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## THE PSOCOPTERA OF THE HAWAIIAN ISLANDS Parts I and II. Introduction and The Nonendemic Fauna<sup>1</sup>

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*Abstract.* Previous work on Hawaiian Psocoptera is summarized, and a key to families is provided. Forty-two species of nonendemic psocopterans, representing 20 genera in 12 families, are treated, and family keys to Hawaiian species are provided. Thirty-three species are known from elsewhere; 13 are tropicopolitan or cosmopolitan, 12 are widespread in the Pacific, and the remainder are predominantly western Pacific and Oriental species. Twenty-nine species occur on more than 1 of the main islands, 8 occurring on all 6 islands. Numbers of species on the islands correspond roughly with the extent of commerce. Forty of the 42 species occur on introduced plants; only 10 have been collected from native forest trees. Twenty-seven species are confined to the lowlands; only 1 is apparently confined to the highlands. The archipelago distribution and ecological distribution of this segment of the psocopteran fauna contrast markedly with the endemic psocopteran fauna.

### PART I. INTRODUCTION

Because of their extreme isolation, the Hawaiian Islands have attracted the attention of entomologists since Perkins's major work (Perkins 1899), and those with an interest in insular evolution had their attention focussed upon this remarkable biota by Zimmerman's (1948a) classic *Introduction* to the *Insects of Hawaii* series. Zimmerman (1948b) provided a most valuable compilation of the then existing knowledge of the Psocoptera of this archipelago and pointed out that the greater part of the psocid fauna, with its immense interest from the point of view of speciation theory, was still largely unknown.

### PREVIOUS STUDIES

McLachlan (1883) described the first psocid from Hawaii, *Elipsocus vinosus*.

Perkins (1899) stated that psocids were richly represented in the islands and dealt with 25 species. He states (p. 35, Neuroptera II):

"Psocidae are richly represented in the islands and twenty-five species are dealt with in the present paper. No doubt many others yet remain to be discovered, indeed other species are certainly included in those collected by me, but owing to their small size and poor state of preservation it was not advisable to attempt the description of the species. Nearly all are subject to much distortion and contraction of the body-segments after drying, as well as discoloration, and owing to the exudation of a sticky substance they are with difficulty relaxed, so as to be suitable for examination. Evidently there are good characters in the

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terminal abdominal segments of the male, but these are not available in dried examples. Many of the species exhibit great variability (in colour, nervuration, etc.), which is so remarkable a feature of so many Hawaiian insects. The difficulties of study in this group are so great from the causes above enumerated, that the present paper on these insects can only be regarded as a preliminary sketch, especially as regards the species referred to the genus *Elipsocus*, in which the instability of nervuration is so great, as to render the discrimination of species almost hopeless, without special attention to the insects in the field. In this preliminary study I have not considered it advisable to enter minutely into the generic question, but have referred all the species to three well-known genera. The solitary species referred to *Stenopsocus* temporarily, is clearly generically distinct therefrom, but only one example, in mutilated condition, was secured. It is very different from any other Hawaiian psocid, and is interesting as having been taken at a high elevation in the mountains, where the nights, even in August, were cold, with hard frosts. Of the other 24 species, 14 are assigned to *Psocus*, most species of which appear to be confined, each one, to a single island, while 10 are placed in the genus *Elipsocus*. Some species of this latter genus are so variable in nervuration, that not only generic, but even characters of superior value, are affected."

Perkins's 10 species placed in *Elipsocus* included McLachlan's species *E. vinosus*.

Enderlein (1913) described 2 new *Ectopsocus* species from Hawaii and transferred Perkins's *Psocus* species to *Clematostigma*, reducing 2 of them to varieties of a single species and providing further records for 3 of them, with additional descriptions of 2. At the same time, this author erected a new elipsocid genus, *Kilauella*, for the species placed in *Elipsocus*, and provided additional records for 2 of them. Later, Enderlein (1920) transferred the species of the family Psocidae back to the genus *Psocus*, reducing them to but 2 species, one with 5, the other with 3 varieties (6 of Perkins's species were reduced to synonyms). In the same paper, Enderlein designated a new genus, *Palistreptus*, for 2 of Perkins's original elipsocid species, which were reduced to varieties of a single species; the remaining 8 elipsocid species were also reduced to a single species with 6 varieties (2 falling as synonyms). Enderlein at the same time described a new species of *Parempheria* from Hawaii. Five years later, Enderlein (1925) designated a new genus of the Psocidae, *Ptycta*, citing one of the Hawaiian Psocidae as the type-species; the other Psocidae species from Hawaii was also placed in this genus.

In 1931 Banks published the results of a study of material originally sent by Perkins and specimens later sent by Williams. This paper added to our knowledge of the nonendemic fauna. Banks erected a new caeciliid genus, *Hageniola*, for a specimen sent by Williams, described new species of *Caecilius* (1), *Ectopsocus* (1), *Psylloneura* (1), and *Echmepteryx* (3), designated a new lepidopsocid genus, *Cyptophania*, for a species found on sugar cane, and reported the occurrence in Hawaii of *Hemipsocus roseus*.

Williams (1932) reported a further 2 immigrant species identified by Banks, *Pso-cathropos lachlani* and *Psoquilla marginepunctata*.

Zimmerman (1948b) summarized previous knowledge of the order, provided new records and information on several species, and recorded *Liposcelis divinatorius* and *Ectopsocus richardsi* from the archipelago. Zimmerman did not accept Enderlein's arrangement of the endemic species of *Kilauella* and *Ptycta*, preferring (rightly in my view) to retain Perkins's original segregates as separate species. Nor did Zimmerman follow Enderlein in transferring the Hawaiian Psocidae to *Ptycta*. Since Zimmerman's

work, there have been no further formal taxonomic studies specifically of Hawaiian Psocoptera, although Chui & Thornton (1972) made a numerical taxonomic study of the relationships of the endemic *Ptycta* complex. At the time of Zimmerman's paper, 40 species were known from Hawaii, 24 of these, in the families Elipsocidae and Psocidae, being endemic.

#### AIM OF THE PRESENT STUDY

Perkins suggested that psocids and Homoptera were probably the original and sole food of endemic species of the hemerobiid genus *Nesomicromus* Perkins. This view was supported by the personal observations of Zimmerman (1957), who also remarked (p. 27), "Psocids are among the most numerous of all insects in our forests." These observations tended to suggest that psocids might be a relatively old component of the fauna, possibly with endemic complexes. The results of a brief period of fieldwork on the islands of Oahu and Hawaii in the summer of 1961 confirmed Zimmerman's belief (1948b) that only a fraction of the Hawaiian psocid fauna was known, and the opinion of Dr D. E. Hardy, Department of Entomology, University of Hawaii, that large endemic complexes of psocids existed on the archipelago (pers. commun.).

The aim of the present study was thus 2-fold: first, to determine the nature of the existing psocid fauna and to describe and classify it; and second, to attempt to uncover interrelationships within this fauna and its relation to that of other areas. Phylogenetic and evolutionary aspects of the endemic complexes, and ecological observations, will be treated in separate works.

#### MATERIAL AND METHODS

Material available for the study includes the collections, primarily pinned specimens, of Bishop Museum, Honolulu (BISHOP), and of the Hawaiian Sugar Planters' Association, Honolulu (HSPA). In addition, Dr E. L. Mockford and the late Mr A. M. Nadler generously provided their considerable alcohol collections of psocids, made in August and September 1957.

Fresh material for study was obtained in 1963, when the author spent 12 months in fieldwork on the 6 high islands. Over 8000 specimens were collected during this period. Four visits were made to Kauai, 2 to Molokai, 1 to Lanai, 5 to Maui and 4 to Hawaii, fieldwork on Oahu being carried out between these visits. Collecting was mainly by beating, although sweeping was resorted to on several occasions. The endemic forms, with a few exceptions, are now restricted to the mountain forests of the islands, being found on the leaves and branches of native forest trees. In many cases these areas are difficult of access, with very high rainfall, and collecting is only possible by staying in an area for several days at a time. The nonendemic species, on the other hand, are predominantly lowland forms, able to exist on the introduced plants of the lower elevations, though 1 or 2 are able to penetrate into the native forests of the mountains. These 2 groups are treated separately in the present work.

More recently, specimens from a program of insect trapping in relation to wind direction by Prof. B. Hocking have been examined.

A preliminary segregation into taxa was made, details of coloration being noted from an examination of fresh material under a stereoscopic microscope. Where possible, at least 5 specimens of each sex were examined in detail, their genitalia being cleared, stained in acid fuchsin, dissected, and mounted in Euparal. The left wings, antenna and left hind leg of each of these specimens were also mounted. The endemic taxa were subjected to further study on return from Hawaii, in order to obtain information on as many characters as possible. A numerical taxonomic study was then carried out on an IBM 1620 computer, using both correlation coefficient and taxonomic distance, in order to provide information about the overall relationships of the taxa of endemic complexes and to cluster them (see e.g., Chui & Thornton 1972). Drawings were made with the use of a microprojector.

Pinned specimens of the loaned collections and those mounted dry on points were floated free in a solution of detergent, which softens them, and then treated in the same way as alcohol preserved and freshly killed specimens.

Visits were made to the Harvard Museum of Comparative Zoology and the British Museum (Natural History), where types of described species were examined and in many cases dissected.

Altogether, some 10,000 specimens of Hawaiian psocids have been examined, about 1000 of these dissected and mounted.

