STUDIES OF THE PHILOPTERIDAE (MALLOPHAGA) FROM BIRDS OF THE ORDER PROCELLARIFORMES
1. THE GENUS *HALIPEURUS* THOMPSON

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The Mallophaga of the birds of the order Procellariformes have attracted the interest of entomologists since the time of Fabricius. My own study was initiated when I had the good fortune to acquire a collection of these insects from the American Museum of Natural History. That material, plus an even larger amount from other sources, totaling well over 2,000 specimens, made it possible to revise the generic concepts of the lice of the family *Philopteridae* found on the procellariforms and to revise the sizeable subgenus *Halipeurus*.

This paper revising the genus *Halipeurus* is the first part of several concerned with the lice of the procellariform birds. This paper and the succeeding papers are based in part or in whole on my thesis, submitted in partial fulfillment of the requirements for the degree of Doctor of Philosophy in the Department of Biology of Harvard University. The papers to follow will be concerned with revisions of the other genera of the family Philopteridae. The final paper in this series will discuss the degree of concomitant phylogeny exhibited between these parasites and their hosts.

METHODS

To be properly studied the lice must be cleared and mounted on microscope slides. The usual technique of clearing in caustic potash and mounting in Canada Balsam is satisfactory but time consuming. A new technique, described by Salmon (1951), using a polyvinyl alcohol, lactic acid, and phenol compound, is much more satisfactory, requires considerably less time, and makes it possible to see the chaetotaxy and subtleties of sclerotization with greater clarity. With a phase microscope, specimens mounted in the polyvinyl alcohol medium show much internal structure formerly destroyed by using KOH. Among the disadvantages of using polyvinyl alcohol is that it does not completely clear the darkly colored material within the alimentary tract, the slides must be examined periodically to fill in the vacuities that occasionally appear under the coverslip, and the medium occasionally hardens with a dispersion of small crystal-like objects in it.

The lice are placed directly in the mixture, regardless of the preservative used. Even dry specimens are satisfactorily re-expanded, although best results are obtained when such material is first soaked a few days in 30 percent alcohol. The various possible solutions are all discussed in Salmon's paper (op. cit.), the most successful mixtures seem to be those with the higher percentages of phenol.

The technique, in addition to clearing well, leaves the general pigmentation more or less unchanged. This is particularly useful in the case of species that have unusually heavy sclerotization.

It is standard procedure on the part of many workers to remove the male genitalia from the lice. In a properly cleared slide this is often not necessary. The genitalia are sufficiently visible when left within the insect to serve their diagnostic purpose, especially since the terminal segments are of such value that the possibility of destroying them outweighs the advantages of removing the genitalia. Removing the genitalia, of course, serves its purpose when more exacting study of the genitalia is required.

Lice may be removed from a bird study skin without damage to the skin if it is in good condition. A blunt dissecting needle thrust under the feathers and then moved out at right angles

Received for publication March 28, 1960.

to the shaft of the feathers while lifting them slightly was found to be most effective. If large numbers of lice are on the bird, tapping will dislodge many of them. Lice so taken from skins are often perfect specimens. They tend to be shaken out over a period of years and thus fall to the bottom of the drawer in which the skins are stored. If, subsequently, another bird is placed upon the louse, it may adhere to this bird. Consequently, unless a bird is found with more than a few lice of one species, some doubt exists concerning the true host. One should keep in mind also that the original collector of the bird may not have kept his freshly collected specimens separated from each other, and thus allowed some of the lice to move about from one host to another before they died.

The drawings were made with the aid of a camera lucida attached conventionally to a compound microscope. A low-power ocular (2×) was used in conjunction with the high power (44×) objective for all drawings in order to keep them at the same scale and sufficiently detailed to cover the wide size range of these lice.

Since the ventral chaetotaxy of the terminal segments was of primary interest, the insects were usually mounted ventral side up on the slide. These species may be determined with a binocular dissecting microscope, providing a magnification of 120× is possible. Using such a microscope, however, these drawings are oriented correctly only if the insects are mounted ventral side down. The method of mounting actually is a matter of choice, and becomes important only when species with peculiar asymmetrical developments are concerned.

The measurements were made with the aid of an ocular micrometer. Since any mounting medium tends to distort the specimens, the measurements vary in reliability. Because of the more or less inflexible structure of the head, those measurements concerned with its length and breadth are very accurate. Total length and abdomen length are less so, while abdomen width is unreliable unless obviously undistorted specimens are used.

The head ratio and abdomen ratio are computed by dividing the length of each by the greatest breadth.

The following abbreviations are used in the text:

(AMNH) American Museum of Natural History, New York City;
(BMNH) British Museum (Natural History), London;
(GBT) Referring to the collection of Gordon B. Thompson;
(Meinertzhagen) Referring to the Meinertzhagen collection of Mallophaga, in the British Museum of Natural History;
(RLE) Material collected personally, as indicated; and
NV No variation within reasonable limits of measurement.

The host names used are those in Peters' *Check List of Birds of the World,* **1,** 1931, unless otherwise noted in the text. All drawings appearing in this paper refer to the genus *Halipeurus.*

ACKNOWLEDGMENTS

For the loan of the material that initiated this study, I am indebted to Dr. C. H. Curran, Department of Entomology, American Museum of Natural History. Since that time he has loaned other material and further aided me in various ways. Miss Theresa Clay, Department of Entomology, British Museum of Natural History, has loaned me comparative material from the British Museum collections and from the Meinertzhagen Collection. Miss Clay has also been helpful on matters taxonomic. Her understanding of the Mallophaga is comprehensive and the discussions that we have had by mail contributed vastly to my understanding of these lice. The late Dr. G. L. Ferris of Stanford University sent me some of Dr. Kellogg's type material and other specimens pertinent to this study. Mr. Gordon B. Thompson loaned me his excellently mounted collection of the subgenus *Halipeurus* and *Trabeculus.* Dr. G. H. E. Hopkins, The Zoological Museum, Tring, loaned me additional material that was collected for him by Mr. H. F. I. Elliot, Administrator of Tristan da Cunha.

The bulk of the material herein discussed was collected personally from museum skins. Mr. James E. Peters, Curator of Birds, Museum of Comparative Zoology, Harvard University, kindly gave me access to the collections of birds. Mr. Charles O'Brien, of the Department of Ornithology, American Museum of Natural History, made collections available to me several times during the past few years.

Dr. K. C. Emerson, presently Lt. Col., U. S. Army, aided me in getting a foundation of systematic knowledge of the Mallophaga in general. The Sigma Xi Society financed a trip to Oklahoma during the summer of 1949 so that I might work personally with Dr. Emerson.

I am particularly grateful to my sponsor, Dr. Frank M. Carpenter, Professor of Entomology, Harvard University. He agreed to guide me in this problem when I was the veriest tyro in Entomology, let alone research in Mallophaga.

The type material resulting from this study has been distributed in such a manner as to give the British Museum (Natural History), the American Museum of Natural History, and the Museum of Comparative Zoology each as complete a set of types and/or paratypes as possible. Additional type material will be deposited in the United States National Museum.

I. BIOLOGY AND ECOLOGY

Ecologically, many of these lice are strongly adapted to restricted niches, i.e., to various localized parts of their bird hosts. Clay (1949) has discussed this aspect particularly well. The elongate lice treated in detail here are adapted to live on the back and wings of the birds. To gain some idea of the ecological diversity of these lice, however, consider the albatross, *Diomedea,* on which the following genera may be found, usually as follows: *Harrisoniella* on the primary wing feathers, *Episbates* on the secondary wing feathers, *Naubates* and *Perineus* on the back and proximally on the wing, *Docophoroides* on the head and neck, and *Austromenopon* (*Menoponidae*) under the wings, and on the breast and belly.

These lice exist in a relatively uniform environment, with a high constant temperature (that of their host) and an abundant food supply (feathers). Their principal enemy seems to be the host. Although they move quickly through the feathers, they must occasionally be brushed off or crushed by the bird's beak.

Transfer from one host to another is presumably largely direct. Mainly, it probably consists of movement from the adult to young, although the lice may migrate at any time that birds come in close contact with one another. It is well known that the *Hippoboscidae* carry Mallophaga about, and while these flies are not known to frequent the procellariform birds, the possibility of that type of transfer exists.

The material at hand indicates that there are only three instars, as in other genera of Mallophaga that have been studied. The length of the period of development from egg to adult is probably about one month; Wilson (1934, 1939) has data on two species infesting chickens which indicates that each instar has a duration of approximately 1 week. Unfortunately, it is almost impossible to obtain living lice of the genera treated here, as the procellariform birds are found typically about the equatorial region and further south. The few species found in the northern hemisphere do not commonly visit the shores of the New England region except under unusual conditions, although small colonies of the storm petrel, *Hydrobates p. pelagicus* (Linn), are known to nest on a few islands off the coast of eastern North America.

Order MALLOPHAGA *Nitzsch*
Suborder ISCHNOCERA *Kellogg*
Family Philopteridae *Burmeister*
Tribe Philoceanini *tribe nov.*

Description: Relatively elongate Philopteridae with broad abdominal buttresses having (usually) well developed anterior and/or posterior medial processes; abdominal tergites sclerotized completely across dorsum, not divided medially in either sex (*Harrisoniella* excepted, with slight medial division); signature not divided medially but sometimes with a gutta, well developed to completely subordinated; genitalia simple, typically asymmetrical, parameres usually subequal and only lightly sclerotized; without complex setal patterns on terminal segments.

Key to the Complexes and Genera of Philoceanini

1. With relatively small, rounded medial processes; signature usually longer than broad, sometimes with a gutta ..... (*Philoceanus*-complex) 2
   With relatively bulbous or elongate medial processes; signature usually broader than long, never with gutta, usually considerably reduced ..... (*Pseudonirmus*-complex) 3
2. Very slender lice, 8 or more times as long as broad ..... *Halipeurus*
   Less than 7 times as long as broad ..... *Philoceanus*
3. Very large lice, (5–11 mm), basal segment of male antenna with elongate process ..... *Harrisoniella*
   Not so large 4
4. Cuticle with obvious 'pebbled' appearance ..... *Episbates*
   Cuticle not as above, may be either darkly pigmented overall or with buttresses only colored ..... *Pseudonirmus*

The *Philoceanus*-complex includes the genera *Philoceanus* and *Halipeurus,* each of which is further divided into subgenera and species-groups. The complex occurs on almost all of the procellariforms, with the possible exception of the albatrosses (*Diomedea* and *Phoebetria*). All the species are well colored. The medial processes are usually well developed but not knobbed, elongate, or bulbous. They are all generally heavily sclerotized, and the mid-abdominal segments of the males typically have a heavily sclerotized band across the tergite that is strongly narrowed medially. The signature is well developed and as long or longer than broad. All of the lice are relatively slender and thereby adapted to live on the wings and backs in particular of their hosts.

The Genus Halipeurus *Thompson*

The genus *Halipeurus* herein revised in part comprises a group of slender, mahogany-colored bird lice of moderate size, 3 to 5 millimeters long. They are typically found on birds of the families Procellaridae, Pelecanoididae, and Hydrobatidae, the shearwaters and petrels, the diving petrels, and the storm petrels, respectively. They are usually found on the backs and wings of those birds, being functionally adapted to these areas.

These lice have attracted the interest of several workers in the past 50 years, particularly Launcelot Harrison of the University of Sydney, Australia. Harrison died before he had published much of his findings, the posthumous publishing of a manuscript (1937) revealing that he had accomplished far more than was indicated in this last paper. There are specimens in existence that he labeled, additional evidence that he did have a clear idea of the species involved although he never published their descriptions. Recently, Mr. Gordon B. Thompson has continued research on these lice, and he has published many papers on them. It was necessary that I make arrangements with him to divide this work. At that time I did not have a clear idea of the validity of the various genera involved and it was agreed that I confine my work to the genus *Halipeurus* of which I had a large collection, and that I would leave the genera *Synnautes* and *Naubates* to him. Since that time it has become abundantly clear that *Synnautes* as a taxon would rank no higher than a subgenus, pending more material, and it is so considered in this work. I have not

described any new typical *Synnautes,* but have taken the liberty of describing one atypical species that is pertinent to the content of this study.

MORPHOLOGY

The homologies of the various parts of the mallophagan head, long debated, were competently investigated by Symmons (1952). This study and that of Clay (1951) have resulted in a considerably different understanding of the morphology and terminology of the head. These two papers should be referred to by anyone interested in these matters. The terminology used in this paper is for the most part that advocated by Clay (op. cit.).

Head: The head is roughly twice as long as broad, in subgenus *Synnautes* slightly narrower and with straighter lateral margins than in *Halipeurus* (see fig. 2, A and B). It is buttressed laterally, as in the thorax and abdomen, with a heavily sclerotized, internally concave bar. This buttress is made up of three parts: the first, the premarginal carina, on either side of the ante-clypeus, giving support to the ante-clypeus; the second, anterior to the antennal socket, the postmarginal carina; and the last, that of the lateral margin of the parietal area, the marginal temporal carina. Anteriorly, the postmarginal carina arcs medially and then posteriorly on the dorsal surface of the head in the form of a heavily sclerotized band, the dorsal carina. In *Synnautes,* the two paralleling dorsal carinae extend posteriorly to a point approximately midway between the mandibles and the signature, ending abruptly. In typical *Halipeurus,* they continue on to roughly the level of the mandibles, where they again arc and join medially. On the ventral surface, a similar carina marks the ventromedial borders of the clypeus. It extends anteriorly to the level of the ante-clypeus. It may or may not be present in subgenus *Halipeurus,* but is very heavily sclerotized in *Synnautes.* At the posterior end, the postmarginal carina again arcs medially for a short distance. The marginal temporal carina tapers out caudad of the eye, becoming heavy again on either side of the posterior border of the gular sclerite. These last mentioned sclerotizations are sometimes referred to as 'occipital blotches.' The head of a third-instar nymph shows that the clypeus is divided medially prior to adulthood, and the dorsal carinae of adult *Halipeurus* demark this nymphal division.

The anterior plate, or signature, a separate sclerotized area lying between the premarginal carinae, is bordered by a broad hyaline margin anteriorly. Apparently movable, it is attached to the surrounding portions of the head with connective tissue. The exact function is unknown, but it is probably largely sensory. The ventral anterior border of the sclerotized portion is marked with scale-like undulations. Ventrally, just anterior of the mandibles, a soft, flap-like projection, the pulvinus, extends about half-way to the signature. The labium and the knob-like rudiments of the maxillae occupy the area immediately posterior of the mandibles. The rounded gular sclerite is situated between the mandibles and the posterior margin of the head.

