1965).

FAMILY RHOPALOPSYLLIDAE

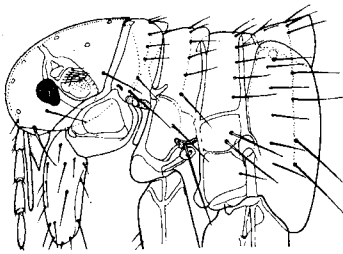
Parapsyllus sp.

Meyer I., nest of *Puffinus p. pacificus*, 19 Jan. 1967, D. E. Crockett — ♀. Mr. Smit writes (*in litt.*) that this may be an undescribed species, but more specimens are needed for certain identification. Five species of the genus have been recorded in New Zealand (Smit, 1965), their hosts being Procellariiformes, shags, penguins and the Kea.

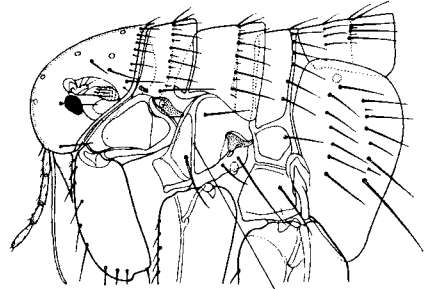
FAMILY PYGIOPSYLLIDAE

Pygiopsylla hoplia Jordan and Rothschild, 1922

Raoul I., mainly Low Flat area, on *Rattus norvegicus*, Dec. 1966 and Jan. 1967, 25 ♂♂, 22 ♀♀. This flea was erroneously recorded as *P. hilli* by Hilgendorf (1917). Other New Zealand records, chiefly from *R. exulans* (including a Kermadec record) are given by Smit (1965). It is a very common flea in Australia, where its main host appears to be *Peremeles* (bandicoot).



15



16

FIGURE 15: *Pulex irritans* (length 2.6 mm) anterior part of body.

FIGURE 16: *Xenopsylla vexabilis* (length 3.2 mm) anterior part of body (after Dunnet, 1970).

FAMILY PULICIDAE

Pulex irritans Linnaeus, 1758. Fig. 15.

Recorded from "Denham Bay, Raoul Island, 1910 [sic — probably 1908], from sand, W. R. B. Oliver," by Smit (1965). This species, the "Human Flea," was not collected by the O.S.N.Z. Expedition.

Xenopsylla vexabilis Jordan, 1925. Fig. 16.

Raoul Island, from *Rattus norvegicus* (6 ♂♂, 2 ♀♀), Jan. 1967. This species was wrongly recorded as *X. cheopis* (from *R. exulans*) by Hilgendorf (1917). It is an Australian species, which in New Zealand is associated mainly with *Rattus exulans* (Smit, 1965).

HOST AND PARASITE LIST

Information is listed below in the following sequence: scientific name of host, common name of host, number of individuals examined for ectoparasites by the O.S.N.Z. Expedition, Mallophaga; Anoplura; Diptera and Siphonaptera. When no specimens were examined, the records are of Johnston and Harrison (1912), or from the collection made by Sorensen, except for the Kermadec Little (Allied) Shearwater (Edwards, 1961). Records of ectoparasite stragglers are given (in brackets).

BIRDS

PROCELLARIIFORMES

Pterodroma neglecta (Kermadec Petrel) — 5.

Austromenopon sp., *Halipeurus kermadecensis*, *Trabeculus fuscoclypeatus*; *Opifex fuscus*.

Pterodroma hypoleuca nigripennis (Black-winged Petrel) — 4.

(*Actornithophilus* sp.) *Ancistrona* sp., *Halipeurus leucophryna*, *Longimenopon* sp., *Saemundssonina* sp., *Trabeculus hexacon*.

- Puffinus p. pacificus* (Wedge-tailed Shearwater) — 3.
Ancistrona sp., *Austromenopon* sp., *Halipeurus mirabilis*,
Naubates harrisoni, *Saemundssonina puellula*, *Trabeculus hexacorn*;
Parapsyllus sp.
- Puffinus assimilis kermadecensis* (Kermadec Little Shearwater) — 0.
Halipeurus placodus, *Saemundssonina* sp., *Trabeculus* sp.
- Pelagodroma marina albiclunis* (Kermadec Storm Petrel) — 0.
Ancistrona procellariae, *Halipeurus pelagicus*.

PELECANIFORMES

- Phaethon rubricauda roseotincta* (Red-tailed Tropic Bird) — 2.
Austromenopon becki, *Saemundssonina hexagona*.
- Sula dactylatra personata* (Masked Booby) — 0.
Pectinopygus annulatus.

ANSERIFORMES

- Anas s. superciliosa* (Grey Duck) — 1.
Anaticola crassicornis, *Anatoecus dentatus*, *Trinoton querquedulae*.

GALLIFORMES

- Gallus domesticus* (Domestic Fowl) — 0.
Menacanthus stramineus, *Menopon gallinae*.

GRUIFORMES

- Porphyrio porphyrio melanotus* (Pukeko) — 4.
Rallicola lugens.

CHARADRIIFORMES

- Pluvialis dominica fulva* (Pacific Golden Plover) — 0.
Actornithophilus timidus, *Saemundssonina hawaiiensis*.
- Numenius phaeopus variegatus* (Asiatic Whimbrel) — 1.
Lunaceps phaeopi, *Saemundssonina numeniicola*, *S. scolopacisphaeopodis*.
- Limosa lapponica baueri* (Eastern Bar-tailed Godwit) — 0.
Austromenopon meyeri, *Actornithophilus limosae*, *Carduceps cingalatus lapponicus*, *Saemundssonina limosae*.
- Sterna fuscata* (Sooty Tern) — 3.
Quadriceps birostris; *Opifex fuscus*.
- Anous m. minutus* (White-capped Noddy) — 3.
Austromenopon atrofulum, *Quadriceps h. hopkinsi*.
- Gygis alba royana* (White Tern) — 1.
 (no ectoparasites).
- Procelsterna cerulea albivitta* (Grey Ternlet) — 3.
Actornithophilus ceruleus, *Austromenopon* sp., *Quadriceps hopkinsi aphotretus*.

PSITTACIFORMES

- Cyanoramphus novaezelandiae cyanurus* (Kermadec Parakeet) — 6.
Ornithoica exilis.

CORACIIFORMES

- Halcyon sancta vagans* (N.Z. Kingfisher) — 2.
Alcedoecus sp.

PASSERIFORMES

- Turdus philomelos* (Song Thrush) — 1.
Brueelia sp., *Menacanthus* sp., *Philopterus turdi*.
Turdus m. merula (Blackbird) — 2.
Brueelia merulensis, *Menacanthus* sp.
Prothemadera n. novaeseelandiae (Tui) — 8.
Brueelia sp. nov., *Menacanthus* sp., *Sturnidoecus* sp.
Sturnus v. vulgaris (Starling) — 18.
Brueelia nebulosa, *Menacanthus mutabilis*, *Sturnidoecus sturni*.

MAMMALS

PRIMATES

- Homo sapiens* (Man).
Opifex fuscus, *Stomoxys calcitrans*; *Pulex irritans*.

RODENTIA

- Rattus exulans* (Polynesian Rat) — 0.
Pygiopsylla hoplia, *Xenopsylla vexabilis*.
Rattus norvegicus (Norway or Brown Rat) — 5.
Polyplax spinulosa; *Pygiopsylla hoplia*; *Xenopsylla vexabilis*;
(*Ornithoica exilis*).

ARTIODACTYLA

- Capra hircus* (Goat) — 2.
Damalinia caprae; *Stomoxys calcitrans*.

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