Collectors are acknowledged by name in the text; the following, who are frequently cited, are acknowledged by initials only: J. W. Beardsley (J.W.B.), E. H. Bryan Jr (E.H.B. Jr), D. T. Fullaway (D.T.F.), W. M. Giffard (W.M.G.), D. E. Hardy (D.E.H.), N. L. H. Krauss (N.L.H.K.), E. L. Mockford (E.L.M.), A. M. Nadler (A.M.N.), R. C. L. Perkins (R.C.L.P.), C. Rutschky (C.R.), O. H. Swezey (O.H.S.), R. L. Usinger (R.L.U.), F. X. Williams (F.X.W.), E. C. Zimmerman (E.C.Z.).

Types of new taxa are deposited in the Bishop Museum, Honolulu (BISHOP) and in the Australian Museum, Sydney (AMS), as noted.

#### LIMITATIONS OF THE STUDY

In spite of the large number of specimens available for study and the large increase in number of species known, it is estimated that some 50 or more endemic species have not yet been discovered. Considerable mountain areas of Kauai, parts of the Waianae Range on Oahu, large areas of the central Molokai mountains, the heights of West Maui, Mauna Kea and the Kohala Mts on Hawaii, have all been little visited, and their fauna is still largely unknown. The native flora of Lanai is now almost nonexistent, and many of the endemic insect species of this island are probably already extinct.

On the other hand, almost all the nonendemic species are probably represented in the collections available as a basis for this work. The only ones likely to have been

TABLE 1. Summary of Hawaiian Psocoptera.\*

FAMILIES	GENERA		SPECIES	
	Nonendemic	Endemic	Nonendemic	Endemic
Lepidopsocidae	4	—	10	—
Trogiidae	2	—	3	—
Psoquillidae	1	—	1	—
Psyllipsocidae	2	—	2	—
Liposcelidae	1	—	2	—
Pachytroctidae	1	—	1	—
Caeciliidae	2	—	4	—
Elipsocidae	2**	1	1	165
Lachesillidae	1	—	2	—
Ectopsocidae	2	—	9	—
Peripsocidae	1	—	3	—
Hemipsocidae	1	—	2	—
Pseudocaeciliidae	1	—	2	—
Psocidae	1**	—	—	51
Totals	22	1	42	216

\* Percentage of present day fauna endemic,  $216/258 \times 100 = 84\%$ ; average no. of species per genus = 11.2; average no. of species per genus in endemic group,  $216/3 = 72.0$ ; average no. of species per genus in nonendemic group,  $42/20 = 2.2$ .

\*\* One genus consists of a complex of endemic species.

missed are those which would not have been collected by beating, for example those species inhabiting soil and litter; no berlese work was attempted in 1963. Moreover, no visits were made to the low atolls and coral islands of the leeward group, where a few nonendemic species might be expected to occur.

Many of the endemic species are superficially extremely similar, and a specific allocation of material in the early pinned collections was only possible after removal from the pin, softening, dissecting and mounting. It was impossible to carry out this procedure with every specimen of the considerable dry collections of endemic psocids of BISHOP and HSPA. Nevertheless, samples of these collections were made for dissection, and many specimens allocated to species on this basis. However, considerable numbers of these dry specimens remain unallocated, and it is possible that 1 or 2 undescribed species are still included in these collections.

#### SUMMARY OF THE FAUNA

As a result of this work, the number of psocid species known from Hawaii now stands at 258. These represent 23 genera in 13 families (TABLE 1). Of these 258 species, 216 belong to endemic complexes: 20 species of *Palistreptus* and 145 of *Kilaueella* (endemic Elipsocidae, the latter an endemic genus); and 51 species of *Ptycta* (Psocidae). The remaining 42 species represent 20 genera of 12 families.

Compared to continental islands and less isolated islands and archipelagos (TABLE 2), Hawaii shows a greater average number of species per genus.

TABLE 2. Psocoptera fauna of various islands and island groups.

	GENERA	SPECIES	AVERAGE NO. OF SPECIES/GENUS
Great Britain	35	68	1.9
Taiwan	36	70	1.9
Galapagos	16	32	2.0*
Hong Kong	40	91	2.3
New Zealand	28	64	2.3
Philippines	28	70	2.5
Tonga	14	36	2.6
Japan	47	125	2.7
Micronesia	25	90	3.6
Madagascar	35	168	4.8**
Fiji	17	81	4.8
Hawaiian Is	23	258	11.2***

\* Distinct island subpopulations of 3 species are recognizable.

\*\* Badonnel, in litt.

\*\*\* This figure is 2.2 if only the nonendemic fauna is considered, and 72.0 if only the endemic fauna is considered.

#### KEY TO THE FAMILIES OF HAWAIIAN PSOCOPTERA

This key is designed for use without resorting to dissection. It should be used only for the identification of psocids from Hawaii.

1. Antenna of more than 20 segments, which are never secondarily ringed, adults with 3-segmented tarsi; paraproct with long spine on outer face . . . 2  
 Antenna usually of 13, never more than 17 segments; if more than 13, segments clearly secondarily ringed; adults with 2- or 3-segmented tarsi; paraproct without long spine on outer face . . . . . 5
2. Head short, horizontal; obvious sense seta on inner side of 2nd segment of maxillary palp; apterous, or with veinless wing stumps, or if winged *ax* and *cu*<sub>2</sub> in fore wing do not meet apically; hind tibia and tarsus together much shorter than abdomen; body and wings sometimes with scales . . . 3  
 Head long, vertical; inner side of 2nd maxillary palp segment without sense seta; never apterous, if brachypterous some venation recognizable, if fully winged *ax* and *cu*<sub>2</sub> in fore wing meet apically in nodulus; hind tibia and tarsus together as long as or longer than abdomen; body and wings never with scales . . . . . **Psyllipsocidae**
3. Body and wings not with scales; fore wing rounded apically or lacking . . . 4  
 Body and wings with scales . . . . . **Lepidopsocidae**
4. Fore wings with veins even if brachypterous . . . . . **Psoquillidae**  
 Fore wings as small veinless scales, or lacking . . . . . **Atropidae**
5. Labial palp 1-segmented; flagellar segments, from 5th apically, secondarily ringed; adults with 3-segmented tarsi . . . . . 6

- Labial palp 2-segmented; antenna never with more than 13 segments; adults with 2- or 3-segmented tarsi, if 3-segmented flagellar segments never secondarily ringed ..... 7
6. Body rounded, short; legs long, thin, hind femur not broad and flat; eyes of many facets even if apterous ..... **Pachytroctidae**  
 Body flat dorsoventrally, fairly long; legs very short, hind femur flat, broad; if apterous, eyes composed of but 2–8 ommatidia ..... **Liposcelidae**
7. In fore wing areola postica joined to media by fusion or crossvein; tarsus 2-segmented; always fully winged ..... 8  
 In fore wing areola postica free, or if not, tarsus 3-segmented; sometimes apterous ..... 9
8. In fore wing areola postica connected to media by crossvein; media 2-branched ..... **Hemipsocidae**  
 In fore wing areola postica fused with media for a distance; media 3-branched ..... **Psocidae**
9. In fore wing areola postica absent; in adult, tarsus 2-segmented; sometimes brachypterous ..... 10  
 In fore wing areola postica present; in adult, tarsus 2- or 3-segmented; sometimes brachypterous, but if so tarsus 3-segmented in adult ..... 11
10. Pterostigma more or less rectangular, *rs* and *m* in hind wing joined by crossvein or point fusion, no subapical tooth on claw ..... **Ectopsocidae**  
 Pterostigma broadening subapically, rounded apically, *rs* and *m* of hind wing usually fused for a distance, claw with subapical tooth **Peripsocidae**
11. Tarsus 3-segmented in adult; hind wing with *cu* recurved apically, or brachypterous ..... **Elipsocidae**  
 Tarsus 2-segmented; hind wing with *cu* not recurved; never brachypterous ..... 12
12. Veins and margin of fore wing setose ..... 13  
 Fore wing completely bare ..... **Lachesillidae**
13. Complete margin of hind wing setose; ♀ lack outer valve of gonapophyses ..... **Caeciliidae**  
 Margin of hind wing setose only between ends of branches of *rs*; ♀ gonapophyses complete ..... **Pseudocaeciliidae**

#### ACKNOWLEDGMENTS

This study was begun as the result of a brief collecting trip to the islands of Oahu and Hawaii in the summer of 1961. The small collection resulting from this visit confirmed E. C. Zimmerman's (1948b) prediction that only a fraction of the Hawaiian psocid fauna was known. Zimmerman's classic *Introduction to the Insects of Hawaii* series was the inspiration for the study, which was made possible by the support and interest shown in the project by my colleague Dr D. Elmo Hardy.

During the whole of 1963 I was, by invitation, Visiting Senior Scholar at the Institute of Advanced Projects, Center for Cultural Exchange between East and West, and I am extremely grateful to the United States Government and the authorities of the East West Center, University of Hawaii, for the complete academic freedom which this Senior Scholarship provided, allowing me to make a fairly extensive sample of the psocid fauna of the main islands. The Center also provided funds for a visit to Dr E. L. Mockford, at Normal, Illinois, and to the Museum of Comparative Zoology, Harvard, Massachusetts. I am again indebted to Dr D. E. Hardy for arranging finance through the National Science Foundation, USA, for this journey to be extended to include a visit to the British Museum (Natural History), London. I wish to thank the Curator of Insects, British Museum (Natural History) and the Director of the Harvard Museum of Comparative Zoology for permission to examine, mount, and in some cases dissect type specimens of Pacific and in particular Hawaiian psocids.

Besides the extensive collection which I made during 1963, I also had at my disposal the collections of Hawaiian psocids of the Bishop Museum and the Hawaiian Sugar Planters Association, and it is a pleasure to record my gratitude to the staff of these organizations. Moreover, Dr E. L. Mockford and the late Mr A. M. Nadler, who made extensive collections on several islands in August and September 1957, most generously sent me the whole of their collections, which were fully documented, excellently preserved and of great value to this study. It is indeed a pleasure to acknowledge this cooperation. Prof. B. Hocking also kindly made available psocopterans from his Pacific trapping study of 1969.