The antennae are dimorphic (fig. 1). In typical *Halipeurus* males, the basal segment is approximately twice as long as the second, and varies, depending on the species, from cylindric to bulbous. The third segment is oblique distally, angling the last two segments dorsally and posteriorly, a condition that presumably aids the male in grasping the female during copulation. In the female, the antennae are simple, with the second segment as long or slightly longer than the first. Typical

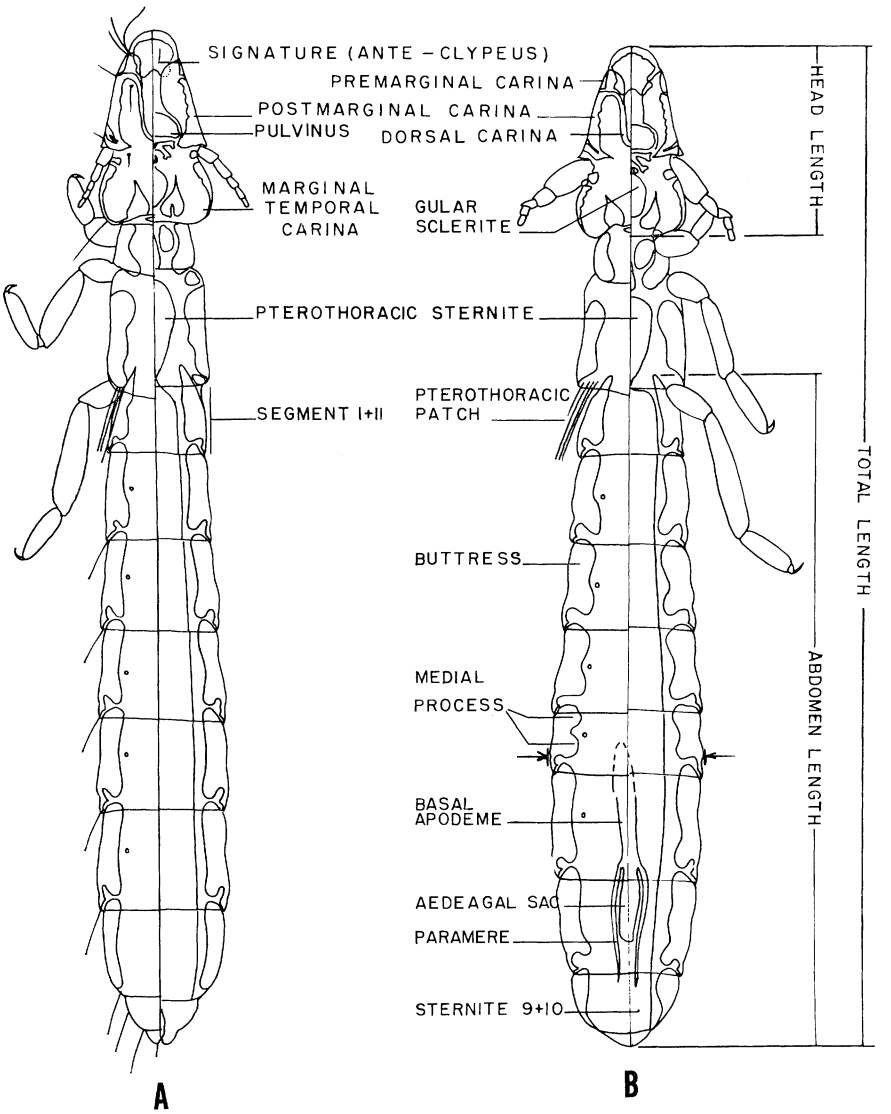

FIGURE 1. Diagrammatic drawings of typical *Halipeurus* to illustrate the principal terms and measurements. A, dorso-ventral view, female; B, dorso-ventral view, male.

Synnautes males have antennae that vary in much the same manner, but tend to be longer and slimmer.

The chaetotaxy of the head is relatively constant and offers little of taxonomic value. The setae inserted on the signature and the premarginal carina curve gracefully in front of the head and presumably serve as tactile organs.

Thorax: The thorax is typical, consisting of a distinct, relatively narrow, short prothorax, and a united meso- and metathorax, jointly termed the pterothorax. It is about as long as the head in this genus. As in the head, fusion and deletion have simplified the makeup of the thorax, but have also in turn obscured exact homologies.

With the exception of a patch of linearly arranged, close-set setae on the posterior border laterally, nothing is present on the thorax that is significant to this study. The setae mentioned, however, herein referred to as the pterothoracic patch, have some taxonomic interest and are mentioned in the descriptions. In the genus *Halipeurus,* there are usually three of these long setae set in a small unsclerotized area, with a small, stout seta adjoining laterally.

Abdomen: The abdomen is almost twice as long as the head plus the thorax. In the adults, there are nine apparent segments, since morphological segments 1 and 2 and 9 and 10 are fused. There is ample evidence in the nymphal stages that 9 and 10 are so fused in the adult, although none that 1 and 2 are (fig. 2, D and E). In the following discussions, the segments are referred to by their morphological

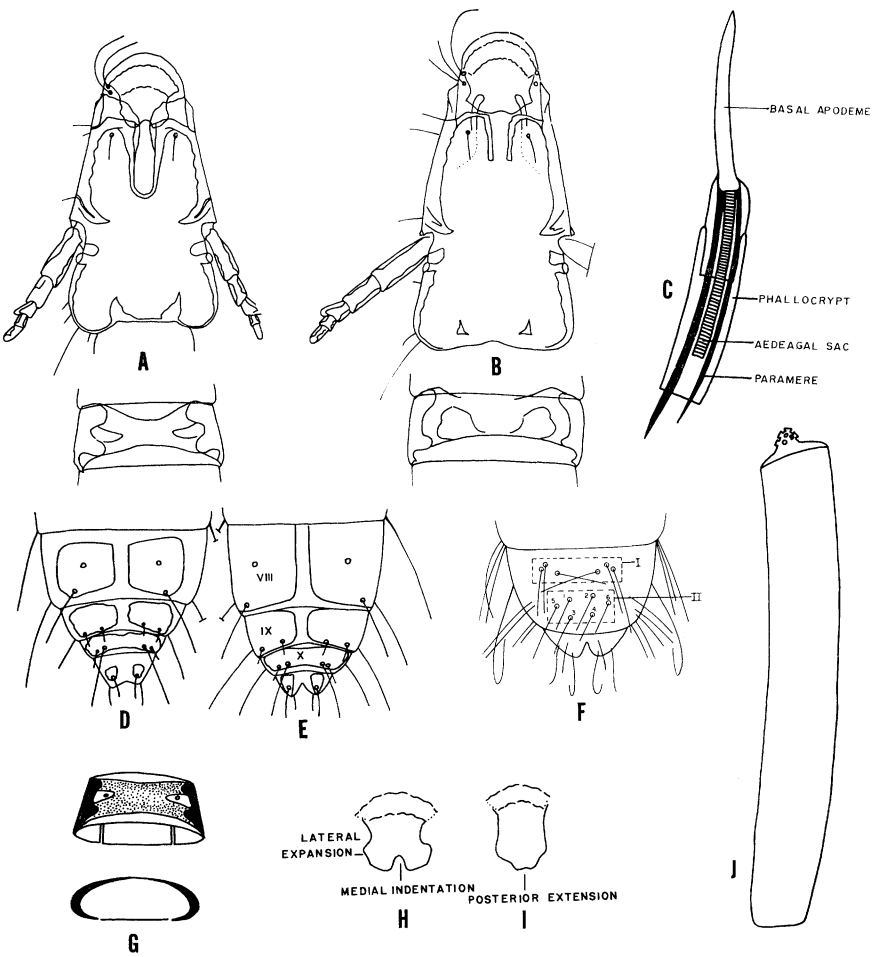

FIGURE 2. A, head and fifth abdominal segment of *H.* (*Halipeurus*) *taxosetus* sp. nov.; B, head and fifth abdominal segment of *H.* (*Synnautes*) *pelagicus* (Denny); C, diagrammatic drawing of male genitalia; D, terminal segment tergites of second-instar nymph; E, terminal segment tergites of third-instar nymph; F, schematic presentation of ventral chaetotaxy of terminal segments of adult male; G, diagrammatic views of abdominal sclerites; H, signature of *'taxosetus'* type, typical of lice from *Puffinus;* I, signature of *'procellariae'* type, typical of lice from *Pterodroma;* J, egg of *H. marquesanus* (Ferris) (cap is distorted).

number, i. e., apparent segment 5 is referred to as segment 6. With the exception of segment 11, each segment is strongly buttressed. These buttresses are relatively narrow in typical *Synnautes* and lack any marked development of medial processes (fig. 2, B). In *Halipeurus,* the buttresses are relatively wide and almost always have medial processes, especially in the middle segments, that involve much of the buttress. A diagrammatic view demonstrating the nature of the abdominal buttresses may be seen in fig. 2, G. The sixth segment is narrow in many species of this genus, allowing the abdomen to flex dorsally at a sharp angle to aid in copulation. This sixth segment retains, more obviously than the rest, the typical sclerotization of tergites of the *Philoceanus*-complex.

The terminal segments 9, 10, and 11 are of considerable interest, since the modifications of sclerites within this area enable one to separate out many of the species quickly. Males are usually more modified than are the females, and for this reason only males are designated as holotypes, a practice that I hope other workers will follow.

There is no doubt that, as mentioned previously, tergites 9 and 10 are fused in the adult, although it is questionable whether a similar condition exists in the sternites. The chaetotaxy of the sternite suggests that it is a result of such fusion, however, and it is considered to be so fused here. For the sake of convenience, the chaetotaxy is divided into two groups, I and II, as indicated in fig. 2, F. Group I remains fairly constant throughout the genus. Group II is often found in the condition figured, but, as the terminal segments are modified, these setae are shifted into other arrangements, and this shifting can be interpreted accurately in most cases.

The fact that the female terminal segment has buttresses suggests that the sclerotized remnants seen in segment 11 of the males are probably reduced buttresses. Typical female *Halipeurus* have a more or less truncate posterior with a rounded medial indentation, while *Synnautes* females have a bifid, pointed posterior, with enlarged setae terminating the buttresses.

The male genitalia consists basically of a pair of variously modified parameres attached proximally to a flat, lightly sclerotized basal apodeme. An aedeagal sac lies between the parameres and is usually only lightly, if at all, sclerotized. The parameres, plus the aedeagal sac, are retracted within an internal, tubular phallocrypt. In some species, at least, there appears to be an endophallus. (Refer to fig. 2, C for terminology.)

The egg is very long and slender (fig. 2, J), with a flat side. Anteriorly, it is obliquely truncate, bearing a lid with an irregular circle of about 15 micropyles, depending on the species.

Genus Halipeurus *Thompson*

Pediculus Linne, *partim,* 1758, Systema Naturae, 10th ed.
Lipeurus Nitzsch, *partim,* 1818, Germar's Magazin, **3,** p. 292.
Esthiopterum Harrison, *partim,* 1916, Parasit., **9,** pp. 21, 26.
Halipeurus Thompson, 1936, Ann. Mag. Nat. Hist., ser. 10, **18,** pp. 40–41. Genotype *Lipeurus angusticeps* Piaget.
Synnautes Thompson, 1936, As above, p. 43.
Halipeurus Harrison, 1937, Australasian Antartic Exped., 1911–14, ser. C, **2,** Pt. 1, p. 31. Genotype *Halipeurus euryphallis,* a nomen nudum.
Naubates Bedford, *partim,* T. Clay, 1940, Brit. Graham Land Exped., 1934–37, **1,** No. 5, pp. 309–310.

Description: Elongate lice adapted to living on the back and proximal parts of wings of *Puffininae* (shearwaters) and *Hydrobatidae* (storm petrels). Signature squarish, well devel-

oped. Head much longer than broad, with well developed dorsal carina extending posteriorly at least to level of pulvinus. Ventral carina indistinct to well developed. Antennae usually markedly dimorphic. Head and thorax about equal in length and breadth. Abdomen about twice as long as head plus thorax, straight-sided to spatulate, always widest in region of segment 7. Abdominal segments 9 and 10 almost indistinguishably fused. Sternite 9 and 10 without unusual sclerotizations or chaetotaxy, never divided medially, as in related genera. Genitalia with two variously modified parameres. Male genital opening ventral, sub-terminal.

Genotype: *Lipeurus angusticeps* Piaget.

Key to the Subgenera of Halipeurus

Dorsal carinae extending to, or almost to level of mandibles, then arcing medially and meeting in mid-line. Female abdomen rounded with slight, rounded medial indentation. Mid-abdominal segments of male with broad buttresses bearing well developed, rounded medial processes; tergites with heavily sclerotized, medially narrowed bands ..... Subgenus *Halipeurus*

Dorsal carina extend only to level of pulvinus and end abruptly. Female abdomen distinctly bifid, with deep, triangular indentation, buttresses of segment 11 each terminated with short, very broad seta. Mid-abdominal segments of male with narrow buttresses bearing poorly developed medial processes, usually only at posterior end of buttress. Tergites of male more evenly sclerotized than in *Halipeurus*. Cuticle with obvious scaly appearance. ..... Subgenus *Synnautes*

This key is detailed to avoid the equivocation present in the literature today. The two groups are almost generically distinct and easily recognized by anyone familiar with them. The overlap in some characters makes it presently undesirable to maintain these taxonts as separate genera, although additional material may prove that they should be so separated.

Subgenus Halipeurus *Thompson*

Halipeurus Thompson, 1936, Ann. Mag. Nat. Hist. ser. 10, **18**, pp. 40–41. Genotype *Lipeurus angusticeps* Piaget.

Description: Pre- and postmarginal carinae separate to almost joined. Premarginal carina tapered, not obliquely cut distally and interrupting outline of head. Dorsal carinae heavily sclerotized, extending to level of, or almost to mandibles, where they arc medially and meet in mid-line. Buttresses of abdomen relatively broad, those of middle segments particularly with well developed, rounded medial processes. Tergites in male with medially narrowed bands. Eleventh segment of female more or less rounded, with rounded medial indentation, without short stout setae terminating abdomen as in *Synnautes*.

Discussion: Twenty-two species and subspecies of the subgenus are described herein, of which 14 are new. In view of the fact that Kellogg saw many of these new species, and others that were new at the time, and referred them all to *diversus* Kellogg, a complete synonymy would be impossible. Even if Kellogg's host records were used as a basis, such a listing would be completely erroneous inasmuch as he or the people that collected for him were not careful of straggling, as evidenced by his collection. It would be hopeless to properly assign various species unless the actual specimens that he was referring to were at hand. The few that I have, kindly loaned by Dr. Ferris, are mostly stragglers, if the hosts listed on the slides are accurate.