During the whole of 1963, Dr D. E. Hardy kindly provided me with laboratory facilities in the Department of Entomology, University of Hawaii, and accompanied me on several field trips. His knowledge of both the local geography and the various habitats found on the islands was of inestimable value. Mr C. J. Davis, then Hawaii State Entomologist, accompanied me on an early visit to Hawaii, and I was able to avail myself of his considerable botanical knowledge. I am also indebted to Mr Noah Pekalo, Game Warden on the Island of Molokai, who acted as guide on numerous expeditions on that island. I was able to join a group of *Drosophila* evolutionists during the summer of 1963 on visits to several islands, and am grateful in particular to Dr L. Throckmorton for several stimulating discussions.

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I gladly acknowledge the assistance given to me by the Chief Ranger, Hawaiian National Parks, by granting permission to collect within the parks themselves.

Finally, I am grateful to Dr E. C. Zimmerman for generously providing original figures from Volume 2, *Insects of Hawaii*, and to Dr D. E. Hardy for sending specimens that he collected since my departure from the islands.

## PART II. THE NONENDEMIC FAUNA

Zimmerman (1948b) listed 16 species as "adventive," these being placed in 12 genera, representing 8 families. In this section, 42 nonendemic species are reported upon, these being placed in 20 genera, representing 13 families; of these, 3 are newly described, and further descriptions are provided for several others. The distribution of all these species, both within the Hawaiian Archipelago and elsewhere, is listed as fully as possible.

Zimmerman (1948a) pointed out that *native* insects, i.e., those occurring in Hawaii naturally, without man's purposeful or accidental intervention, may be either *endemic* (peculiar to the archipelago) or *indigenous* (occurring also elsewhere). He further suggested that *foreign* insects, i.e., those whose presence in Hawaii is solely due to man's activities, may be designated either as *immigrant* (accidentally brought by man) or *purposely introduced*. These terms will be used in Zimmerman's sense throughout the present work.

Zimmerman clearly delineates the characteristics of the endemic Hawaiian insects, characteristics which are all shown by the 2 large Hawaiian psocid complexes; these are thus regarded as endemic complexes and treated in detail in the later sections of this work.

## EXTRA-HAWAIIAN DISTRIBUTION

None of the Hawaiian psocids has been purposely introduced. However, it is sometimes difficult to decide whether a nonendemic species is an immigrant or is indigenous. Evidence of extra-Hawaiian distribution, habitat, range in the Hawaiian Archipelago, host plants, and frequency of capture in the aerial plankton, however, often makes it possible to arrive at a reasonable guess as to whether the species was accidentally introduced or arrived by natural means.

In the over-sea trapping program of the Bishop Museum, 6 of the nonendemic Hawaiian psocid species have been captured, 2 of these on 2 occasions, 1 on 3 occasions, and 1 on 4 occasions. However, in the case of those species known to be particularly associated with man's dwellings, such evidence must be carefully weighed, taking into account the position and type of trap in which the insect was captured (see Thornton 1964a, and Thornton & Harrell 1965). Almost half (20) of the species occur on 3 or more of the main islands, and of the 13 occurring on only 1 island, 8 are from Oahu.

Ten of the species considered here are known to be associated in one way or another with man's dwellings and activities, and these were probably introduced accidentally to the archipelago by man. Six species are found on sugar cane, the principal crop of Hawaii, some commonly so; it is possible that these were introduced into the archipelago with the crop, and also should therefore be regarded as accidental immigrants.

TABLE 3. Summary of nonendemic Hawaiian fauna.

	MAIN ISLANDS						ELSEWHERE
	Kauai	Oahu	Molo- kai	La- nai	Maui	Hawaii	
<b>Lepidopsocidae</b>							
<i>Lepidopsocus marmoratus</i> (Banks)	X	X			X	X	Southern Marianas, Fiji, Tonga
<i>L. aureus</i> , n. sp.	X	X			X	X	
<i>L. fasciatus</i> Thornton	X	X			X	X	Fiji
<i>L. maculatus</i> Thornton, Lee & Chui	X	X	X	X	X	X	Southern Marianas, Fiji, Galapagos
<i>L. magnus</i> , n. sp.					X	X	
<i>Echmepteryx</i> ( <i>Thylacopsis</i> ) <i>madagascariensis</i> (Kolbe)	X	X		X	X	X	Tropicopolitan
<i>E.</i> ( <i>Thylacopsis</i> ) <i>lunulata</i> Thornton, Lee & Chui		X			X	X	Diego Garcia, southern Marianas, Carolines, Fiji, Tonga, Galapagos
<i>E. unicolor</i> Banks		X					
<i>Cytophania hirsuta</i> Banks	X	X	X	X	X	X	Laysan, Fiji
<i>Lepolepis pictus</i> , n. sp.	X	X	X		X	X	Laysan
<b>Trogiidae</b>							
<i>Cerobasis guesfalica</i> (Kolbe)	X	X	X	X	X	X	Europe, Hong Kong, Australia, North and South America
<i>C. annulata</i> (Hagen)*						X	Lisiansky; widespread
<i>Lepmotus reticulatus</i> End.*	X						Kure, Australs; widespread
<b>Psoquillidae</b>							
<i>Psoquilla marginepunctata</i> Hagen*	X	X					Widespread
<b>Psyllipsocidae</b>							
<i>Psocathropos lachlani</i> Rib.*		X					Africa, Europe
<i>Psyllipsocus</i> ( <i>Parempheria</i> ) <i>minutissimus</i> (End.)*		X					Taiwan
<b>Liposcelidae</b>							
<i>Liposcelis</i> sp. 1*		X			X		
<i>L.</i> sp. 2		X			X		
<b>Pachytroctidae</b>							
<i>Tapinella formosana</i> End.**	X	X		X	X		India, Taiwan, southern Marianas
<b>Caeciliidae</b>							
<i>Hagenioli solitary</i> Banks		X					
<i>Caecilius analis</i> Banks	X	X	X	X	X	X	Southern Marianas, Carolines, Marshalls, Marquesas, Samoa, Malaya, Hong Kong
<i>C. casarum</i> Bad.**		X			X		Mozambique, Hong Kong, Micronesia, New Guinea, Fiji, Samoa, Easter, Neo- tropics (coastal)
<i>C. badiostigma</i> Ok.	X	X			X	X	Japan

TABLE 3. Continued.

	MAIN ISLANDS						ELSEWHERE
	Kauai	Oahu	Molo- kai	La- nai	Maui	Hawaii	
<b>Elipsocidae</b>							
<i>Protopsocus pulchripennis</i> (Perkins)					X	X	Southern Hemisphere, widespread
<b>Lachesillidae</b>							
<i>Lachesilla nubilis</i> (Aaron)		X					North America
<i>L. pedicularia</i> (L.)**		X					Cosmopolitan
<b>Peripsocidae</b>							
<i>Peripsocus nitens</i> W. & T.	X	X			X	X	New Zealand, Chile, Robinson Crusoe I
<i>P. ferrugineus</i> W. & T.	X	X	X	X	X	X	Fiji, Samoa, Carolines, Marianas
<i>P. similis</i> End.	X	X	X		X	X	Singapore, Hong Kong, Fiji, Tonga
<b>Ectopsocidae</b>							
<i>Ectopsocopsis cryptomeriae</i> (End.)*						X	Widespread E & W of Pacific, southern Marianas
<i>Ectopsocus fullawayi</i> End.**	X	X	X	X	X	X	Laysan; widespread Pacific
<i>E. hawaiiensis</i> End.		X					? dubious species
<i>E. maindroni</i> Bad.*	X	X					Widespread
<i>E. spilotus</i> W. & T.						X	Fiji, Tonga, Samoa, Marshalls, Gilberts
<i>E. meridionalis</i> Rib.			X			X	Widespread
<i>E. ornatooides</i> W. & T.		X					Fiji, Samoa, Carolines, Marianas, Marshalls, Bonins, Volcanos
<i>E. perkinsi</i> Banks		X				X	Kure, Midway, Nihoa, Fiji, Tonga, Samoa, Tubuai
<i>E. richardsi</i> (Pearman)*		X			X	X	Widespread
<b>Hemipsocidae</b>							
<i>Hemipsocus chloroticus</i> (Hagen)						X	Oriental Region, Japan, Amami Is, Micronesia
<i>H. roseus</i> (Hagen)**		X		X	X		Widespread
<b>Pseudocaeciliidae</b>							
<i>Pseudocaecilius criniger</i> (Perkins)**	X	X	X	X	X	X	Widespread
<i>Lobocaecilius monicus</i> L. & T.	X	X	X	X	X	X	Possibly endemic

\* Household or stored products species.

\*\* Also possibly carried by commerce.

Over  $\frac{3}{4}$  (33) of the nonendemic species are known from elsewhere (TABLE 3). The remaining 9 species, several of which are recently or newly discovered, and 2 of which are of doubtful validity, are not regarded as true endemics; their wide archipelago distribution, wide host range, lowland habitat, and lack of numbers of related forms in Hawaii all suggest that they may subsequently be found elsewhere.

Of the 33 species for which an extra-Hawaiian distribution is known, 13 are tropicopolitan or cosmopolitan; 12 are widespread in the Pacific, including, for example, Fiji; 2 occur in the Pacific only to the west of the Hawaiian Islands, their eastern limit, apart from Hawaii, being Micronesia. Six species occur in the Oriental Region, 1 in Japan, 1 in Chile and New Zealand, 1 in North America, and 1 has a wide Southern Hemisphere distribution. Thus, apart from those species with a world-wide distribution, the nonendemic Hawaiian fauna is predominantly western Pacific and Oriental, or widespread Pacific.

#### ARCHIPELAGO DISTRIBUTION

Of the 42 nonendemic species, 29 occur on more than 1 of the main islands, 8 occurring on all 6 main islands. All but 5 of the 13 species which are confined, so far as is known, to a single island, are recorded from Oahu, the island on which Honolulu is situated, and which is the most intensively collected. Six species occur on 1 or more of the low Northwestern Hawaiian Islands in addition to the high islands of the main group.

This archipelago distribution contrasts markedly with the restricted distribution of the endemic forms, most of which are confined to single high islands of the main group.

The insular numbers of nonendemic species on the high islands of the archipelago (Oahu 34, Hawaii 28, Maui 23, Kauai 19, Molokai 13, Lanai 10) correspond roughly with the extent of commerce, and are unrelated to area, elevation, or isolation of the islands. Again this contrasts with the insular numbers of the endemic species, which are most closely correlated with isolation.

Only 10 of the 42 species considered here are found on native forest trees, and of these 8 also occur on introduced plants. The 2 species for which there are no records on introduced plants are rare. The majority (27) of the nonendemics is confined to the lowlands, and an additional species is found at high elevations only on introduced plantation trees. Only a single species is apparently confined to the highlands. This ecological distribution is in contrast to that of the endemic complexes, the majority of endemic species being confined to the high native forests.

In the following treatment the classification used is that of Badonnel (1951), except that, following Roesler (1952), the families Ectopsocidae and Peripsocidae are recognized.

#### Family LEPIDOPSOCIDAE Pearman, 1936

*Characteristics.* Fore wing lacking nodulus, pterostigma not thickened, areola postica long, *cu* short before bifurcation; vein *m* in hind wing 2-branched; wings, body and legs usually covered with scales; antennae with more than 20 segments, not ringed; tarsi 3-segmented; maxillary palp with peglike sensillum on mesial surface of 2nd segment; paraproct with strong apical spine.

The genera in this family are not well defined. I have followed Roesler (1944) in placing the following species.

The following key is designed for insects which have been collected in alcohol and lost most of their scales. However, wherever possible, lepidopsocids should also be collected dry.

KEY TO THE SPECIES OF LEPIDOPSOCIDAE FOUND IN HAWAII

1. Hind wings well developed ..... 2  
Hind wings aborted ..... 9
2. In fore wing  $r$  fused with  $rs$  for a distance; radius basal to pterostigma reduced ..... *Lepidopsocus* ... 3  
In fore wing  $r$  joined to  $rs$  by a crossvein or free; radius developed up to pterostigma ..... *Echmepteryx* ... 8
3. Front of head unpatterned; fore wing membrane concolorous ..... 4  
Front of head patterned; fore wing membrane patterned ..... 5
4. Head with very dense shaggy clothing of scales ..... **Lepidopsocus unicolor**  
Head less densely clothed; eyes greenish gold ..... **Lepidopsocus aureus**
5. Two continuous dark stripes over vertex, frons, and clypeus .....  
..... **Lepidopsocus fasciatus**  
Marks on vertex not continuous with those on frons and clypeus ..... 6
6. Vertex marks distinctly wedge-shaped; forewing membrane extensively pigmented, with hyaline marginal and apical areas ... **Lepidopsocus maculatus**  
Vertex marks not as above; pigment on fore wing membrane largely confined to middle of wing ..... 7
7. Vertex marks distinct, rounded spots; fore wing pigment as a fairly regular rounded mark ..... **Lepidopsocus marmoratus**  
Vertex marks indistinct, short; fore wing pigment as an irregular but distinctly emarginate central mark ..... **Lepidopsocus magnus**
8. Head markings only as narrow stripes from orbit to antennal socket; fore wing membrane with broad longitudinal brown fascia;  $r_1$  free from  $rs$  ..... **Echmepteryx (Thylacopsis) madagascariensis**  
Head with narrow crescentic mark anterior to ocelli in addition to antennal-orbital stripe; dark thoracic pleural stripe; fore wing membrane hyaline;  $r_1$  joined to  $rs$  by a crossvein ..... **Echmepteryx (Thylacopsis) lunulata**
9. Fore wings horny, meeting in a straight median line, elytralike, with mottled pattern on membrane; no complex pattern on vertex . **Cytophania hirsuta**  
Fore wings short, scalelike, uniform in color; complex pattern on vertex ..... **Lepolepis pictus**

Genus **Lepidopsocus** Enderlein

*Lepidopsocus* Enderlein, 1903a: 328.

**Lepidopsocus marmoratus** (Banks)

*Echmepteryx marmorata* Banks, 1931: 439.—Williams, 1931: 371.—Krauss, 1945: 310.

*Lepidopsocus marmoratus* (Banks): Zimmerman, 1948b: 225.—Thornton 1981a: 21.  
For full synonymy see Thornton et al. (1972: 70).

*Distribution.* KAUAI, OAHU, MAUI, HAWAII, accidental or natural introduction; frequent. The species also occurs in the southern Marianas and Fiji.

*L. marmoratus* was found together with *L. maculatus* and *L. fasciatus* at Waihee, Maui. It is apparently confined to the lowlands. Zimmerman recorded it from Oahu and Maui, and cited as hosts tomato, *Acacia koa*, *Albizzia*, *Coprosma*, *Erythrina*, *Euphorbia* and *Plumeria*.

*Hawaiian records since those reported by Zimmerman.* KAUAI: Napali Coast cliffs, 165 m (500 ft), nr Haena, *Metrosideros*, 12.IV.1963; Kalalau Val, below 100 m (300 ft), *Psidium guajava* and beach vegetation, 29.30.XI.1963. OAHU: University of Hawaii, 7.IX.1957, A.M.N.; Oahu Country Club, 14.IX.1957, A.M.N.; Waimanalo, *Acerola glabra*, *Macadamia*, 6-8.V.1963, *Macadamia*, 12.XI.1963. MAUI: Kaiku, *Araucaria excelsa*, 13.V.1963; Waihee, *Prosopis chilensis*, 20.IX.1963. HAWAII: Kailua, Kona, 18.IX.1957, A.M.N.

This species will probably be found eventually also on Molokai and Lanai.

### ***Lepidopsocus aureus* Thornton, new species**

FIG. 1-5

♀. *Coloration* (freshly killed, in alcohol). Head, mesothoracic terga and abdomen creamy yellow, rest of insect including wings pale yellow, except eyes greenish gold, turning black with storage. *Morphology*. I.O.:D = 3.0:1 [the ratio of the interocular distance to the eye diameter, as measured by Pearman's method (see Ball 1943)]; epicranial and frontal sutures not obvious. Head sparsely setose. Mesothoracic terga waxy. Basal hind tarsal segments with 17 ctenidiobothria, claw untoothed, Pearman's organ present. Fore and hind wings pointed, venation as in FIG. 1 and 2, scales lost. Scales on underside of abdomen symmetrical, of 2 types (FIG. 4). Epiproct simple, hind margin rounded, sparsely setose. Paraproct simple, posterior spine slightly curved, 6 trichobothria. Subgenital plate simple. Gonapophyses (FIG. 3), reduced, but vestige of ventral valve recognizable. Spermatheca (FIG. 5). Body length (in alcohol): 1.45-2.00 mm (10 specimens: average 1.74 mm).

♂. Unknown.

*Distribution.* KAUAI, OAHU, MAUI, HAWAII, accidental introduction or natural immigrant; frequent.

Zimmerman states (1948b: 225), "Swezey and I have each collected a specimen of a beautiful yellow-gold species which has yet not been identified. It will run to *unicolor* in the key, but its colour, wing venation and less densely hairy head will serve to distinguish it." I believe this is the species to which Zimmerman is referring. It probably occurs on all the high islands. No males of this species were taken in 1963, although altogether over 50 females were collected. It is thus probable that the species is parthenogenetic. It has been collected in April, May, June, September, November and December.

Holotype ♂, OAHU: Waimanalo Experimental Station, 8.V.1963, on *Acerola glabra*, I.W.B. Thornton (BISHOP 12,085). 20 ♀ paratypes, same data as holotype. Holotype, 10 ♀ paratypes in BISHOP; 10 ♀ paratypes in AMS.