The 22 species and subspecies recognized here may be divided into four major groups of species named as follows: *angusticeps, taxosetus, procellariae,* and *marquesanus* species groups. The first, *angusticeps,* may be readily distinguished by the asymmetry of the terminal segments. It includes three species and one subspecies. There is no way to determine from which of the other groups it evolved, although it seems to be *taxosetus.* In any event, there is no doubt that it is a derivative group. The second, *taxosetus,* is distinguished principally by the shape of the signature. Of the 11 species included within it, 9 are typically parasitic on the birds of the genus *Puffinus.* The third, *procellariae* (three species), and fourth, *marquesanus* (three species), are distinguished from *taxosetus* principally on the basis of the shape of the signature. The relative length of male segment six, near the length

of the fifth in *marquesanus* and only about one-half the length of the fifth in *procellariae,* readily separates these two groups. Both *procellariae* and *marquesanus* species groups are typically parasitic on birds of the genus *Pterodroma.*

Key to the Species Groups and Species of Subgenus Halipeurus

This key is primarily based on males, except where females are specifically mentioned. The females by themselves are very difficult to determine, the best technique being to compare them critically with previously determined females of the same size range. When familiar with the lice, one may quickly place females by virtue of certain qualitative aspects that cannot be successfully applied in a key.

1. With obvious asymmetry of part or all of sclerites of terminal segments ..... *angusticeps* species group
   Without asymmetrical developments of sclerites of terminal segments 2
2. Signature with lateral expansions and/or without narrow posterior extension ..... *taxosetus* species group
   Signature with greatly reduced or no lateral expansions, and with narrow posterior extension 3
3. Female terminal segments typical, not apparently fused into a single, evenly sclerotized unit, medial indentation obvious ..... *procellariae* species group
   Female terminal segments apparently fused into a single, more-or-less evenly sclerotized unit, medial indentation greatly reduced or absent; posterior border of segment 11 broad and squared; males without obviously shortened abdominal segment ..... *marquesanus* species group

angusticeps *species group*

1. Sternite 9 and 10 only asymmetrical ..... *angusticeps* subspp. 2
   Segment 11 markedly asymmetrical 3
2. Sternite 9 and 10 with irregular posterior margin, sharply angled caudad to right; total length greater than 3.6 mm. ..... *a. angusticeps*
   Sternite 9 and 10 as above, but less irregular and less sharply angled; total length less than 3.6 mm. ..... *a. fosteri*
3. Buttresses of 11th segment only involved in knob-like postanal extension on the right side ..... *mirabilis*
   Buttresses of segment 9 and 10 and 11 fused on right side, and form hook-like postanal extension ..... *abnormis*

taxosetus *species group*

1. Posterior border of sternite 9 and 10 triangular, heavily sclerotized, with completely atypical setal pattern 9
   Sternite 9 and 10 without excessive modification 2
2. Parameres short, broadened, and widely set apart 10
   Parameres slender, not widely set apart. 3
3. With a row of three closely set setae on each latero-posterior border 7
   Without such a row 4
4. Parameres slender, equal or only slightly sub-equal in length. 5
5. Parameres subspatulate, relatively broad, and differing greatly in length; group II setae somewhat irregular in pattern. ..... *placodus*
   Parameres very slender, not varying in width 6
   Parameres slender, but variable in width, from specimen to specimen and point to point along each paramere ..... *diversus*
6. Sternite 9 and 10 with rounded, heavily sclerotized corners, presenting superficial 'pincers-like' appearance. ..... *forficulatus*
   Sternite not so modified, group 11 setae distinctly caudad on sternite. ..... *bulweriae*
7. More than 3.0 mm in length, parasites of *Puffinus.* ..... *taxosetus*
   Less than 3.0 mm in length, parasites of *Pelecanoides* ..... *falsus* subspp. 8
8. Signature more-or-less *diversus*-type, but irregular. ..... *f. falsus*
   Signature distinctive, with large, regularly expanded lateral expansions, narrowing smoothly to small but distinctive medial indentation. ..... *f. pacificus*

9. Parameres slender, lightly sclerotized; 11th segment heavily sclerotized but not greatly reduced ..... *thompsoni*
   Parameres not so slender, heavily sclerotized; aedeagal sac with curious sclerotizations; a large species with 11th segment greatly reduced ..... *micariproctus*
10. Sternite 9 and 10 with longitudinally drawn out setal pattern; signature very long, rectangular in shape. ..... *attenuatus*
    Sternite 9 and 10 with fairly typical setal pattern 11
11. Basal segment of antenna almost bulbous; with slightly irregular setal pattern; aedeagal sac almost as long as parameres; over 3.5 mm in length ..... *mundae*
    Basal segment of antenna sub-bulbous; with group II setae 5 and 6 distinctly laterad; aedeagal sac with rod-like, obliquely cut sclerotization, less than 3.5 mm in length. ... *turtur*

procellariae *species group*

1. Parameres relatively broad, of medium length, with spatulate tips, subequal and only slightly asymmetrical; with variously modified rod-like sclerotizations within aedeagal sac. 2
   Parameres equal in length, symmetrically curved mediad; without sclerotization within aedeagal sac. ..... *procellariae*
2. Sternite 9 and 10 rectangular, with typical setal pattern ..... *kermadecense*
   Sternite 9 and 10 with broadly rounded posterior margin. ..... *accentor*

marquesanus *species group*

1. Parameres long and slender 2
   Parameres short and relatively broad. ..... *intermedius*
2. Sternite 9 and 10 with narrow, rectangular extension overlapping 11th segment. *marquesanus*
   Sternite 9 and 10 without such extension, group II setae crowded posteriorly. *postmarquesanus*

Halipeurus (Halipeurus) angusticeps (Piaget)

Lipeurus angusticeps Piaget, 1880, Les Pediculines, pp. 306–308, pt. 25, fig. 4. *Type-host: Procellaria cinerea.*

Description: A medium-sized species, ± 3.5 mm. Characterized by the irregular, obliquely cut posterior border of sternite 9 and 10 in the male. Signature with deep, triangular medial indentation in female. See descriptions of subspecies for detailed information.

Halipeurus (Halipeurus) angusticeps angusticeps (Piaget)
(Figs. 3–7, A)

Lipeurus angusticeps Piaget, 1880, Les Pediculines, pp. 306–308, pl. 25, fig. 4. *Type-host: Procellaria cinerea.*

Esthiopterum angusticeps (Piaget). Harrison, 1916, Parasit., **9**, No. 1, p. 130.

Halipeurus angusticeps (Piaget). Thompson, 1936, Ann. Mag. Nat. Hist., ser. 10, **18**, p. 41. Designated as genotype.

Description: Head ratio 2.2. Signature with rounded medial indentation, pointed in female. Basal segment of antenna sub-bulbous. Dorsal carina extends to mandibles, only lightly sclerotized in male. Abdomen ratio 5.8, narrow. Sixth segment as long as fifth. Segments 4, 5 and 6 with well developed paratergal processes, 7, 8 and 9 and 10 without processes. Posterior border of sternite 9 and 10 asymmetrical, cut obliquely downward to right and distinctly irregular. Terminal segments relatively attenuate. Eleventh segment bilobed, relatively unsclerotized, deeply indented. Parameres slender, lightly sclerotized, right paramere shorter and arced medially. Basal apodeme indistinct. Female typical.

Type-host: Unknown. Listed as *Procellaria cinerea* by Piaget, presumably meaning *Adamastor cinereus* (Gmelin).

Measurements: A single male and female, in millimeters:

	Male	*Female*
Total length:	3.84	4.63
Length of head:	0.85	
Width of head:	0.39	
Length of abdomen:	2.38	
Width of abdomen:	0.41	

Material examined: one male, one female, from *Procellaria cinerea* from the Piaget Collection, slide no. 445, BMNH no. 1928–325, kindly loaned by Miss Clay. Male on above slide designated as lectotype. Two male and three female paratypes from same material, all specimens in the British Museum (Natural History).

Discussion: Careful examination of almost 75 museum skins of *Adamastor cinereus* (Gmelin) failed to uncover any specimens of this louse. This seems strange, since the lice of this subgenus are usually reasonably easy to obtain from

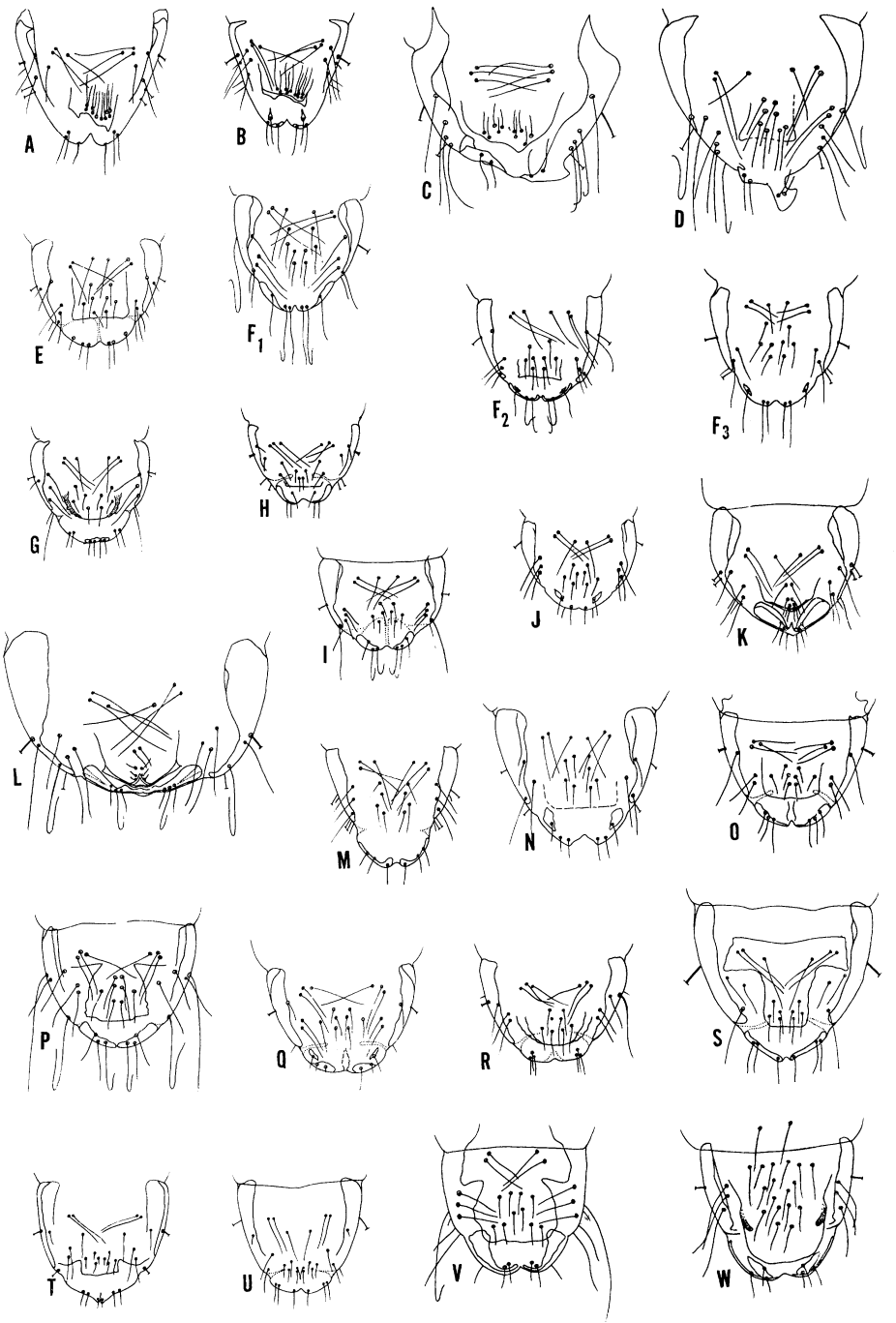

FIGURE 3. Ventral chaetotaxy of male terminal segments.

The diagnostic drawings of figures 3, 4, 5, 6, and 7 are consistently lettered (as listed below) to facilitate their use. They represent specimens from the type-host unless otherwise noted.

A. *Halipeurus* (*Halipeurus*) *a. angusticeps* (Piaget)
B. *Halipeurus* (*Halipeurus*) *a. fosteri* subsp. nov.
C. *Halipeurus* (*Halipeurus*) *abnormis* (Piaget)
D. *Halipeurus* (*Halipeurus*) *mirabilis* Thompson
E. *Halipeurus* (*Halipeurus*) *placodus* sp nov.
F. *Halipeurus* (*Halipeurus*) *diversus* (Kellogg)
   1, specimens from type host *Puffinus griseus* (Gmelin)
   2, specimens from *Puffinus l. boydi* Mathews
   3, specimens from *Puffinus p. yelkouan* (Acerbi)
G. *Halipeurus* (*Halipeurus*) *forficulatus* sp. nov.
H. *Halipeurus* (*Halipeurus*) *bulweriae* sp. nov.
I. *Halipeurus* (*Halipeurus*) *taxosetus* sp. nov.
J. *Halipeurus* (*Halipeurus*) *falsus* Eichler
   1, specimens from *Pelecanoides garnotti* (Lesson), the type host
   2, specimens from *Pelecanoides urinatrix* (Gmelin), type host of *H. f. pacificus* subsp. nov.
K. *Halipeurus* (*Halipeurus*) *thompsoni* sp. nov.
L. *Halipeurus* (*Halipeurus*) *micariproctus* sp. nov.
M. *Halipeurus* (*Halipeurus*) *attenuatus* sp. nov.
N. *Halipeurus* (*Halipeurus*) *mundae* sp. nov.
O. *Halipeurus* (*Halipeurus*) *turtur* sp. nov.
P. *Halipeurus* (*Halipeurus*) *procellariae* (Fabricius)
Q. *Halipeurus* (*Halipeurus*) *kermadecense* (Johnston and Harrison)
R. *Halipeurus* (*Halipeurus*) *accentor* sp. nov.
S. *Halipeurus* (*Halipeurus*) *intermedius* nom. nov.
T. *Halipeurus* (*Halipeurus*) *marquesanus* (Ferris)
U. *Halipeurus* (*Halipeurus*) *postmarquesanus* sp. nov.
V. *Halipeurus* (*Synnautes*) *pelagicus* (Denny)
W. *Halipeurus* (*Synnautes*) *nesofregettae* sp. nov.

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skins. None of the other species of birds of the subfamily Puffininae examined carried specimens of *angusticeps*.

This species of louse is very closely related to that parasitizing *Puffinus leucomelas*, and, in view of the opinion that *leucomelas* is closely, perhaps subspecifically related to *Puffinus kuhlii*, *H. a. angusticeps* may parasitize a local population of *kuhlii*. However, all of the skins of the various subspecies of *kuhlii* examined carried specimens of *H. abnormis* (Piaget) only.