*Other Hawaiian records.* KAUAI: Kalalau Val, sea level to 67 m (200 ft), *Psidium guajava*, *Eugenia cumini*, 30.XI.1963. OAHU: Manoa Val, *Hibiscus*, 25.XI.1931, O.H.S.; Honolulu, dead coconut fronds,

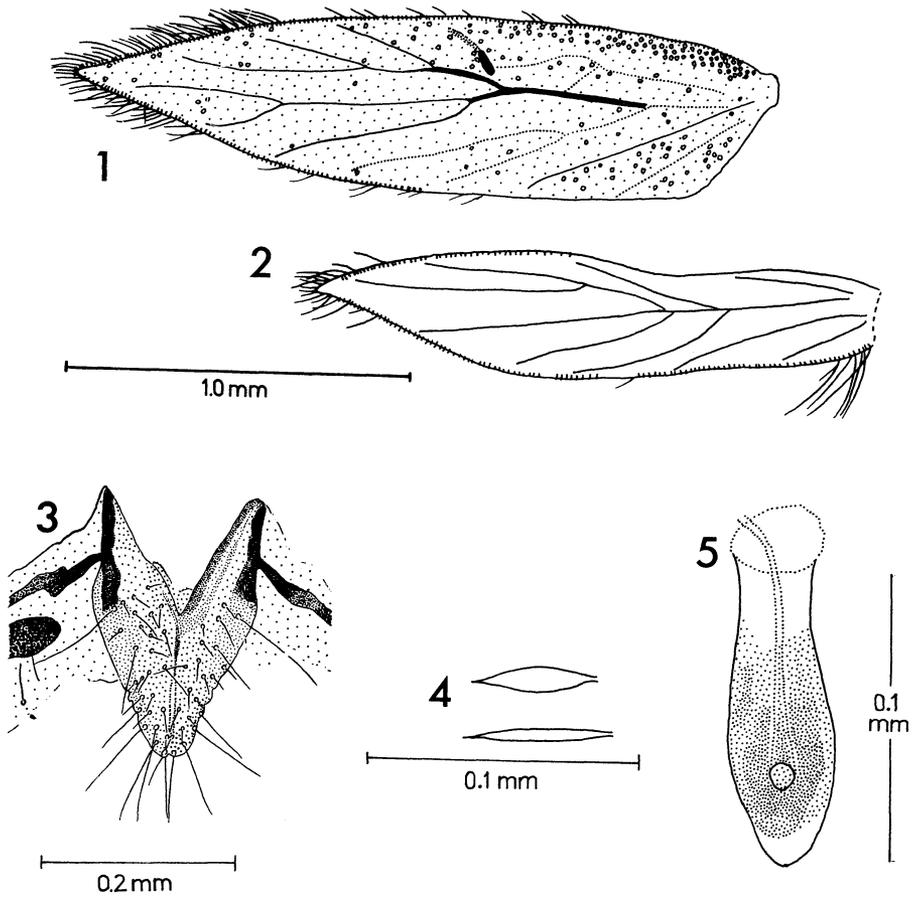


FIG. 1-5. *Lepidopsocus aureus*: 1, fore wing; 2, hind wing, with scales removed; 3, gonapophyses; 4, abdominal scales; 5, spermathecal sheath. FIG. 1 and 2 to common scale.

28.IV.1943, E.C.Z.; Waimanalo, *Macadamia ternifolia*, 6-8.V.1963. MAUI: Kapaniwai Park, 19.IX.1957, A.M.N. HAWAII: 400 m (1200 ft), above Captain Cook, dead fronds of *Cibotium*, 28.VI.1963; Honokohau, 6.IX.1957, E.L.M., 19.IX.1957, A.M.N.

### ***Lepidopsocus fasciatus* Thornton**

*Lepidopsocus fasciatus* Thornton, 1981a: 15; 1981b: 109.

**Distribution.** KAUAI, OAHU, MAUI, HAWAII, possibly accidentally introduced; frequent. The species also occurs in Fiji and Tonga.

There are 2 forms of this species, differing in the extent of pigmentation on the head, wings and abdomen. A few intermediates are found, and both forms occur together on the same trees. Were it not for the intermediate forms, and the fact that all nymphs are of 1 type, these 2 forms might be considered separate species. Males have not been collected.

*Hawaiian records.* KAUAI: Kalalau Val, 100 m (300 ft), *Psidium guajava*, 30.IX.1963. OAHU: Waikane, 28.VIII.1957, E.L.M.; 29.VIII.1957, A.M.N.; 9.IX.1957, E.L.M.; upper Palolo Val, 14.VIII.1957, E.L.M.; Oahu Country Club, 14.IX.1957, A.M.N. MAUI: Waihee, *Prosopis chilensis*, 20.IX.1963. HAWAII: Honokohau, 19.IX.1957, A.M.N.; 6.IX.1957, E.L.M.; S Kona Agric. Exp. Stn, *Macadamia*, 28.VI.1963.

### **Lepidopsocus maculatus** Thornton, Lee & Chui, 1972

*Lepidopsocus maculatus* Thornton et al., 1972: 68-70.—Thornton & Woo, 1973: 8-9.—Thornton, 1981a: 17; 1981b: 111.

*Distribution.* KAUAI, OAHU, MOLOKAI, LANAI, MAUI, HAWAII, possibly natural immigrant, more likely accidentally introduced; common. The species is also recorded from the southern Marianas, Fiji, Tonga, and the Galapagos.

This is the commonest Hawaiian lepidopsocid, indeed one of the commonest psocids, and occurs in all months of the year in the lowlands, on a wide variety of host plants. Nevertheless, some "preference" is evident. On the Napali Coast, Kauai, although 92 specimens were beaten from *Metrosideros*, only 1 was collected from adjacent *Pandanus odoratissimus*. The highest altitude at which the species is recorded is 1150 m (3500 ft) in the Kohala foothills, Hawaii, but this is exceptional. All specimens taken were females; this species is evidently parthenogenetic in Hawaii.

*Hawaiian records.* KAUAI: Haena, 1.I.1944, N.H.L.K.; Kihue [prob. Lihue], 11.I.1944, N.H.L.K.; Hanapepe Val, *Dodonaea viscosa*, 11.IV.1963; cliffs nr Haena, 100 m (300 ft), *Metrosideros* and *Pandanus odoratissimus*, 12.IV.1963; Spouting Horn beach, Koloa, *Euphorbia*, 13.IV.1963; Kokee Road, 700-850 m (2100-2600 ft), *Acacia koa*, 29.VII.1963; Kalalau Val, 100 m (300 ft), *Aleurites moluccanus*, *Psidium guajava*, *Eugenia cumini*, 29,30.XI.1963. OAHU: Malamalama, *Coprosma*, 8.X.1916, O.H.S.; Manoa, tomato, 14.XII.1930, O.H.S.; Manoa Val, 28.XII.1930, O.H.S.; Manoa, *Acacia koa*, 4.I.1932, O.H.S.; Honolulu, Pacific Heights, 21.V.1932, O.H.S.; Kamokunui Val, *Erythrina*, 1.X.1933, O.H.S.; Mt Tantalus, *Euphorbia*, 20.V.1934, O.H.S.; Koko Crater, *Gossypium tomentosum*, XII.1939, E.C.Z.; Makua Val, 339 m (1000 ft), 22.II.1940, E.C.Z.; Mt Tantalus, 8.III.1940, E.C.Z.; Honolulu, on old pod of *Ipomoea tuberosa*, 7.III.1944, O.H.S.; Honolulu, rotten *Plumeria*, 7.IV.1944, O.H.S.; Manoa Val, in house on screen, 9.II.1947, O.H.S.; upper Palolo Val, 14.VIII.1957, E.L.M.; Nuuanu Pali, 13.VIII.1957, E.L.M.; Waianae Range, Pali Kea, 15.VIII.1957, E.L.M.; nr Waikane, 28.VIII.1957, E.L.M.; Waikane, 7.IX.1957, E.L.M.; University of Hawaii, 7.IX.1957, A.M.N.; Honolulu, Woodlawn, 8.IX.1957, A.M.N.; Oahu Country Club, 14.IX.1957, A.M.N.; Moanalua Golf Course, 15.IX.1957, A.M.N.; Maunawili, 300 m (900 ft), 5.X.1957, W.M.G.; Aiea Heights, *Metrosideros*, *Acacia koa*, *Araucaria*, 21.VIII.1961; Pupukea ridge trail, *Metrosideros*, 19.II.1963; Mt Tantalus, 590 m (1800 ft), *Acacia koa*, 22.II.1963; Mt Kaala, 590 m (1800 ft), *Metrosideros*, 14.III.1963; Waimanalo, *Macadamia* and *Acerola glabra*, 6-8.V.1963; University of Hawaii, 19.VI.1963; Mt Tantalus, *Araucaria*, 20.VI.1963; Waipahu Heights, *Casuarina*, 11.XI.1963; Mt Kaala, 590 m and 980 m (1800 and 3000 ft), *Metrosideros*, 29.XII.1963; Pupukea, 480 m (1500 ft), *Metrosideros*, dead leaves, *Acacia koa*, *Eucalyptus*, 30.XII.1963. MOLOKAI: Kainalu, 650 m (2000 ft), ferns, 22.VII.1920, E.H.B. Jr; Dunbar's pasture, 650 m (2000 ft), *Metrosideros*, 9.IV.1963; above Kamiloloa, 820 m (2500 ft), *Acacia koa*, *Eucalyptus*, *Myoporum*, *Diospyros*, *Dodonaea*, 19.VII.1963. LANAI: Kapana, *Cyathodes*, 27.XI.1916, W.M.G.; Lanai City, 22.IX.1957, A.M.N. MAUI: Kipahulu, 6.VII.1920, E.H.B. Jr; Mahena, *Acacia koa*, 12.X.1926, O.H.S.; Hana, 8.VI.1943, N.H.L.K.; Iao Val, 490 m (1500 ft), *Metrosideros*, *Psidium guajava*, 13.V.1963; Haiku, *Araucaria*, *Casuarina*, 13.V.1963; Upper Iao Val, below Puu Kukui, *Aleurites molluccana*, *Cheirodendron*, 17.IX.1963. HAWAII: Kahuku Kau, 16.I.1917, W.M.G.; Pahoa, 490-650 m (1500-2000 ft), 30.VIII.1957, E.L.M.; Hilo Country Club, 30.VIII.1957, A.M.N.; Honokohau, Kona, 6.IX.1957, A.M.N.; Honokohau, 19.IX.1957, A.M.N.; Hilo, *Araucaria*, 6.IX.1961; Kawaihae Uka, 1150 m (3500 ft), *Acacia koaia*, 29.I.1963; Halepula, N Kona, 650 m (2000 ft), *Diospyros* with lichen, 29.I.1963; Halepula, 27.VI.1963; above Captain Cook, *Cibotium*, 28.IV.1963; S Kona, Agric. Exp. Stn, *Macadamia*, *Acerola glabra*, 28.VI.1963.

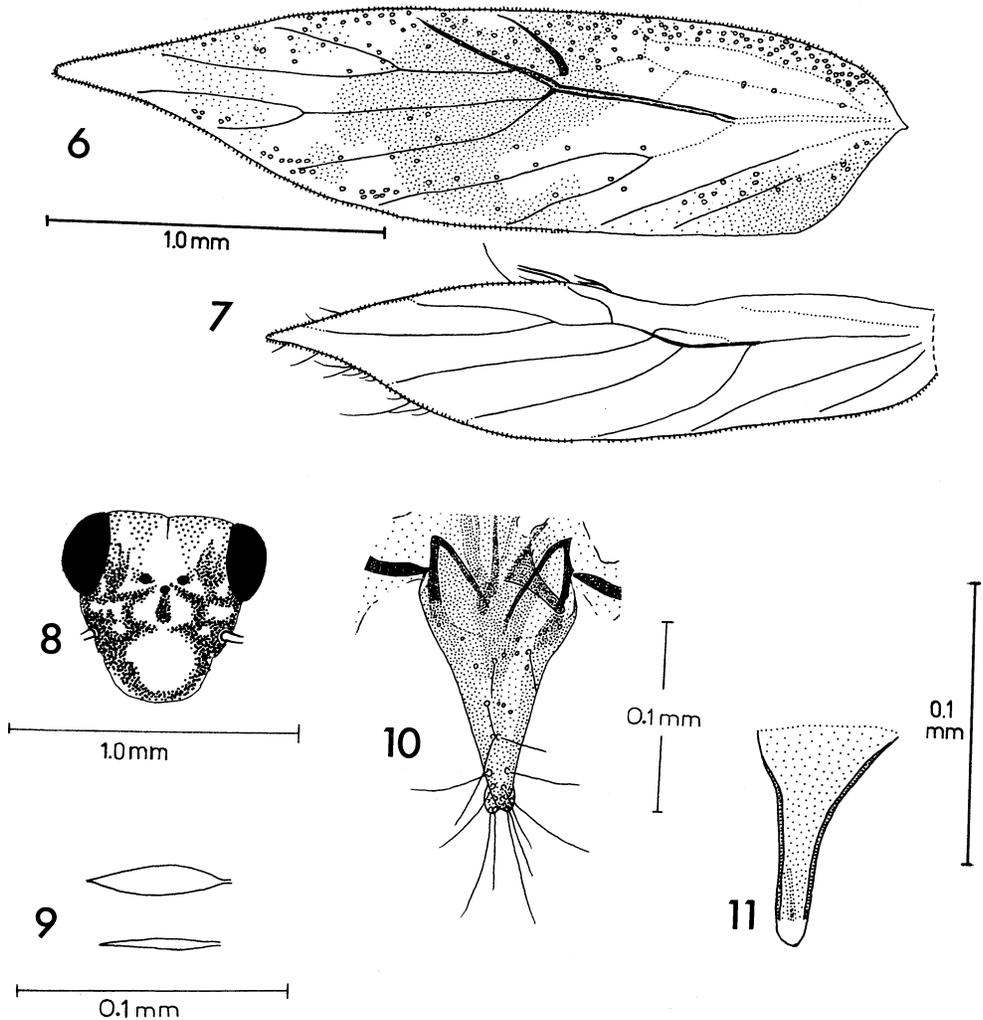


FIG. 6-11. *Lepidopsocus magnus*: 6, fore wing; 7, hind wing, with scales removed; 8, head pattern; 9, abdominal scales; 10, gonapophyses; 11, spermathecal sheath. FIG. 6 and 7 to common scale.

***Lepidopsocus magnus* Thornton, new species**

FIG. 6-11

♀. *Coloration* (freshly killed, in alcohol). Head buff, pattern from in front as in FIG. 8. Genae pale cream with a distinct diagonal band running from upper posterior margin to antennal socket. Eyes black, ocelli pale with dark brown inner borders. Maxillary palps pale, apical segment gray-brown at apex, antenna with scape and pedicel marked with dark gray-brown, flagellum brown. Thoracic terga brown, pleura dark gray-brown. Legs pale cream, markings as *L. maculatus*, hind coxa as others, pale cream. Fore wing membrane marking (FIG. 6), hind wing hyaline. Abdomen cream, transverse gray-brown bands dorsally, these fading medially. *Morphology*. I.O.:D. = 5.0:1. Thoracic terga waxy. Basal hind tarsal segment with 24 ctenidiobothria, claws with small subapical tooth, Pearman's organ present. Venation of wings as

in FIG. 6 & 7. Scales on ventral surface of abdomen symmetrical, of various shapes (FIG. 9). Paraproct simple, rounded, epiproct with 6 trichobothria. Subgenital plate simple, setose; gonapophyses as usual for the genus (FIG. 10), opening of spermatheca funnel-shaped (FIG. 11). Body length (in alcohol): 2.5 mm.  $\delta$ . Unknown.

Nymphs recognizable on head pattern.

*Distribution.* MAUI, HAWAII, possibly accidentally introduced; occasional.

This large species, with distinctive fore wing membrane markings, differs from *L. marmoratus* and *L. maculatus* in head pattern. It has only been taken in the lowlands, on introduced plants. No males have yet been taken.

The fore wing shows faint traces of a complete *sc*, *r*, and a crossvein between *r* and *rs+m*. Moreover, in the hind wing there is an enclosed cell on *rs+m*, and vein *r* arises distal to *m*<sub>1</sub>. Thus features of *Soa* End. are present, although the antennae possess more than 40 segments and the fore wing has stout macrotrichiae on the veins and membrane besides the costal area—features of the Lepidopsocinae—and the wing is decidedly pointed. Following Roesler's key, the species runs to *Lepidopsocus*, although the venation of hind and fore wings are unusual for this genus. The whole family Lepidopsocidae is in need of revision, and for the present the species is placed in *Lepidopsocus*. It is closely similar to another large species, *L. major* Thornton, from Fiji.

Holotype ♀, HAWAII: S Kona Agric. Stn, 28.VI.1963, on *Macadamia*, I.W.B. Thornton (BISHOP 12,086). 10 ♀ paratypes, same data as holotype. Holotype, 5 paratypes in BISHOP; 5 paratypes in AMS.

*Other Hawaiian records.* MAUI: Haiku, *Casuarina*, 13.V.1963. HAWAII: Honokohau, Kona, 6.IX.1957, E.L.M.; Kailua, Kona, 18.IX.1957, A.M.N.; Honokohau, 19.IX.1957, A.M.N.; S Kona Agric. Stn, *Acerola glabra*, 28.VI.1963.

### Genus *Echmepteryx* Aaron

*Echmepteryx* Aaron, 1886: 17.

In Hawaii species of this genus have the stalk of *rs* in the fore wing decidedly longer than *r*<sub>4+5</sub> and are thus placed in the subgenus *Thylacopsis* (see Enderlein 1911; Roesler 1944).

#### *Echmepteryx* (*Thylacopsis*) *madagascariensis* (Kolbe)

*Thylax madagascariensis* Kolbe, 1885: 184.—Enderlein, 1908a: 255.

For synonymy see Thornton & Woo (1973) and Thornton (1981a, 1981b).

*Distribution.* KAUAI, OAHU, MOLOKAI, MAUI, HAWAII, accidental introduction, possibly on sugar cane; common in the lowlands. This is a very widespread species, with a range including West Africa, Madagascar, the Seychelles, Diego Garcia, Hong Kong, Marianas, Bonins, Australia, Kermadecs, Fiji, Tonga, Galapagos, Chile, Jamaica and possibly eastern Central America, and northeastern South America. In Hawaii, it is found predominantly in ephemeral habitats; this is often correlated in psocids with good powers of dispersal and a very wide range.

*Hawaiian records.* KAUAI: Lihue, dead dried leaves, 31.VII.1963, N.H.L.K. OAHU: Oahu Sugar Company, III.1905; Ewa, 18.III.1914; Honolulu, 15.I.1918, F.X.W.; H.S.P.A. Exp. Stn, sugar cane, XI.1929, F.X.W.; Honolulu, H.S.P.A. Exp. Stn, sugar cane, 11.XII.1929, F.X.W.; Honolulu, in laboratory, 19.IV.1934, O.H.S.; Manoa Val, in book, 14.III.1939, O.H.S.; Honolulu, dead coconut fronds, 28.IV.1943, E.C.Z.; Honolulu, 15.V.1943, E.C.Z.; University of Hawaii, 17.IX.1957, A.M.N.; Moanalua Golf Course, 15.IX.1957, A.M.N.; Waimanalo, birds nest in *Macadamia*, 4.XI.1963. MOLOKAI: Airport, dead *Pandanus* leaves, 19.VII.1963. MAUI: Lahaina, sugar cane, 15.V.1963. HAWAII: Hilo, 12.IV.1944, N.H.L.K.; Wai-mea, 5.IX.1957, 17.IX.1957, A.M.N.; Honokohau, 19.IX.1957, A.M.N.; S Watershed Reserve, 15.IX.1957, E.L.M.; Kailua, 18.IX.1957, A.M.N.; Kukuiahaele, fallen rice bird nest in cane field, 21.XI.1962, G. E. Haas; above Captain Cook, 400 m (1200 ft), dead fronds *Cibotium*, 28.VI.1963.

### ***Echmepteryx unicolor* Banks**

*Echmepteryx unicolor* Banks, 1931: 439.

*Lepidopsocus unicolor* (Banks): Zimmerman, 1948b: 225.

*Distribution.* OAHU, probably accidental introduction; rare.

This species, described from Honolulu by Banks, has not been found since. I have examined Type 16404 in the Harvard Museum of Comparative Zoology. The fore wing color is uniform, but this is due to an even admixture of brown and golden scales. The venation of the hind wing shows that  $r_1$  and  $cu$  meet the main vein together. Scales were not removed from the fore wing, but the faint distal section of  $r_1$  in the hind wing is a feature of species of *Echmepteryx* occurring in Micronesia.