Halipeurus (*Halipeurus*) *a. fosteri* subsp. nov.
(Figs. 3-7, B)

Description: Smaller, but essentially as *H. a. angusticeps*, differing as follows: Head ratio 2.1. Dorsal carina typical, except only lightly sclerotized near level of mandibles. Abdomen ratio 6.0. Sternite 9 and 10 with irregular posterior margin, obliquely cut to right, heavily sclerotized, but not sloped as sharply and less irregular. Right paramere only slightly curved medially.

Measurements: 9 males, 5 females, averages and ranges, in millimeters:

	Males	*Females*
Total length	3.53 (3.38 to 3.54)	4.38 (4.31 to 4.46)
Length of head	0.75 (0.73 to 0.78)	
Width of head	0.36 (0.36 to 0.37)	
Length of abdomen	2.24 (2.16 to 2.32)	
Width of abdomen	0.37 (0.34 to 0.41)	

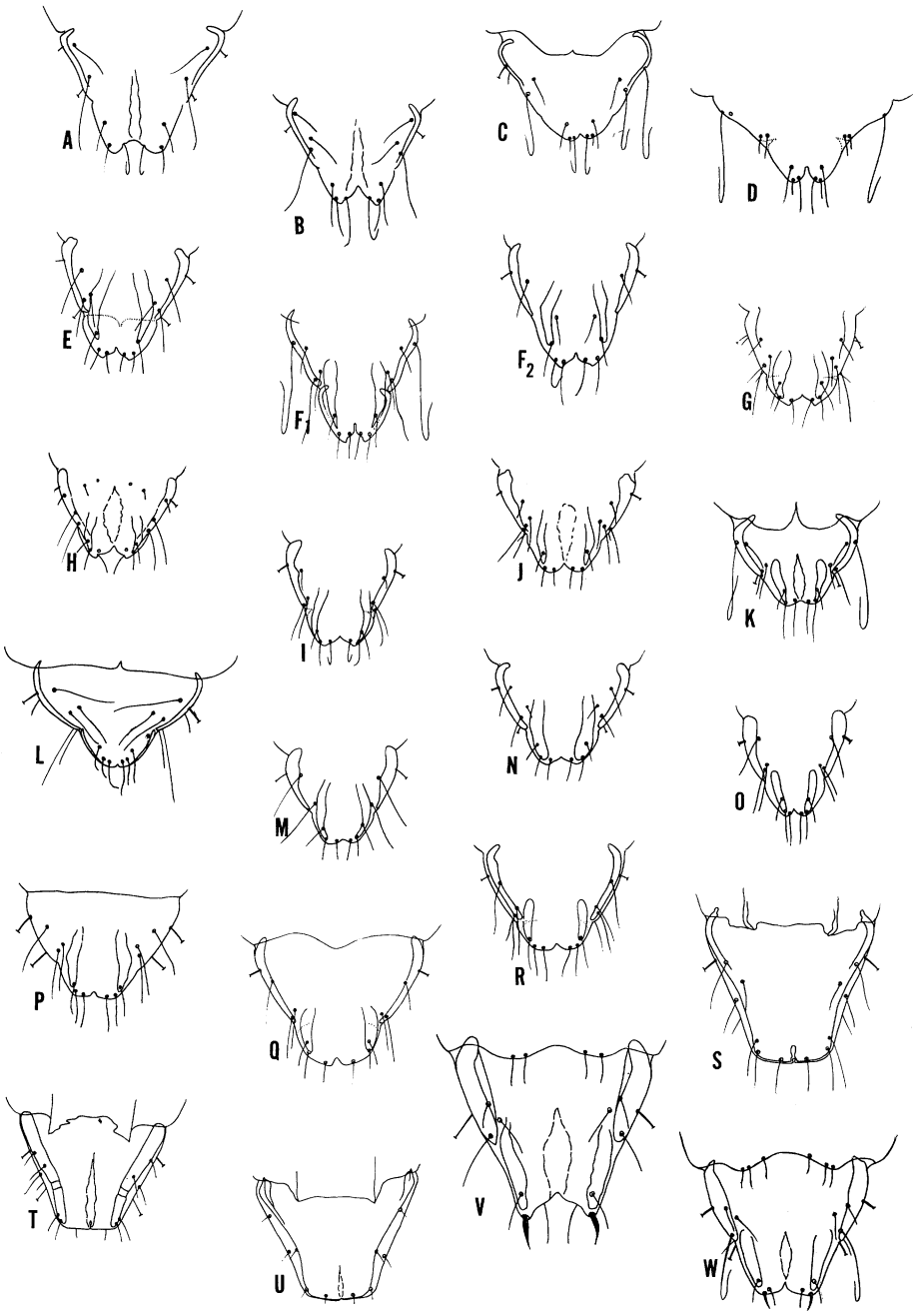

FIGURE 4. Ventral chaetotaxy of female terminal segments. (Labeling same as for figure 3.)

Type-host: Puffinus leucomelas (Temminck).

Material Examined: All from the type-host as follows: Holotype male, allotype female, 1 male and 8 female paratypes, from MCZ skin no. 131515, collected from China Sea between Shanghai and Foochow (RLE); 1 male, 1 female, paratypes, from 3° 10′ S, 155° E, no further data (AMNH) slide); 4 male, 6 female paratypes, from New Guinea, no further data (GBT); 3 male, 6 female paratypes from AMNH skin no. 220603, collected at 3° 10′ S, 155° E (RLE).

Halipeurus (*Halipeurus*) *abnormis* (Piaget)
(Figs. 3–7, C)

Lipeurus abnormis Piaget, 1885, Les Pediculines, sup., pp. 65–66, pl. 7, fig. 2. *Type-host: Puffinus major.*

Esthiopterum abnorme (Piaget). Harrison, 1916, Parasit., **9**, No. 1, p. 129.

Halipeurus abnormis (Piaget). Thompson, 1938, Ann. Mag. Nat. Hist., ser, 11, **2**, p. 482.

Description: A large species, head ratio 1.8, signature squarish; rounded posterior indentation, usually shallow and indistinct. Basal segment of antenna bulbous, second enlarged, distal two segments relatively small; first three segments more or less coalesced into a single tapered unit. Abdomen ratio 4.8, relatively broad, spatulate. Paratergites as in *H. angusticeps* and *fosteri.* Segment 6 about three-fourths as long as 5th. Terminal segments assymmetrical, heavily sclerotized. Paratergites 9, 10, and 11 fused and terminally arced laterad on right, 11th separate on left. Sternite 9 and 10 broad, heavily sclerotized and slightly asymmetrical, pattern typical, slightly distorted. Genitalia also heavily sclerotized, with parameres broadened out basically as in *H. a. fosteri.* Many irregular sclerotizations within or upon aedeagal sac. Female with distinct ventral clypeal bands. Terminal segments short, weakly sclerotized.

Measurements: 7 males, 10 females, averages and ranges in millimeters, from *Puffinus kuhlii edwardsi:*

	Males	*Females*
Total length	4.36 (4.15 to 4.54)	4.97 (4.76 to 5.38)
Length of head	0.89 (0.85 to 0.92)	
Width of head	0.49 (0.46 to 0.51)	
Length of abdomen	2.77 (2.62 to 2.93)	
Width of abdomen	0.58 (0.54 to 0.65)	

Type-host: Puffinus gravis (O'Reilly)

Material Examined: From various subspecies of *Kuhlii* and the type-host as follows:

Puffinus k. kuhlii (Scopoli): 1 male, 1 female, from MCZ skin no. 47230, South Spain (RLE): 3 males, 8 females, from Greece and Spain, (GBT).

Puffinus k. borealis Cory: 8 males, 16 females, from MCZ skin no. 135290, Azores, (RLE).

Puffinus k. edwardsii (Oustalet): 7 males, 16 females from MCZ skin no. 94293, (RLE).

Puffinus k. flavirostris (Gould): 1 male, Cape Seas, (GBT).

Puffinus gravis (O'Reilly): Male (here designated as lectotype) in the Piaget Collection, BMNH slide no. 454. Four male and two female paratypes.

Discussion: This large species is obviously related to *H. a. fosteri* and *H. angusticeps.* It differs, however, in that it has an unusual asymmetrical development of its terminal segment. The parameres are basically the same shape as in the above mentioned species, but are broader, more heavily sclerotized, and overshadowed by the sclerotizations in the aedeagal sac.

Puffinus gravis carries two species of *Halipeurus; abnormis* and *micariproctus* sp. nov. It is unusual for a host to be parasitized by two so closely related species. There seems little doubt, however, that this situation is a true one. It would be interesting to know if any one individual bird has thriving populations of both of these *Halipeurus* species.

Halipeurus (*Halipeurus*) *mirabilis* Thompson
(Figs. 3–7, D)

Halipeurus mirabilis Thompson, 1940, Ann. Mag. Nat. Hist., ser. 11, **5**, pp. 499–502, text figs. 1–5, pl. 10, figs. 1, 2.

Type-host: Puffinus pacificus chlororhynchus Lesson.

Description: Head ratio 2.0. Signature with broadly rounded posterior indentation. Basal

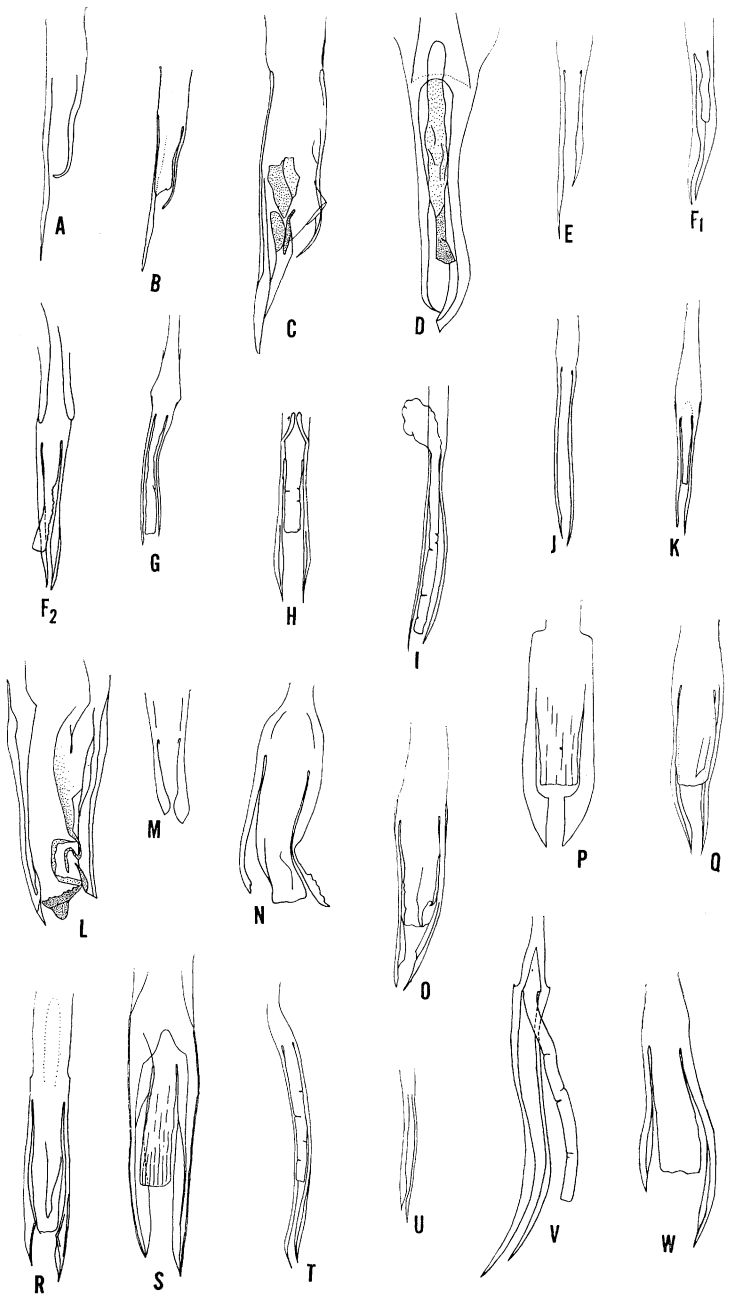

FIGURE 5. Male genitalia. (Labeling same as for figure 3.)

segment of antenna bulbous, second segment only slightly enlarged. Abdomen ratio 5.1, subspatulate. Sixth segment slightly longer than fifth. Paratergites as in *H. angusticeps*. Eleventh segment has heavily sclerotized asymmetrical developments, with knob-like extension on right side. Sternite 9 and 10 narrow, sclerotized, with typical but slightly distorted setal pattern. Genitalia heavily scrclotized, subequal, parameres broad, curved mediad distally.

Measurements: 5 males and 6 females, averages and ranges in millimeters:

	Males	*Females*
Total length	4.50 (4.38 to 4.62)	4.64 (4.62 to 4.70)
Length of head	0.83 (0.82 to 0.85)	
Width of head	0.43 (0.41 to 0.44)	
Length of abdomen	3.04 (2.92 to 3.08)	
Width of abdomen	0.59 (0.58 to 0.64)	

Type-host: Puffinus pacificus chlororhynchus Lesson.

Material examined: 1 male, 2 female paratypes from the type-host, kindly loaned by Mr. G. B. Thompson, the original describer. Other material as follows:

Puffinus pacificus chlororhynchus Lesson: 4 males, 4 females, from AMNH skin collected near Banks Island (RLE).

Puffinus pacificus pacificus (Gmelin): 4 males, 8 females, collected near Sunday, Kermadec Islands (RLE).

Puffinus pacificus cuneatus Salvin: 2 males, 5 females from MCZ skin no. 239641, Oahu, Hawaiian Islands (RLE).

Discussion: The relationship of other species to this one is obscure, although it seems to be related to those previously discussed. It is easily distinguished by the asymmetrical developments of the 11th segment.

Halipeurus (*Halipeurus*) *placodus* sp. nov.
(Figs. 3–7, E)

Description: Like *diversus,* from many hosts and variable. Head ratio 2.1. Signature with shallow medial indentation. Abdomen ratio 5.8, broader relatively than *diversus,* slightly broadened posteriorly. Buttresses with well developed medial processes. Sixth segment less than one-half as long as fifth. Terminal segments similar to *diversus* with less sclerotization of 11th and considerably more of sternite 9 and 10. Setal pattern of sternite 9 and 10 typical, with almost no variation. Parameres of genitalia distinctly subequal, broadened distally with pointed tips. Basal apodeme broad, moderately sclerotized.

Type-host: Puffinus assimilis tunneyi Mathews.

Measurements: Averages and ranges in millimeters of 6 males, 6 females, from type-host:

	Males	*Females*
Total length	3.37 (3.31 to 3.39)	4.08 (4.00 to 4.15)
Length of head	0.69 (0.68 to 0.72)	
Width of head	0.33 (0.32 to 0.34)	
Length of abdomen	2.05 (2.00 to 2.16)	
Width of abdomen	0.35 (0.34 to 0.37)	

Material examined: From the type-host; holotype male, allotype female, 3 male, 5 female paratypes, from MCZ skin no. 166366, West Wallaby Island, Australia, (RLE). From other hosts as follows:

Puffinus assimilis assimilis Gould: 4 males, 7 females from MCZ skin no. 236975, collected near the Herald Islands, South Pacific, (RLE).

Puffinus assimilis kermadecensis Murphy: 10 male, 11 female paratypes collected near Kermadec Islands, (RLE).

Puffinus l'herminieri nugax Mathews: 2 male, 4 female paratypes, from AMNH skin no. 216890, collected near New Hebrides, (RLE).

Puffinus auricularis Townsend: 3 males, stragglers?, MCZ skin from Charion Islands, (RLE).

Discussion: The apparently anomalous distribution of this louse on various host species illustrates the ever-present danger of leaning too heavily on parasitic distribution as a clue to host relationship. This is especially true at the species level of the louse. This species, *placodus,* may be found on three subspecies of *Puffinus assimilis* as well as one subspecies of *P. l'herminieri* and perhaps lends some slight support to Murphy's (1927) division of *assimilis* into two species, *assimilis* and *l'herminieri.*

This species can be readily separated from *diversus* which it superficially resembles by the unequal parameres, the typical setal pattern, the shorter 6th abdominal segment, the more obviously sclerotized sternite 9 and 10 with its distinct posterior margin, and the narrower abdomen. The females may be separated by size differences only.

Halipeurus (*Halipeurus*) *diversus* (Kellogg)
(Figs. 3–7, F)

Lipeurus diversus Kellogg, 1896, New Mallophaga 1, pp. 123–124, pl. 8, figs. 3, 4. *Type-host: Puffinus opisthomelas* Coues.
Lipeurus limitatus Kellogg, as above, pl. 8, figs. 5, 6. Immature of *diversus*. *Type-host: Puffinus griseus* (Gmelin).
Esthiopterum diversum (Kellogg). Harrison, 1916, Parasit., **9**, No. 1, p. 133.
Esthiopterum constrictiventre Pessoa and Guimaraes, 1935, Ann. Fac. Med., Sao Paulo, fasc. 3, **11**, pp. 5–6, figs. 6, 7. *Type-host: Aestrelata macroptera* Smith.
Halipeurus diversus (Kellogg). Thompson, 1938, Ann. Mag. Nat. Hist., ser. 11, **2**, p. 485.

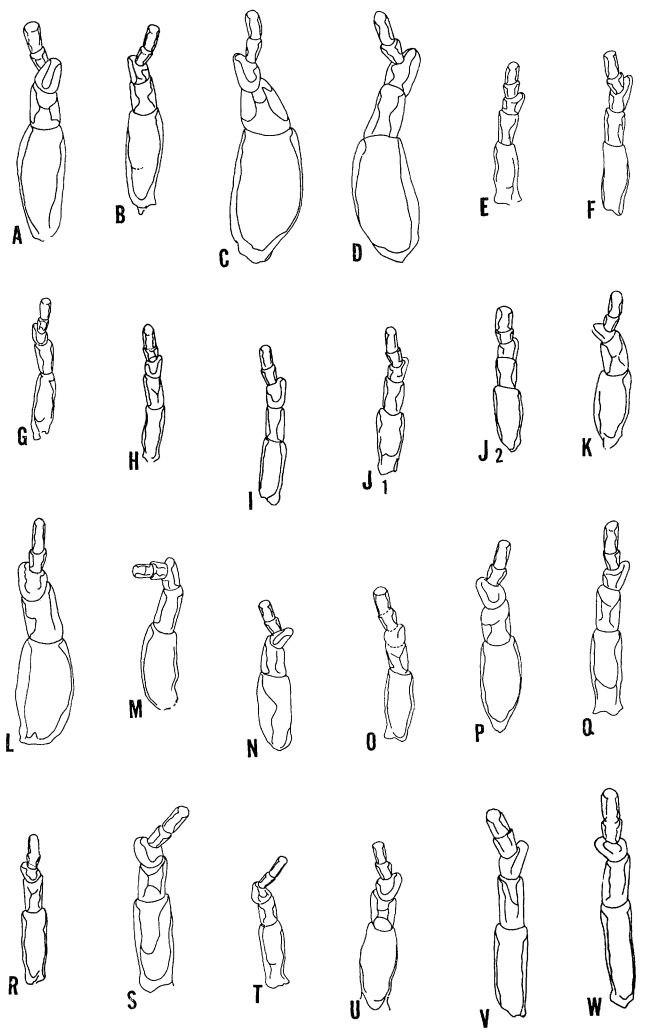

FIGURE 6. Male antennae. (Labeling sames as for figure 3.)

Description: Head ratio 2.0. Signature with well-developed lateral extensions and shallow medial indentation. Basal segment cylindric. Abdomen ratio 6.1, almost straight-sided. Sixth segment one-half or more longer than 5th. All paratergal buttresses with medial processes. Paratergite 9 and 10 relatively long, slender, tapering. Setal pattern of sternite 9 and 10 almost typical, except that setae nos. 1 and (especially) 2 vary in position anteriorly. Seta no. 2 usually displaced further anteriorly, often paralleled by nos. 5 and 6, (specimens from *Puffinus puffinus* subspp. vary the most). Sternite 9 and 10 sufficiently sclerotized so that posterior margin is especially distinct. Parameres long, relatively broad, barely subequal.

Measurements: 10 males and 10 females from *Puffinus griseus,* averages and ranges as follows:

	Males	*Females*
Total length	3.69 (3.53 to 3.84)	4.36 (4.15 to 4.53)
Length of head	0.76 (0.73 to 0.78)	
Width of head	0.38 (0.36 to 0.39)	
Length of abdomen	2.27 (2.15 to 2.31)	
Width of abdomen	0.37 (0.34 to 0.39)	

Type-host: Puffinus griseus (Gmelin), see discussion.

Material examined: Kellogg types, 2 males, 1 female, host labeled as *Puffinus opisthomelas,* Pacific Grove, Calif., slide no. 140b, and types of *Lipeurus limitatus,* similarly labeled, slide no. 140c, kindly loaned me by Dr. G. E. Ferris, Stanford University. Other material as follows:

Puffinus griseus (Gmelin): 13 males, 25 females, off Moki Hinau, New Zealand (RLE); 1 male, 1 female, Depoe Bay, Oregon, H. S. Fuller, collector.

Puffinus tenuirostris (Temminck): 11 males, 10 females, from MCZ skin no. 318119, collected near Kodiak Island, Alaska (RLE); 3 males, 1 female from Bass Straits, New Zealand (RLE).

Puffinus puffinus puffinus (Brunnich): 1 male, 4 females from Mar del Plata, Argentina, (RLE); 15 males, 13 females, from British Isles, (Meinertzhagen); 3 males, 7 females, from British Isles, (GBT).

Puffinus puffinus yelkouan (Acerbi): 4 females, from MCZ skin, collected at Majorca, (RLE).

Puffinus puffinus mauretanicus Lowe: 3 females, from MCZ skin, British Isles, (RLE); 1 female, Balearic Islands, (Meinertzhagen).

Puffinus l'herminieri boydi Mathews: 4 males, 10 females, from AMNH skin no. 527894, Robbos Group, Cape Verde Islands, (RLE); 1 male and 3 females, Cape Verde Island (Meinertzhagen).

Pterodroma macroptera macroptera Smith: 1 male, 1 female compared with type of *Esthiopterum constrictiventre,* collected at Guaruja, S. P., Brazil, kindly sent to me by Dr. Lindolfo Guimaraes. There are almost certainly stragglers, *Halipeurus procellariae* (Fab.) usually parasitizing this host.

Discussion: Kellogg's types of *diversus* are almost certainly stragglers or the result of a mix-up during processing. The type-host, *Puffinus griseus,* was chosen because it harbors this species of louse commonly and because Kellogg assigns the type-host of the nymph, which he described as *Lipeurus limitatus,* as *Puffinus griseus* in the text. This, despite the fact that the type label gives *Puffinus opisthomelas* as the host.

This species ranges almost around the world on its various hosts. Although differences can be seen in populations from each of these species, the range of differences in each precludes the possibility that they have subspeciated to the extent that each host bears lice that have a consistent morphological identity. The lice from *Puffinus l. boydi* (figs. 3 and 5, F-2) range from typical *diversus* to a condition in which sternite 9 and 10 is obviously more heavily sclerotized, while those from *Puffinus p. yelkouan* (figs. 3, 4 and 7, F-3) range from typical *diversus* to specimens having only a minute amount of sclerotization in the terminal segments.. This unusual amount of variation from collection to collection within each host species strongly suggests that changes are presently taking place.

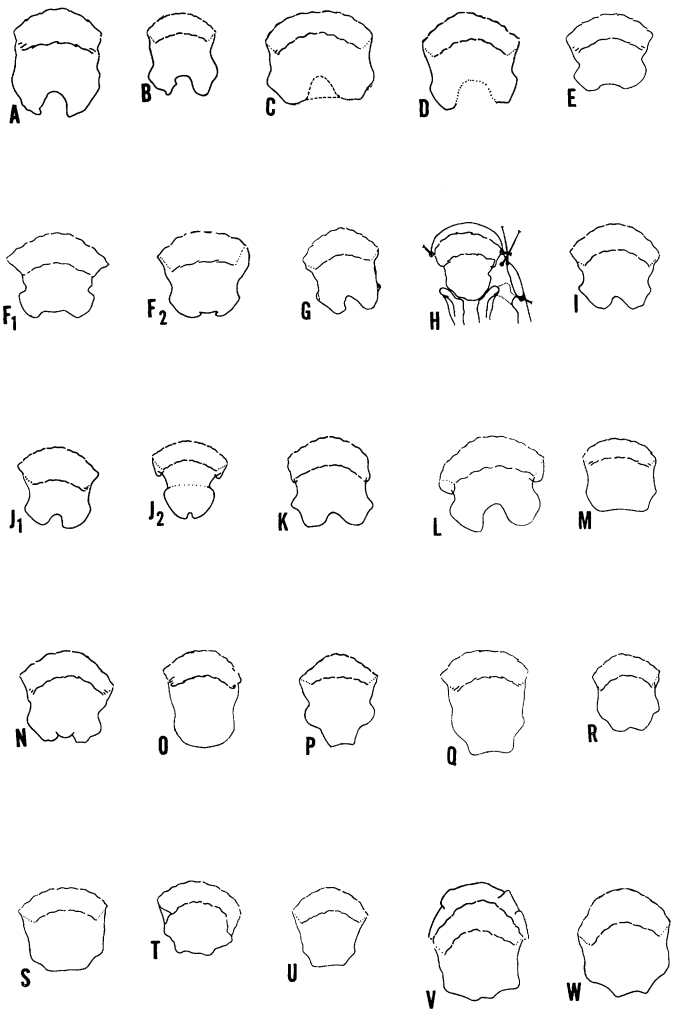

FIGURE 7. Male signatures. (Labeling same as for figure 3.)

Halipeurus (*Halipeurus*) *forficulatus* sp. nov.
(Figs. 3–7, G)

Description: Head ratio 2.3, very narrow. Signature elongated, relatively straight-sided; relatively deep, irregularly rounded medial indentation. Basal segment of antenna cylindric. Abdomen ratio 6.8, narrow and straight-sided. Segments 2 to 8 with well developed medial processes on buttresses. Sixth segment slightly less than one-half as long as 5th. Eleventh segment rounded, no medial division, with distinct apical sclerotizations. Sternite 9 and 10 heavily sclerotized, broadly rounded posteriorly, with lateral margins built up and irregularly scalloped, presenting the appearance of a pair of pincers. Parameres long and slender, barely subequal, with aedeagal sac almost as long as shortest paramere.

Measurements: 10 males, 10 females from all hosts, averages and ranges in millimeters:

	Males	*Females*
Total length	3.36 (3.15 to 3.54)	3.94 (3.85 to 4.00)
Length of head	0.69 (0.65 to 0.71)	

Width of head	0.30 (0.28 to 0.31)
Length of abdomen	2.11 (2.00 to 2.24)
Width of abdomen	0.31 (0.27 to 0.34)

Type-host: *Puffinus l'herminieri polynesiae* Murphy.

Material examined: From the type-host: Holotype male and allotype female, 4 male and 5 female paratypes, from MCZ skin no. 191742, collected near Manoui, (RLE); 3 male, 2 female paratypes, Marquesas Islands, (BMNH).

Puffinus l'herminieri dichrous Finsch and Hartlaub: 3 male, 5 female paratypes, from AMNH skin, collected near Palau, Caroline Islands, (RLE).

Puffinus heinrothi Reichenow: 3 males from AMNH skin no. 230280, New Britain, (RLE). Stragglers?

Discussion: A distinctive louse; the modification of sternite 9 and 10 and the elongate signature serve to separate it from all other species. If the record from *Puffinus heinrothi* is valid, the list of hosts again suggests that geography, with the aid of an unknown agent, sometimes has more to do with the distribution of these lice than the relationships of the hosts.

Halipeurus (*Halipeurus*) *bulweriae* sp. nov.
(Figs. 3–7, H)

Description: A small species, superficially like *Synnautes*. Head ratio 2.4, very narrow. Signature elongated, rounded posterially. With obvious hiatus between postmarginal carina and dorsal carina. Premarginal and postmarginal carinae are virtually fused. Abdomen ratio 6.8, narrow and straight-sided. Buttresses very narrow, with knob-like medial processes developed only on posterior ends. Segment 6 about one-half the length of 5. Parameres long, slender, only slightly sub-equal, curved mediad slightly at tips. Aedeagal sac almost as long as parameres.

Measurements: 5 males, 5 females from the type-host, averages and ranges in millimeters.

	Males	*Females*
Total length	3.30 (3.15 to 3.46)	3.78 (3.70 to 3.85)
Length of head	0.69 (0.67 to 0.72)	
Width of head	0.29 (0.27 to 0.31)	
Length of abdomen	2.13 (2.07 to 2.22)	
Width of abdomen	0.31	

Type-host: *Bulweria bulweria* (Jardine and Selby).

Material examined: Holotype male, allotype female, 2 males, 3 female paratypes, from type host, from MCZ skin collected near Canary Islands, (RLE); 1 male, 2 female paratypes, no data, (GBT); 1 male, 2 female paratypes, Canary and Madeira Islands, (Meinertzhagen).