### ***Echmepteryx (Thylacopsis) lunulata* Thornton, Lee & Chui**

*Echmepteryx (Thylacopsis) lunulata* Thornton et al., 1972: 64–66.

For synonymy see Thornton (1981a).

*Distribution.* OAHU, MAUI, HAWAII, accidentally introduced or natural immigrant; occasional. The species is known also in the Pacific from the Marianas, Carolines, Fiji, Tonga, and the Galapagos Is, and from Diego Garcia in the Indian Ocean. It has been taken in Hawaii only in the lowlands, on introduced plants.

*Hawaiian records.* OAHU: Nuuanu, Oahu Country Club, 14.IX.1957, A.M.N.; Waikane, 7.IX.1957, E.L.M.; Manoa Val, 11.VIII.1957, E.L.M. MAUI: Waihee, *Prosopis chilensis*, 20.IX.1963. HAWAII: Honokohau, 19.IX.1957, A.M.N.; Hilo, *Araucaria*, 6.IX.1961.

### **Genus *Cyptophania* Banks**

*Cyptophania* Banks, 1931: 440.

*Ptenocorium* Enderlein, 1931: 223.

*Pteroxaniella* Karny, 1932: 122.

*Pteroxaniella* was synonymized with this genus by Roesler (1944). I have examined the type of *P. bifurcata* Karny, the type-species of *Pteroxaniella*, in the British Museum (Natural History) and am satisfied that it can be regarded as congeneric with the Hawaiian species. Roesler placed *Ptenocorium* (Seychelles) as a subgenus of *Cyptophania*, but the grounds for such a subdivision appear to be slight.

### **Cyrtophania hirsuta** Banks

*Cyrtophania hirsuta* Banks, 1931: 440.—Zimmerman, 1948a: 123, 225.—Butler, 1961: 381.—Thornton, 1981a: 4.

*Distribution.* LAYSAN, KAUAI, OAHU, MOLOKAI, LANAI, MAUI, HAWAII, accidental or possibly natural immigrant; common. *C. hirsuta* has also been recorded from Fiji.

It has been collected in Hawaii in all months except October, from ephemeral habitats.

This differs from the other described species, *C. marginata* Thornton, Lee & Chui (Micronesia, Fiji), *C. bifurcata* (Karny) (Samoa) and *C. alutacium* (End.) (Seychelles) in wing pigmentation and details of venation.

*Hawaiian records.* LAYSAN: Wedge-tailed Shearwater and Laysan Albatross nests, 9.XII.1963, N. Wilson; "abundant in duff under *Casuarina*" (Butler 1961). OAHU: Kaimuki, 13.XII.1926, O.H.S.; Waimano, *Cibotium*, 24.I.1926, O.H.S.; Mt Kaala, dead *Sideroxylon*, 11.XI.1925; Honolulu, sugar cane trash, XII.1929, F.X.W.; H.S.P.A. Exp. Stn, sugar cane, 19.XII.1929, F.X.W.; Mt Tantalus, 650 m (2000 ft), old fern stele, 1.I.1930, F.X.W.; Moanalua, 30.XI.1930, O.H.S.; Koko Head, 27.XI.1930, O.H.S.; Haleauau, *Cibotium*, 3.I.1932, O.H.S.; Pacific Heights, 21.V.1932, O.H.S.; Mt Tantalus, *Acacia koa*, 10.III.1935, O.H.S.; Mt Tantalus, 23.VI.1935, R.L.U.; Honolulu, 28.XII.1939, E.C.Z.; Mt Tantalus, 19.III.1940, E.C.Z.; Manoa Val, dead *Pandanus* leaf, 4.II.1944, O.H.S.; Waikane, 7.IX.1957, E.L.M.; Mt Tantalus, 17.VIII.1937, E.L.M.; Nuuanu Pali, 13.VIII.1957, E.L.M.; Honolulu, sugar cane (Butler 1961); Pupukea, 500 m (1500 ft), 30.XII.1963. KAUAI: Hanahanapuni, nr Kapaia, 20.I.1944, N.L.H.K.; south side Sleeping Giant, 150 m (450 ft), *Psidium guajava*, 13.IV.1963. MOLOKAI: N ridge, Halawa Val, nr Kepookoholoaa, dead fronds *Cibotium*, 16.VII.1963. LANAI: Lanai City, 22.IX.1957, A.M.N. MAUI: Kepaniwai Park, 16.IX.1957, A.M.N. HAWAII: Waipio, 27.IV.1944, N.H.L.K.; Hilo, Saddle Road, 500 m (1500 ft), 24.VIII.1957, E.L.M.; Hukuihaele, 320 m (960 ft), fallen rice bird nest in cane field, 21.XI.1962, G.E. Haas.

### Genus **Lepolepis** Enderlein

*Lepolepis* Enderlein, 1906c: 112.

Only 3 species of this genus have so far been reported: *L. ceylonica* Enderlein, from Ceylon and Taiwan; *L. occidentalis* Mockford, from eastern North America; and *L. bicolor* Broadhead, from England (in warehouse).

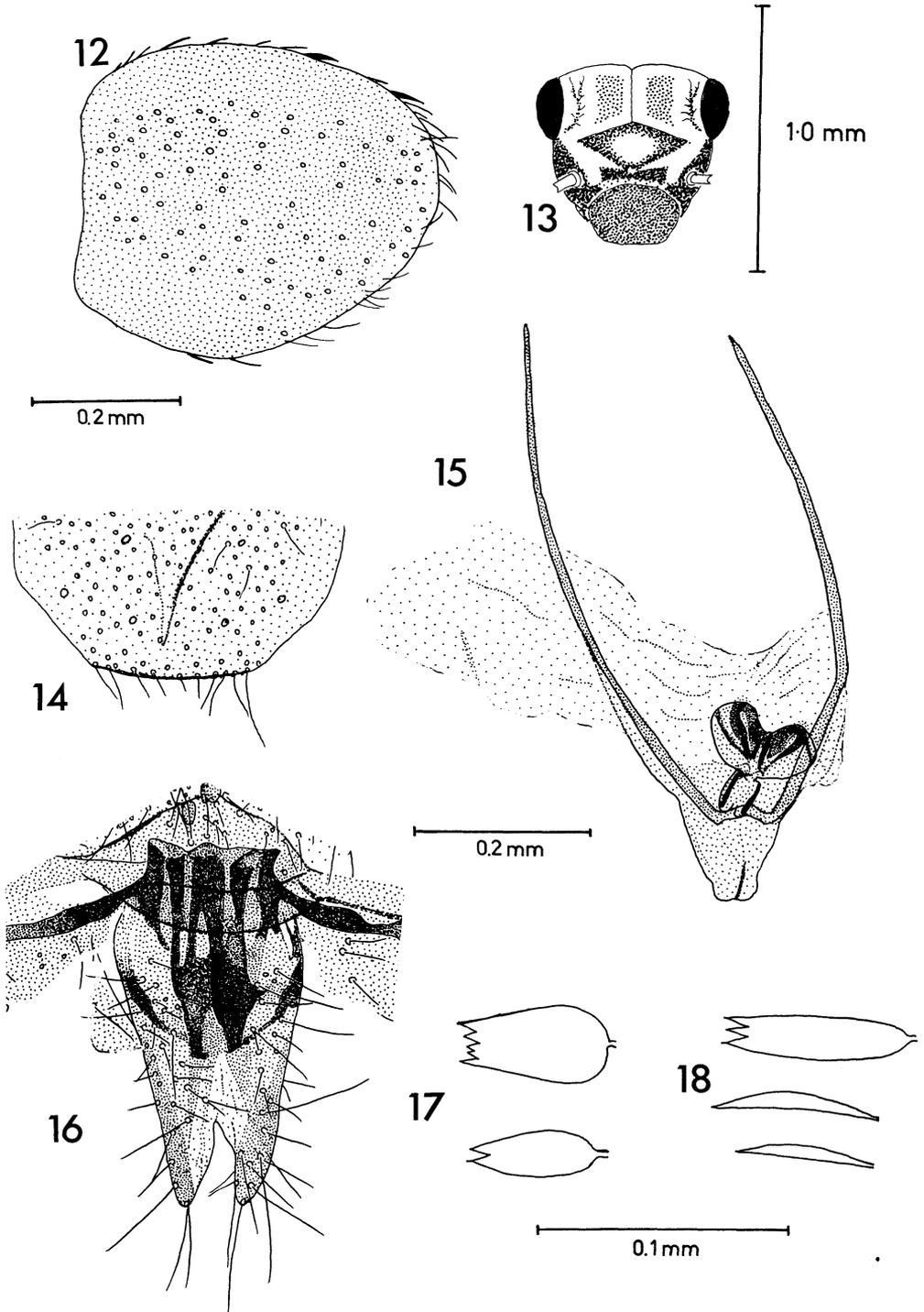
### **Lepolepis pictus** Thornton, new species

FIG. 12-18

♀. *Coloration* (after ca. 6 years in alcohol). Head buff, marked with dark brown as in FIG. 13. Gena with an oblique dark brown band from upper posterior margin to orbit. Eyes black, ocelli absent. Maxillary palps and antenna brown. Thoracic terga and pleura brown. Legs brown, except pale buff at apices of femur, tibia, basal tarsal segment and whole of rest of tarsus. Fore wings densely covered with brown scales, membrane brown after their removal, paler apically (FIG. 12). Abdomen light buff, covered with brown scales. *Morphology.* I.O.:D. = 4.5:1, eyes with straight inner margins, situated at hind angles of head. Occipital and frontal sutures not very conspicuous. Clypeus slightly bulging. Vertex, frons, and sides of

→

FIG. 12-18. *Lepolepis pictus*: 12, fore wing; 13, head pattern; 14, hypandrium; 15, phallosome; 16, gonapophyses; 17, abdominal scales; 18, fore wing scales. FIG. 14-16, and FIG. 17-18 to common scales.



clypeus sparsely clothed with long, slender, upright, curving scales. Maxillary palp with stout subapical setae and basal sensillum on 2nd segment. Thoracic nota of almost equal size. No ctenidiobothria on basal hind tarsal segment, Pearman's organ lacking, claw with strong subapical tooth and basal serrations, coxae very large, tibiae and tarsi long and slender. Fore wings veinless, scales similar to those of *L. ceylonica* but in addition larger scales, bifid or trifid at apex (FIG. 18). Hind wings rudimentary, scaleless. Abdominal scales differ from those of *L. ceylonica* in being truncate and serrated apically (FIG. 17). Tergite of segment 8, and segments 9 and 10 sclerotized. Paraprocts with long slender spine and 2 trichobothria in rosette sockets. Gonapophyses (FIG. 16) setose.