Halipeurus (*Halipeurus*) *taxosetus* sp. nov.
(Figs. 3–7, I)

Description: Similar to *H. diversus*. Head ratio 2.0. Signature variable, usually slightly elongate compared with *H. diversus,* with pronounced lateral extensions and rounded medial indentation. Basal segment of antenna cylindric. Abdomen ratio 6.2. Buttresses with well developed medial processes. Segment 6 slightly more than one-half as long as 5. Eleventh segment with lightly sclerotized buttress, rounded, with only a slight medial indentation. Sternite 9 and 10 with typical setal pattern, two rows of three closely set, stouter setae laterad of group II. Parameres long and slender, slightly subequal. Female typical.

Measurements: 10 males and 10 females from *Puffinus nativitatis,* averages and ranges in millimeters.

	Males	*Females*
Total length	3.39 (3.31 to 3.54)	3.93 (3.85 to 4.00)
Length of head	0.70 (0.68 to 0.73)	
Width of head	0.34 (0.33 to 0.35)	
Length of abdomen	2.10 (2.00 to 2.16)	
Width of abdomen	0.34 (0.32 to 0.35)	

Type-host: *Puffinus nativitatis* Streets.

Material examined: From the type-host, holotype male, allotype female, 20 male, 27 female paratypes, from Dukie Island, and Christmas Island, collected by R. H. Beck (AMNH); 8 male, 12 female paratypes, from MCZ skins, Laysan Island (RLE).

Puffinus gavia (Forster) (=*P. reinholdi* Mathews): 8 males, 5 females, collected by R. H. Beck at 44 S, 173 W. (AMNH).

Puffinus opisthomelas Coues: 8 males, 8 females, from MCZ skin, Monterey and Santa Monica, Calif., (RLE).

Puffinus l'herminieri l'herminieri Lesson: 9 males, 14 females, from MCZ skin no. 90670, Ginger Island, Bahamas, (RLE), 1 male, 1 female, from the Bahamas, (GBT).

Two males, 2 females, Krusenstern Island, (GBT). Other material as follows:

Puffinus l'herminieri bannermani Mathews and Iredale: 2 males, 2 females, from MCZ skin no. 82908, near North Iwo Jima, Bonin Islands, (RLE).

Puffinus l'herminieri bailloni (Bonaparte): 1 male, from AMNH skin collected at Prustin Island, Seychelles, (RLE).

Puffinus assimilis baroli (Bonaparte): 2 males, 4 females, from MCZ skin no. 42011, collected near Porto Santo, Madeira Islands, (RLE).

Discussion: Closely related to *Halipeurus falsus* Eichler and possibly conspecific with it. I believe that these two species should be left as is, pending further material from *Pelecanoides* and knowledge of these lice in general. It differs in the shape of the parameres, size generally and in length of the parameres. The usually conservative females can be separated instantly on the basis of the shape of the signature. With the above noted exception, it can be instantly separated from all other species on the basis of the two rows of three closely set setae on sternite 9 and 10. The sclerotization of the 11th segment links this species with *Halipeurus thompsoni.*

Halipeurus (*Halipeurus*) *falsus* Eichler

Halipeurus falsus Eichler, 1949, Rev. Brasil. Biol. **9**, No. 3, pp. 338, text figs. 2, 3. Type-host: *Pelecanoides garnotti* (Lesson).

Description: Essentially as *diversus,* but much smaller, less than 2.7 mm in length. Signature with broad but variable lateral expansions. For detailed information, see descriptions of subspecies below.

Type-host: *Pelecanoides garnotti* (Lesson).

Discussion: Eichler's description, beyond the fact that a type-host is designated, is virtually useless, and is based on a single female! It is presumed here that the specimens collected from *Pelecanoides garnotti* are the same as his.

Halipeurus (*Halipeurus*) *falsus falsus* Eichler
(Figs. 3–7, J-1)

Halipeurus falsus Eichler, 1949, Rev. Brasil. Biol. **9**, No. 3, pp. 338, text figs. 2, 3. Type-host: *Pelecanoides garnotti* (Lesson).

Description: Much smaller, but similar generally to *H. taxosetus* sp. nov. Head ratio 2.0. Signature variable, but generally distinctive in that lateral expansions are large and irregular in outline. Medial indentation variable, usually narrow and straight sided. Abdomen ratio 6.0. Buttresses with well-developed medial processes. Buttress 9 and 10 only lightly sclerotized. Sixth segment only slightly more than one-half as long as the 5th. Setal pattern as in *H. taxosetus,* with small variations, especially in two rows of three closely set setae laterad on sternite 9 and 10. Female with signature like that of male.

Measurements: 10 males, 10 females, from the type-host; averages and ranges in millimeters.

	Males	*Females*
Total length	2.90 (2.70 to 2.93)	3.45 (3.32 to 3.70)
Length of head	0.63 (0.60 to 0.66)	
Width of head	0.32 (0.31 to 0.34)	
Length of abdomen	1.80 (1.69 to 1.85)	
Width of abdomen	0.30 (0.27 to 0.32)	

Type-host: Pelecanoides garnotti (Lesson).

Material examined: All from the type-host as follows: Allotype male, 5 other males and 2 females, from MCZ skin no. 82890, Valparaiso, Chile (RLE); 1 male, 2 females, Valparaiso, Chile, (GBT); 13 males, 13 females, Ancon, Peru, (AMNH).

Halipeurus (Halipeurus) falsus pacificus subsp. nov.
(Figs. 3–7, J-2)

Description: Head ratio 1.9. Signature distinctly modified, with hyaline, 'ear-like' processes laterad of lined area, and broadly expanded, lateral expansions which smoothly curve mediad to a small, rounded medial indentation. Basal segment of antenna relatively short and sub-bulbous; distal two segments barely angled. Abdomen ratio 5.2. Sixth segment two-thirds as long as 5th. Female with distinctive signature.

Measurements: 6 males and 16 females from all hosts; averages and ranges in millimeters.

	Males	*Females*
Total length	2.74 (2.62 to 2.77)	3.16 (3.00 to 3.38)
Length of head	0.61 (0.61)	
Width of head	0.32 (0.31 to 0.34)	
Length of abdomen	1.68 (1.61 to 1.69)	
Width of abdomen	0.32 (0.29 to 0.33)	

Type-host: Pelecanoides urinatrix (Gmelin). See discussion.

Material examined: On various hosts as follows:

Pelecanoides urinatrix (Gmelin): Holotype male, allotype female, paratype male, from AMNH skin no. 528725, New Zealand (RLE). 1 damaged male, 1 female from New Zealand (GBT). 1 male, 1 female, paratypes, New Zealand (RLE).

Pelecanoides magellani (Mathews): 2 male, 10 female paratypes, from southern coast of Chile, (AMNH).

Pelecanoides exsul Salvin: 1 male, 3 females, from AMNH skin no. 211800, collected near Channel Island, New Zealand, (RLE). 1 male and 1 female, from New Zealand, (GBT).

Halipeurus (Halipeurus) thompsoni sp. nov.
(Figs. 3–7, K)

Description: Head ratio 2.1. Signature variable in length, with deep, irregularly rounded median indentation. Small 'ear-like' hyaline extensions of lateral margin anteriorly. Basal segment of antenna relatively short, essentially sub-bulbous; 2d segment enlarged, as broad as basal segment. Abdomen ratio 5.1. Buttresses with medial processes developed. Segment 6 about two-thirds the length of 5. Buttress 9 and 10 relatively long and narrow, curving mediad distally. Segment 11 with moderately sclerotized tergite and buttress, not divided apically. Sternite 9 and 10 with heavily sclerotized posterior margin, overlapping 11th segment. Setal pattern modified, group II setae in two parallel rows. Parameres only lightly sclerotized, slender, subequal. Basal apodeme broad, indistinct. Terminal segments of female reduced slightly. Signature like that of *taxosetus*.

Measurements: 8 males and 4 females from type-host; averages and ranges in millimeters.

	Males	*Females*
Total length	3.46 (3.23 to 3.54)	4.02 (3.93 to 4.08)
Length of head	0.78 (0.73 to 0.80)	
Width of head	0.37 (0.34 to 0.37)	
Length of abdomen	2.12 (2.00 to 2.15)	
Width of abdomen	0.41 (0.37 to 0.44)	

Type-host: Puffinus bulleri Salvin.

Material examined: From the type-host, holotype male, allotype female, 24 male, 21 female paratypes, collected at various places along the coast of Chile by R. H. Beck, (AMNH).

Discussion: This species is named for Mr. Gordon B. Thompson, who has kindly supplied me with considerable material.

This species links *Halipeurus taxosetus* with *H. micariproctus* sp. nov. a larger species with extreme reduction and sclerotization of the 11th segment.

It is easily separated from all other species by the sclerotized modifications of the terminal segments.

Halipeurus (Halipeurus) micariproctus sp. nov.
(Figs. 3–7, L)

Description: Large. Head ratio 1.85, broad. Signature with pronounced hyaline 'ear-like' processes anteriorly; median indentation broadly rounded. Posterior margin of lateral expansion occasionally irregularly fused to dorsal carina. Basal segment of antenna bulbous, 2nd segment enlarged. Abdomen ratio 4.6, spatulate. Medial processes broadly rounded where present, buttresses 7 and 8 almost straight medially. Segment 6 only slightly shorter than 5. Distal portion of buttress 9 and 10 strongly curved mediad. 11th segment greatly reduced, although heavily and distinctively sclerotized. Sternite 9 and 10 essentially as in *H. thompsoni,* although more heavily sclerotized and extending almost to apex of abdomen. Genitalia heavily sclerotized, with subequal parameres and a caplike sclerotization distad on the aedeagal sac. Basal apodeme indistinct. Female not larger than male, an unusual condition, and with greatly reduced terminal segments; signature without 'ears'.

Measurements: 8 males, 14 females from the type-host; averages and ranges in millimeters:

	Males	*Females*
Total length	4.98 (4.76 to 5.15)	4.90 (4.76 to 5.15)
Length of head	0.91 (0.88 to 0.95)	
Width of head	0.49 (0.48 to 0.51)	
Length of abdomen	3.32 (3.15 to 3.38)	
Width of abdomen	0.72 (0.65 to 0.78)	

Type-host: Puffinus carneipes Gould.

Material examined: From the type-host, holotype male, allotype female, 6 male and 20 female paratypes, from various places around New Zealand (RLE). From other hosts as follows:

Puffinus creatopus Coues: 6 males, 18 females, from MCZ skins collected at Monterey Bay, Calif., and along Chilean coast, (RLE).

Puffinus gravis (O'Reilly): 12 males and 15 females from AMNH skins, collected along the Argentine coast (RLE); 1 male and 2 females from the South Atlantic, (GBT).

Discussion: This species may be readily separated from all others on the basis of its modified terminal segments. It is most unusual in that the females are not markedly larger than the males.

Halipeurus (Halipeurus) attenuatus sp. nov.
(Figs. 3–7, M)

Description: Head ratio 1.9, broadest above antenna. Signature more-or-less straight-sided, elongated, without a median indentation. Ventral carina indistinct. Basal segment of antenna subcylindric. Abdomen ratio 6.8. All buttresses with only slightly developed medial processes. Segment 6 only one-third the length of 5. Terminal segments elongated, 11th segment with obvious buttress, broadened distally. Sternite 9 and 10 with drawn-out setal pattern. Parameres short, straight and spatulate, subequal. Aedeagal sac almost as long as longest paramere. Female signature squared, as in male; with relatively elongate terminal segment.

Measurements: 7 males, 6 females from the type-host, averages and ranges in millimeters:

	Males	*Females*
Total length	3.52 (3.38 to 3.54)	3.87 (3.85 to 4.00)
Length of head	0.70 (0.68 to 0.73)	
Width of head	0.37 (0.34 to 0.38)	
Length of abdomen	2.18 (2.08 to 2.23)	
Width of abdomen	0.32 (0.29 to 0.34)	

Type-host: Puffinus l'herminieri subalaris Ridgway.

Material examined: Holotype male, allotype female and 3 male, 4 female paratypes, from MCZ skins nos. 112417 and 112418, collected near the Galapagos Islands, from the type-host, (RLE); 5 males, 2 females, paratypes, from type-host, same locality, in Kellogg collection.

Discussion: The type specimens of *Lipeurus diversus* var *major* Kellogg and Kuwana, from the same host, will be discussed under *Halipeurus intermedius* nom.

nov. *H. attenuatus* is closely allied morphologically to *H. mundae* sp. nov., but may be distinguished from it by the shape of the signature and the male genitalia.

Halipeurus (*Halipeurus*) *mundae* sp. nov.
(Figs. 3–7, N)

Description: Unusual louse belonging to *diversus* species group. Head ratio 2.1. Basal segment of antenna almost bulbous. Signature more-or-less typical with indistinct medial indentation. Abdomen ratio 5.4, subspatulate. Medial processes on all buttresses. Sixth segment one-half the length of 5th. Sternite 9 and 10 squared posteriorly, with typical, but slightly drawn out and irregular setal pattern. Parameres short, with spatulate, irregularly margined tips. Aedeagal sac obviously sclerotized, almost as long as longest paramere. Female typical.

Measurements: 2 males, 2 females from the type-host, averages in millimeters:

	Males	*Females*
Total length	3.93	4.08
Length of head	0.78	
Width of head	0.37	
Length of abdomen	2.50	
Width of abdomen	0.46	

Type-host: Puffinus assimilis mundae (Salvin).

Material examined: Holotype male, allotype female, 1 male, 1 female, paratypes, from AMNH skin no. 211652, collected by R. H. Beck and J. G. Correia, at 49° S, 179° W, (RLE). *Puffinus assimilis elegans* Giglioli and Salvadori, 2 females, Inaccessible Island, collected by F. H. I. Elliot, 5 July 50.

Discussion: This species represents an unusual development of the *diversus*-type, with short, modified parameres, and enlarged basal segment of the male antenna.

Halipeurus (*Halipeurus*) *turtur* sp. nov.
(Figs. 3–7, O)

Description: A small species closely related to *H. accentor* sp. nov. Head ratio 2.1. Antenna with cylindric basal segment. Abdomen ratio 5.8, relatively narrow. Buttresses IV–VIII with well developed medial processes. Genitalia broad, with parameres essentially symmetrical, tips broadened, spatulate. Obvious and distinctive sclerotization within aedeagal sac, reminiscent of that found in *H. accentor.* Setae 5 and 6 of group II moved to lateral margin of sternite 9 and 10, leaving 1 to 4 joined by the two setae normally anteriad, forming two closely set rows of three setae each. Female with obvious medial indentation in signature.

Measurements: 2 males, 1 female, averages only in millimeters:

	Males	*Females*
Total length	3.38	4.00
Length of head	0.70	
Width of head	0.34	
Length of abdomen	2.16	
Width of abdomen	0.37	

Type-host: Pachyptila turtur turtur Kuhl.

Material examined: From type-host, holotype male, allotype female, 1 female paratype, from AMNH skin no. 334593, collected by R. H. Beck, 35° S, 175° W, (RLE).

Discussion: A small distinctive species, that, like *H. bulweria,* appears to be derived from a species found typically on *Puffinus* or *Pterodroma.* In this case, it appears that *H. accentor* from *Pterodroma leucoptera* and *cookii* is the most closely related species.

Halipeurus (*Halipeurus*) *procellariae* (Fabricius)
(Figs. 3–7, P)

Pediculus procellariae Fabricius, 1775, (nec *procellariae* Gurlt (1837), nec *procellariae* Leach MS., Denny (1852) both *nomina nuda*), Systema Entomologiae, Flensburg, p. 808.

Type-host: See discussion below. Considered unrecognizable. Thompson, 1938, Ann. Mag. Nat. Hist., ser. 11, **2,** p. 491.

Miss Theresa Clay, working with Mr. G. H. E. Hopkins, is doing a commendable job revising the early literature of Mallophaga and wishes to place *Pediculus procellariae* Fabricius. The description is brief, translated from Latin as follows: "—a filiform, fuscous, pale footed species on a Brazilian procellariform." While description is apt for *Halipeurus,* and since *Esthiopterum constrictiventre* Pessoa and Guimaraes from *Pterodroma macroptera* is synonymous with *H. diversus* (Kellogg), the louse typically found on this host is undescribed. This louse is also commonly found on four species of *Pterodroma,* namely *mollis, incerta, lessoni* and *macroptera,* that range widely over the South Atlantic making it a very likely possibility. No neotypes will be erected.

Description: Another species of the *H. marquesanus* group. Head ratio 1.9, broad, strikingly 'egg-shaped'. Signature elongate with tapering posterior extension. Premarginal carina not interrupting head outline as usual. Ventral carina distinct. Basal segment of antenna subcylindric, 2d segment relatively large. Pterothoracic patch typical. Abdomen ratio 5.9, barely subspatulate. Buttresses relatively large and with well developed medial processes. Sixth segment one-half the length of the 5th. Sternite 9 and 10 heavily sclerotized, with basic 'T' shape, the shaft of the 'T' expanded and bell-shaped, overlapping the 11th segment slightly. Genitalia broad, parameres relatively short, broadened distally and curving medially, symmetrical. Aedeagal sac about two-fifths the length of parameres. Females typical.

Measurements: 10 males, 8 females from *Pterodroma incerta,* averages and ranges in millimeters:

	Males	*Females*
Total length	4.10 (3.69 to 4.45)	4.60 (4.15 to 4.77)
Length of head	0.82 (0.75 to 0.88)	
Width of head	0.43 (0.37 to 0.47)	
Length of abdomen	2.60 (2.46 to 2.85)	
Width of abdomen	0.44 (0.41 to 0.48)	

Type-host: Pterodroma macroptera (Smith).

Material examined: Pterodroma incerta (Schlegel): 11 males, 9 females, collected 36° S, 46° W, no further data (RLE): 2 males and 1 female, (GBT). Other hosts as follows:

Pterodroma lessoni lessoni (Garnot): 2 males, 4 females, collected by R. H. Beck from the Antipodes Islands, New Zealand, (RLE).

Pterodroma lessoni australis (Mathews): 6 males, 3 females, collected by R. H. Beck from the Antipodes Islands, New Zealand; 1 female, same locality, (GBT).

Pterodroma caribbaea Carte: 2 females, from MCZ skin collected at Jamaica, 1879, (RLE).

Pterodroma macroptera (Smith): 1 male and 1 female, no data, (GBT).

Pterodroma macroptera gouldi (Hulton): 2 males and 2 females, New Zealand, (GBT).

Pterodroma macroptera albani Mathews: 5 males and 1 female, Albany, (GBT).

Pterodroma mollis mollis (Gould): 2 males, 2 females from AMNH skin no. 132496, collected at 36° S, 46° W, (RLE).

Halipeurus (Halipeurus) kermadecense (Johnston and Harrison) (Figs. 3–7, Q)

Lipeurus kermadecense Johnston and Harrison, 1912, Tr. & Proc. New Zeal. Inst., **44,** p. 365, fig. 1. Immature. *Type-host: Aestrelata neglecta* Schlegel.

Lipeurus diversus var. *excavatus* Johnston and Harrison, as above, p. 366, fig. 2. *Type-host: Aestrelata neglecta* Schlegel. Adult of *kermadecense.*

Esthiopterum kermadecense (Johnston and Harrison). Harrison, 1916, Parasit., **9,** No. 1, p. 136.

Halipeurus kermadecense (Johnston and Harrison). Thompson, 1938, Ann. Mag. Nat. Hist., ser. 11, **2,** p. 488.

Description: Head ratio 2.1. Signature with medial posterior extension. Well developed ventral carina. Premarginal carina as in *H. procellariae,* narrow and not interrupting outline of head. Antenna relatively long and slender. Abdomen ratio 5.5. Buttresses broad, with well-developed medial processes. Sixth segment about one-half the length of 5th. Terminal segments generally darkened ventrally, but without obvious development seen in closely related *H. procellariae.* Genitalia broad, parameres with spatulate tips, only slightly subequal, not as symmetrical as in procellariae. Tube-like sclerotization within aedeagal sac, obliquely cut distally. Setal pattern typical. Signature of female squarer than in male but with similar outline.

Measurements: 10 males, 10 females from various hosts, averages and ranges in millimeters:

	Males	Females
Total length	3.66 (3.54 to 3.70)	4.36 (4.24 to 4.62)
Length of head	0.77 (0.75 to 0.82)	
Width of head	0.37 (0.34 to 0.39)	
Length of abdomen	2.22 (2.15 to 2.31)	
Width of abdomen	0.40 (0.37 to 0.44)	

Type-host: Pterodroma phillipii Gray.

Material examined: From the type-host: 4 males, 5 females, from MCZ skin no. 82907, Masa Tierra Island, (RLE); 8 males, 3 females, no locality, (GBT). From other hosts as follows:

Pterodroma arminjoniana (Giglioli and Salvadori): 2 males, 2 females, from South Trinidad Island, (Meinertzhagen); 1 male, 2 females, South Trinidad Island, (GBT).

Pterodroma externa externa (Salvin): 2 males, from MCZ skin no. 82905, Masa Tierra Island, (RLE).

Discussion: The classification of the genus *Pterodroma* used by Peters (1931) needs radical revision; it is used here for the sake of uniformity.

The specimens from *P. externa* listed above are probably stragglers, this host normally is infested with *H. intermedius* nom. nov.

H. kermadecense may be separated from *H. procellariae* by virtue of the similar, but distinctly asymmetrical parameres.

Halipeurus (*Halipeurus*) *accentor* sp. nov.
(Figs. 3–7, R)

Description: Head ratio 2.1, relatively narrow. Signature more-or-less typical of *Pterodroma* species, extended posteriorly with slight medial indentation. Barely distinct ventral carina. Pterothoracic setal patch with three closely set setae. Abdomen ratio 6.0, relatively straight sided. Sixth segment about one-half as long as 5th. Sternite 9 and 10 overlapping 11th with rounded posterior border. Sclerotized laterally, superficially resembling *H. forficulatus* sp. nov. Setal pattern typical. Genitalia broad with moderately sclerotized basal apodeme. Parameres subequal, spatulate and pointed, variable depending on orientation within body. Aedeagal sac about three-fourths the length of parameres. Females typical.

Measurements: 8 males, 7 females, from various hosts, averages and ranges in millimeters:

	Males	Females
Total length	3.78 (3.69 to 3.92)	4.15 (3.99 to 4.30)
Length of head	0.72 (0.68 to 0.75)	
Width of head	0.35 (0.34 to 0.37)	
Length of abdomen	2.42 (2.31 to 2.62)	
Width of abdomen	0.40 (0.37 to 0.42)	

Type-host: Pterodroma leucoptera masafuerae Lonnberg.

Material examined: From the type-host, holotype male, allotype female, 7 male and 5 female paratypes, from AMNH skin no. 446141, collected near Masa Tierra Island, Chile, (RLE). Other material as follows:

Pterodroma leucoptera hypoleuca (Salvin): 1 male, 1 female, paratypes, from the Bonin Islands, (GBT).

Pterodroma cookii nigripennis (Rothschild): Paratype female from MCZ skin no. 39895, collected near Kermadec Islands, (RLE); 3 male, 3 female paratypes, Kermadec Islands, (GBT).

Pterdroma cookii difilipianna (Giglioli and Salvatori): 3 paratype males from MCZ skin no. 82092, collected near Masa Tierra Island, (RLE); male and female, 80 miles west Ancon, Peru, (Curran-AMNH).

Halipeurus (*Halipeurus*) *intermedius* nom. nov.
(Figs. 3–7, S)

Lipeurus diversus var. *major* Kellogg and Kuwana, 1902, (nec Piaget, 1880) Proc. Wash. Acad. Sci., 4, p. 477. Type-host: *Puffinus subalaris.*

Halipeurus sp?. Thompson, Ann. Mag. Nat. Hist., ser. 11, **2,** p. 485.

Description: Head ratio 2.1, narrow. Signature squarish, posterior extension narrowed. Premarginal carina barely separated from post-marginal carina. Basal segment of antenna essentially cylindric, but very wide, 2d and 3d segments enlarged relatively. Pterothoracic patch divided. Abdomen ratio 6.2. Buttress with posterior medial processes well developed, more or less pointed. Segment 6 only slightly smaller than 5. Sternite 9 and 10 with faint 'T' shaped sclerotization, slightly overlapping 11. Setal pattern typical but variable. Eleventh segment short and triangular, with narrow buttresslike sclerotization. Genitalla broad with long distinct basal apodeme. Parameres moderately long, broad, sub-equal, with tips pointed and turned mediad slightly. Aedeagal sac about three-fourths length of parameres. Female with terminal segments as in *H. marquesanus* and *postmarquesanus.*

Measurements: 6 males, 5 females from hosts listed:

	Males	*Females*
Total length	4.82 (4.62 to 4.92)	4.94 (4.85 to 5.00)
Length of head	0.81 (0.78 to 0.85)	
Width of head	0.38 (0.38 to 0.41)	
Length of abdomen	3.16 (3.08 to 3.23)	
Width of abdomen	0.51 (0.49 to 0.52)	

Type-host: Pterodroma phaeopygia phaeopygia (Salvin).

Material examined: From the type host, holotype male, allotype female, from AMNH skins collected by R. H. Beck from the Galapagos (RLE); 4 paratype males from MCZ skin no. 65683, Galapagos (RLE); male paratype, Galapagos (GBT).

Pterodroma externa cervicales (Salvin): 2 males paratypes, collected by R. H. Beck near Sunday, Kermadec Islands (AMNH); 3 male, 3 female paratypes, Kermadec Islands (GBT); 3 male, 5 female paratypes, from MCZ skin no. 39893, Kermadec Islands (RLE).

Puffinus subalaris Ridgway: 1 male, 1 female, syntypes of Kellogg and Kuwana's *Lipeurus diversus* var. *major,* (these are, without doubt, stragglers).

Discussion: These species may be separated from the other closely related species, *H. marquesanus* and *postmarquesanus* by the genitalia and chaetotaxy of the male terminal segments.

Halipeurus (*Halipeurus*) *marquesanus* (Ferris)
(Figs. 3–7, T)

Esthiopterum marquesanus Ferris, 1932, Bull. Bishop Mus. Honolulu, **98,** pp. 62–63, figs. 14, 15. *Type-host: Pterodroma rostrata. Halipeurus marquesanus* (Ferris). Thompson, 1938, Ann. Mag. Nat. Hist., ser. 11, **2,** p. 489.

Description: Head ratio 2.1, narrow. Signature relatively short, with prolonged medial portion posteriorly. Pre- and postmarginal carinae more-or-less fused. Dorsal carinae extend to level of mandibles in male, but are much shorter in female. Pterothoracic patch atypical in male, usually in two parts, one part with a single long seta, the other with two setae. Abdomen ratio 7.3, exceptionally narrow, straight-sided. Sixth segment slightly smaller than 5th. Buttresses relatively narrow with only moderately developed medial processes. Sternite 9 and 10 with rectangular extension posteriorly, overlapping segment 11. Setal pattern of group II crowded, slightly distorted, with setae 1 and 2 close set, and 5 and 6 moved anteriorly. Parameres long and slender, with slightly broadened tips. Aedeagal sac about two-thirds as long as parameres. Sternite 9 of female expanded and extended as an obvious loose flap over next segment. Buttresses 9 and 10 and 11 smoothly fused, as same tergites almost are.

Measurements: 5 males and 8 females from the type-host, averages and ranges in millimeters:

	Males	*Females*
Total length	4.00 (3.85 to 4.16)	4.46 (4.15 to 4.62)
Length of head	0.74 (0.71 to 0.75)	
Width of head	0.34 (N.V.)	
Length of abdomen	2.62 (2.62 to 2.69)	
Width of abdomen	0.36 (0.34 to 0.37)	

Type-host: Pterodroma rostrata rostrata (Peale).

Material examined: 1 male, 2 female paratypes kindly loaned by Mr. Gordon B. Thompson;

26 males, 29 females, from MCZ skin no. 166885, from the Society Islands, (RLE), all from type-host.

Halipeurus (Halipeurus) postmarquesanus sp. nov.
(Figs. 3–7, U)

Description: Very close to *H. marquesanus*. Head ratio 2.0. Pre- and postmarginal carinae not fused. Pterothoracic patch variable, usually divided into two groups. Abdomen ratio 6.8, very similar to *H. marquesanus* except for the elongated segment 9 and 10. Group II setae crowded posteriorly. Parameres and basal apodeme forming very long, narrowly 'S' shaped unit. Female with terminal segments like those of *H. marquesanus*.

Measurements: 5 males and 6 females from the type-host, averages and ranges in millimeters:

	Males	*Females*
Total length	3.72 (3.62 to 3.85)	4.30 (4.15 to 4.38)
Length of head	0.68 (0.65 to 0.70)	
Width of head	0.34 (0.32 to 0.35)	
Length of abdomen	2.43 (2.32 to 2.46)	
Width of abdomen	0.36 (0.34 to 0.37)	

Type-host: Pterodroma heraldica (Salvin).

Material examined: Holotype male, allotype female, 3 male, 4 female paratypes, from AMNH skin collected in the South Pacific, (RLE); 1 male and 2 female paratypes, Chesterfield Group, (GBT).

Pterodroma parvirostris (Peale): 1 male, 1 female, no data, (GBT).

Discussion: Readily separated from both *H. marquesanus* and *intermedius* by the distinctly shaped male genitalia.

List of the Species and Subspecies of Halipeurus (Halipeurus) *and Their Hosts*
(* *Type-Host*)

H. angusticeps angusticeps (Piaget)
Host unknown.
H. a. fosteri subsp. nov.
* *Puffinus leucomelas* (Temminck)
H. abnormis (Piaget)
* *Puffinus gravis* (O'Reilly)
Puffinus kuhlii kuhlii (Scopoli)
Puffinus kuhlii borealis Cory
Puffinus kuhlii edwardsi Oustalet
Puffinus kuhlii flavirostris (Gould)
H. mirabilis Thompson
Puffinus pacificus pacificus (Gmelin)
* *Puffinus pacificus chlorohynchus* Lesson
Puffinus pacificus cuneatus Salvin
H. placodus sp. nov.
Puffinus assimilis assimilis Gould
* *Puffinus assimilis tunneyi* Mathews
Puffinus assimilis kermadecensis Murphy
Puffinus l'herminieri nugax Mathews
Puffinus auricularis Townsend
H. diversus (Kellogg)
* *Puffinus griseus* (Gmelin)
Puffinus tenuirostris (Temminck)
Puffinus puffinus puffinus (Brunnich)
Puffinus puffinus yelkouen (Acerbi)
Puffinus puffinus mauretanicus Lowe
H. forficulatis sp. nov.
* *Puffinus l'herminieri polynesiae* Murphy
Puffinus l'herminieri dichrous Finsch and Hartlaub
Puffinus heinrothi Reichenow

H. bulweriae sp. nov.
* *Bulweria bulweria* (Jardine and Selby)
H. taxosetus sp. nov.
* *Puffinus nativitatis* Streets
Puffinus gavia Forster
Puffinus opisthomelas Coues
Puffinus l'herminieri l'herminieri Lesson
Puffinus l'herminieri bannermani Mathews & Iredale
Puffinus l'herminieri bailloni (Bonaparte)
Puffinus assimilis baroli (Bonaparte)
H. falsus falsus Eichler
* *Pelecanoides garnotti* (Lesson)
H. f. pacificus subsp. nov.
* *Pelecanoides urinatrix* (Gmelin)
Pelecanoides magellani (Mathews)
Pelecanoides exsul Salvin
H. thompsoni sp. nov.
* *Puffinus bulleri* Salvin
H. micariproctus sp. nov.
* *Puffinus carneipes* Gould
Puffinus creatopus Coues
Puffinus gravis (O'Reilly)
H. attenuatus sp. nov.
* *Puffinus l'herminieri subalaris* Ridgway
H. mundae sp. nov.
* *Puffinus assimilis munda* (Salvin)
Puffinus assimilis elegans Giglioli and Salvadori
H. turtur sp. nov.
* *Pachyptila turtur turtur* (Kuhl) (Tentative)
H. procellariae (Fabricius)
Pterodroma incerta (Schlegel)
Pterodroma lessoni lessoni (Garnot)
Pterodroma lessoni australis (Mathews)
Pterodroma caribbaea Carte
* *Pterodroma macroptera macroptera* (Smith)
Pterodroma macroptera gouldi (Hutton)
Pterodroma macroptera albani Mathews
Pterodroma mollis mollis (Gould)
Pterodroma inexpectata (Forster)
H. kermadecense (Johnston and Harrison)
* *Pterodroma phillipii* (Gray)
Pterodroma arminjoniana (Giglioli and Salvadori)
Pterodroma externa externa (Salvin)
H. accentor sp. nov.
* *Pterodroma leucoptera masafuerae* Lonnberg
Pterodroma leucoptera hypoleuca (Salvin)
Pterodroma cookii nigripennis (Rothschild)
Pterodroma cookii difilipianna (Giglioli and Salvadori)
H. intermedius nom. nov.
* *Pterodroma phaeopygia phaeopygia* (Salvin)
Pterodroma externa cervicalis (Salvin)
H. marquesanus (Ferris)
* *Pterodroma rostrata rostrata* Peale
H. postmarquesanus sp. nov.
* *Pterodroma heraldica* (Salvin)
Pterodroma parvirostris (Peale)

Subgenus Synnautes *Thompson*

Synnautes Thompson, 1936, Ann. Mag. Nat. Hist., ser. 10, **18,** p. 43. Genotype: *Lipeurus pelagicus* Denny.
Naubates Bedford, *partim.* T. Clay, 1940, Brit. Graham Land Exped., 1911–14, ser. C, **2,** pt. 1, p. 31.

Description: Similar to subgenus *Halipeurus,* differing as follows: Buttresses of abdomen

very narrow, with medial processes limited to small, knob-like enlargements at posterior ends of buttresses. Ventral carina usually heavily sclerotized; dorsal carina typically extending only to mid-point between signature and mandibles (exception *nesofregettae* sp. nov.). Pre- and post-marginal carinae more or less fused; premarginal carina obliquely truncate anteriorly, interrupting outline of head (fig. 6). Female abdomen sharply bifid, always with very stout, short seta terminating each buttress of segment 11. Cuticle obviously scaly, more so than in subgenus *Halipeurus*.

Type of subgenus: Halipeurus (Synnautes) pelagicus (Denny) 1842.

Discussion: The species of subgenus *Synnautes* are limited to birds of the family *Hydrobatidae*. They seem best adapted for living on the back and proximal portions of the wings, as are species of subgenus *Halipeurus*.

The new species herein described is the second, and several more remain to be described. The subgenus has species that reflect many of the variations of subgenus *Halipeurus*, indicating that considerable parallel evolution has taken place between the two subgenera.

Halipeurus (Synnautes) pelagicus (Denny)
(Figs. 3–7, V)

Lipeurus pelagicus Denny, 1842, Mono. Anoplurorum Brit., pp. 173–174, pl. 14, fig. 2. *Type-host: Thalassodroma pelagica* (cf. Thompson, 1937, on the Denny collection).
Lipeurus subangusticeps Piaget, 1880, Les Pediculines, pp. 308–309, pl. 25, fig. 5. *Type-host: Thallassodroma leachi* (from Rotterdam Zoo).
Lipeurus languidus Kellogg and Kuwana, 1902, Proc. Wash. Acad. Sci., **4**, pp. 475–476, pl. 29, fig. 8. *Type-hosts: Oceanodroma tethys* and *Oceanites gracilis.*
Lipeurus exiguus Kellogg and Kuwana, as above, p. 479, pl. 30, fig. 2. Immatures. *Type-host: Oceanites gracilis.*
Esthiopterum pelagicum (Denny). Harrison, 1916, Parasit., **9**, No. 1, p. 139.
Synnautes pelagicus (Denny). Thompson, 1936, Ann. Mag. Nat. Hist., ser. 10, **18**, p. 43. Genotype of genus *Synnautes* Thompson.

Description: As for subgenus, further details as follows: Slender, very dark lice, widely distributed on *Hydrobatidae*. Head ratio 2.2, very slender, with nearly parallel sides. Signature triangular anteriorly, with very broad hyaline border, straight-sided, with tapered posterior extension and small, narrow medial indentation. Thorax with narrow buttresses. Abdomen ratio 5.0, very slender. Tergites evenly sclerotized, with band narrowed slightly only on segments 6, 7, and 8. Buttresses very small, best developed on ends of buttresses of segments 6, 7, and 8. Buttresses 9 and 10 smoothely tapered. Sternite 9 and 10 distinctly sclerotized, with setal pattern similar to that of *H. (Halipeurus) taxosetus,* with slight modification. Parameres long, slender, flattened, and somewhat irregularly curved from specimen to specimen. Female typical of subgenus, with signature very much like that of male.

Measurements: 5 males, 3 females, from *Pelagodroma m. marina,* averages and ranges in millimeters as follows:

	Males	*Females*
Total length	3.52 (3.32 to 3.63)	4.03
Length of head	0.78 (0.75 to 0.82)	0.80
Width of head	0.37 (0.34 to 0.39)	0.45
Length of abdomen	2.14 (2.02 to 2.24)	2.67
Width of abdomen	0.42 (0.37 to 0.44)	0.54

Type-host: Hydrobates pelagicus (Linné).

Material examined: From the type-host, 2 males, 1 female, from MCZ skin no. 235247, Basket Islands, Ireland (RLE). Other material as follows:

Bulweria bulweria (Jardine and Selby) : 2 females, from MCZ skin no. 98117, collected near Madeira Island, (RLE). Stragglers?

Oceanites oceanicus oceanicus (Kuhl) : 2 females, mar del Plata, Argentina, (AMNH).

Oceanites gracilis gracilis (Elliot) : 1 male, 4 females, from AMNH skin no. 206965, collected near Pacas Mayo, Peru, (RLE).

Oceanites gracilis galapagoensis Lowe: 1 female, from Galapagos Islands, (AMNH).

Pelagodroma marina marina (Latham) : 4 males, 3 females, from AMNH skin no. 254335, from Herald Islands, New Zealand, (RLE) ; 5 males, 6 females, from skin in Preparations Department of AMNH, collected at Tristan da Cunha.

Pelagodroma marina maoriana Mathews: 2 females from AMNH skin, no further data, (RLE); 7 males, 6 females, from 37° S–179° W, (AMNH).

Fregetta grallaria grallaria (Vieillot): 2 males, 4 females, from AMNH skin no. 446402, collected near Masa Tierra Island, Chile, (RLE); 8 males, 8 females, from Masa Tierra Island, Chile, (AMNH).

Fregetta grallaria titan Murphy: 1 male, from Rapa Island, (AMNH).

Fregetta tropica melanogaster (Gould): 1 male, 2 females, from AMNH skin no. 212047, 49° S–179° W, (RLE).

Oceanodroma tethys tethys (Bonaparte): 3 males, from AMNH skin no. 196377, 2° S–91° W, (RLE). 3 males, 5 females, from MCZ skin no. 111806, Galapagos Islands, (RLE).

Oceanodroma castro castro (Harcourt): 3 males, 2 females, from MCZ skin no. 300905, from Porto Santo, Madeira, (RLE).

Oceanodroma castro bangsi Nichols: 1 female, Galapagos, (AMNH).

Oceanodroma leucorhoa keadingi Anthony: 1 male, Guadalope Island, (AMNH).

Oceanodroma macrodactyla Bryant: 1 male from AMNH skin, no data, (RLE).

Oceanodroma markhami tristrami Salvin: 1 female, from Hawaiian Islands, (AMNH).

Oceanodroma hornbyi (Gray): 1 male, from 80 miles west of Ancon, Peru, (AMNH).

Oceanodroma furcata (Gmelin): 1 female, from MCZ skin no. 321672, collected near Sitka, Alaska, (RLE).

Halocyptena microsoma Coues: 1 damaged male, from MCZ skin no. 101692, from San Benito Island, (RLE); 1 female from AMNH skin, same locality, (RLE).

Discussion: *Synnautes* species are closely related to the *procellariae* species group of *Halipeurus,* as evidenced by their general structure, sclerotization of terminal segments, shape of head, type of signature and male genitalia.

Synnautes pelagicus is notable in that it may be found on so many different host species. The other two species of *Synnautes* in my collection, *nesofregettae* and one undescribed, are each restricted to one host species.

Halipeurus (*Synnautes*) *nesofregettae* sp. nov.
(Figs. 3–7, W)

Description: Typical *Synnautes* with some features of typical *Halipeurus.* Head ratio 2.2, narrow, with straight-sided lateral margin. No hiatus between pre- and postmarginal carinae. Dorsal carinae extend to level of mandibles and then unite medially. Ventral carina very distinct. Signature squarish, with posterior extension like that of species of *Halipeurus* from *Pterodroma.* Antenna with long cylindric basal and 2d segment. Pterothoracic patch typical. Abdomen ratio 5.0. Buttresses very narrow, with only slight medial processes, restricted to ends of buttresses. Sixth segment three-fourths as long as 5th. Sternite 9 and 10 overlapping most of 11th segment, with irregular, atypical setal pattern. Parameres moderate in length and breadth, distinctly sub-equal.

Measurements: 5 males, 3 females from type-host, averages and ranges in millimeters:

	Males	*Females*
Total length	3.85 (3.77 to 3.93)	4.16 (4.08 to 4.24)
Length of head	0.83 (0.80 to 0.85)	
Width of head	0.37 (0.36 to 0.38)	
Length of abdomen	2.37 (2.31 to 2.46)	
Width of abdomen	0.47 (0.43 to 0.48)	

Type-host: *Nesofregetta albigularis* (Finsch).

Material examined: From the type-host: Holotype male, allotype female, 4 male and 2 female paratypes, from AMNH skin no. 205901, collected at Phoenix, Phoenix Group, (RLE); 1 female, paratype, from New Hebrides, (GBT).

Discussion: This species closely unites the taxonts *Synnautes* and *Halipeurus,* (cf. Clay 1940, pp. 309–310). It resembles *Halipeurus* in that the dorsal carina definitely extends to the level of the mandibles, and in that the pre- and postmarginal carinae are not united. The female, however, has the typical *Synnautes* terminal segments, with the broadened seta apically on each 11th buttress.

SUMMARY

The genus *Halipeurus,* typically parasitizing the shearwaters and petrels, is revised. Twelve new species and two new subspecies are described. All previously described species are redescribed and refigured and, where necessary, lectotypes designated. Host-parasite relationships are discussed.

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RESEARCH NOTE

A SMALL CULTURE DISH AND AN INVERTED DISSECTING MICROSCOPE FOR IN VITRO CULTURE WORK.

Optically superior cell culture chambers of different designs and varying in complexity have been described from time to time. Two recent reports on this subject are those of Cruickshank, Cooper, and Conran (1959, Exp. Cell Res. **16:** 695–698) and Sykes and Moore (1960, Rept. Biol. Med. **18:** 288–297). Fairly comprehensive references on various designs can be obtained from these two papers. Other versions of cell culture chambers not included in the above references were described by Paul (1959) in his book "Cell and Tissue Culture."

In our work on in vitro cultivation of protozoan parasites whether alone or with host tissue, we have developed a small petri dish that has the following features: (1) Small size (0.2 to 0.6 ml medium capacity) for easy scanning of its contents; (2) convenience for changing medium or transferring the cultured organisms; (3) suitability for maintaining a desired gas phase by confining the dishes in a gassed chamber; (4) optical superiority for oil-immersion photomicrography when used with the aid of an inverted compound microscope; (5) resistance to the rigors of acid baths and autoclaving. Only prolonged soaking in detergents seems to affect the integrity of the dish.