♂. *Coloration* (after ca. 6 years in alcohol). As ♀. *Morphology*. A. ♀, apart from genitalia. *Genitalia*. Hypandrium (FIG. 14) simple, somewhat truncate, setose. Penis frame (FIG. 15 of paratype) differing somewhat from that of *L. occidentalis*.

Nymph recognizable on head markings.

*Distribution*. LAYSAN, KAUAI, OAHU, MOLOKAI, MAUI, HAWAII, probably a natural immigrant; common, found up to 1300 m (4000 ft), on both introduced and native plants.

This species differs from *L. ceylonica* and *L. ceylonica* var. *formosana* End. 1908 by having a pattern on the head, and from *L. bicolor* and *L. occidentalis* in the head pattern itself, which is similar to that of *Pteroxanium kelloggi* (Ribaga) but differs in detail.

Holotype ♀, OAHU: Waianae Range, Pali Kea, 15.VIII.1957, E.L. Mockford (BISHOP 12,087). Allotype ♂, same data as holotype. 10♀, 6♂ paratypes, same data as holotype. Holotype, allotype, 5♀, 3♂ paratypes in BISHOP, 5♀, 3♂ paratypes in AMS.

*Other Hawaiian records*. LAYSAN: bird nest under *Eragrostis*, ex berlese, 15.VI.1962, J.W.B. KAUAI: Halemanu, *Straussia*, *Acacia koa*, 29.VIII.1921, O.H.S.; Alakai Swamp, 22.VIII.1957, E.L.M.; Kalalalau Lookout, 23.VIII.1957, A.M.N.; Kokee, 21.VIII.1957, E.L.M.; Kokee, 10.IX.1957, A.M.N.; Kokee, *Araucaria*, 27.VII.1963; Mohihi Stream, 29.VII.1963; Kokee, *Acacia koa*, 30.VII.1963; Camp Slogget, dead branches *Acacia koa*, 1.VIII.1963. OAHU: Mt Kaala, 22.I.1929, F.X.W.; Haleauau, *Eucalyptus* bark, 1.XII.1929, O.H.S.; Kukuiala Val, *Euphorbia*, 16.IX.1933, O.H.S.; Kamokuiki Val, *Urera sandwicensis*, 8.IV.1934, O.H.S.; Koko Crater, bred from *Gossypium tomentosum*, XII.1939, E.C.Z.; Nuuanu Pali, 13,17.VIII.1957, E.L.M.; Tantalus trail, 17.VIII.1957, E.L.M.; Mt Kaala, 980 m (3000 ft), *Metrosideros*, 29.XII.1963. MOLOKAI: Dunbar's pasture, *Metrosideros*, 9.IV.1963; Hipuapua Gulch, *Metrosideros* and *Cheirodendron*, 15.VII.1963. MAUI: Upper Iao Val, 17.IX.1963. HAWAII: Kilauea, *Cibotium*, 20.VII.1934, O.H.S.; Kipuka Puauulu, Kilauea, 1,2.IX.1957, A.M.N., E.L.M.; Kipuka Puauulu, *Sophora*, 24.VI.1963; Kohala watershed reserve, 4.IX.1957, E.L.M.; Kamuela (Waimea), 5.IX.1957, E.L.M.

### Family TROGIIDAE Enderlein, 1903a

*Characteristics*. Antennae of more than 20 segments which are not secondarily ringed. Tarsi 3-segmented. Body and wings without scales. Paraproct with long posterior spine, without trichobothria. Fore wings reduced or absent, hind wings and ocelli absent. Second segment of maxillary palp with peglike sensillum on inner face. Claws lack teeth. Female gonapophyses reduced, dorsal valve rudimentary, ventral valve lacking.

#### KEY TO HAWAIIAN SPECIES OF TROGIIDAE

1. Fore wings present ..... 2  
   Fore wings represented only as minute lateral stubs, anchor-shaped mark on  
   front of head ..... **Cerobasis guestfalica**
2. Fore wings with 7 distinct dark spots, head patterned but not with an anchor-  
   shaped mark ..... **Cerobasis annulata**

Fore wings with reticulate pattern without spots, head uniformly colored ..... **Lepinotus reticulatus**

### Genus **Cerobasis** Kolbe

- Cerobasis* Kolbe, 1882: 212.  
*Hyperetes* Kolbe, 1880: 132 (preoccupied).  
*Tichobia* Kolbe, 1882: 212.  
*Albardia* Jacobson & Bianchi, 1904: 496.  
*Myopsoenema* Enderlein, 1905: 17.  
*Zlinia* Obr, 1948: 93, 103.

#### **Cerobasis guestfalica** (Kolbe)

- Hyperetes guestfalicus* Kolbe, 1880: 132.  
*Cerobasis guestfalica* (Kolbe): Roesler, 1944: 119.—Gurney, 1949: 63.—Mockford & Gurney, 1956: 355.—Badonnel, 1962: 187.  
*Cerobasis guestfalicus*: Smithers, 1965b: 79.  
*Cerobasis muraria* Kolbe, 1882: 212 (nymph).  
*Tichobia alternans* Kolbe, 1882: 212 (nymph).  
*Hyperetes tessulatus* Hagen, 1882: Plate 2; 1883: 316.

*Distribution.* KAUAI, OAHU, MOLOKAI, LANAI, MAUI, HAWAII, accidental introduction; frequent. This species has also been found in Europe, Hong Kong, Australia, North America, Argentina, and in material from the Virgin Is. It has not been recorded previously from Hawaii, where it may occur up to 1300 m (4000 ft).

*Hawaiian records.* KAUAI: Kokee, 10.IX.1957, A.M.N.; Kokee Road, 500–1000 m (1500–3000 ft), *Acacia koa*, 29.VII.1963. OAHU: University of Hawaii, 7.IX.1957, A.M.N.; same locality, 19.VI.1963. MOLOKAI: Hoolehua, 23.IX.1957, A.M.N.; 650–830 m (2000–2500 ft) above Kamiloloa, *Eucalyptus*, *Myoporum*, *Diospyros*, 19.VII.1963. LANAI: Lanai City, 15,20.IX.1957, A.M.N. MAUI: Haiku, *Araucaria*, 13.V.1963. HAWAII: Kamuela (Waimea), 5,17.IX.1957, E.L.M.; Kamuela (Waimea), 4.IX.1961; Pohakaloa, 4.IX.1961.

#### **Cerobasis annulata** (Hagen)

- Clothilla annulata*, Hagen 1865: 122; 1866: 207; 1882: 526; 1883: 307, 316.—Rostock, 1878: 93.—Tetens, 1891: 373.  
*Atropos annulata* (Hagen): Kolbe, 1880: 135; 1888: 191.—Rostock, 1888: 165.—Loens, 1889: 332.  
*Myopsoenema annulata*: Enderlein, 1905: 17.—Banks, 1907: 162.—Laing, 1932: 68.—Badonnel, 1943b: 145, 1944: 53.—Gurney, 1949: 63.  
*Cerobasis annulata*: Smithers, 1967: 11.—Thornton & New, 1981: 180.

*Distribution.* LISIANSKY, HAWAII, accidental introduction; rare. This household species, easily recognized by the 7 dark spots on the wings, has been recorded from Europe, the Canary Is, Robinson Crusoe I, and North America, but not previously from Hawaii.

*Hawaiian records.* LISIANSKY: grass patch, NE corner, 17.V.1923, C. Grant. HAWAII: Kamuela (Waimea), 17.IX.1957, A.M.N.

### Genus *Lepinotus* Heyden

*Lepinotus* Heyden, 1850: 84.

*Paradoxides* Motschulsky, 1851: 510 (nec Brongniard 1822).

*Paradoxenus* Motschulsky, 1852: 19.

#### *Lepinotus reticulatus* Enderlein

*Clothilla inquilina* (Heyden): Hagen, 1882: 526; 1883: 309-14 (partim).

*Atropos inquilina* (Heyden): Kolbe, in Rostock, 1888: 190.

*Lepinotus reticulatus* Enderlein, 1905: 31.—Pearman, 1931b: 50.—Badonnel, 1931: 258; 1943b: 149; 1944: 53; 1945: 33; 1963: 301.—Gurney, 1949: 63.—Mockford & Gurney, 1956: 355.—Smithers, 1964a: 85; 1965b: 79.—New & Thornton 1981: 140.

*Lepinotus tasmanensis* Hickman, 1934: 81.

*Distribution.* KURE, KAUAI, accidental introduction; rare. This cosmopolitan species has also been found in Europe, the Canary Is, North Africa, Egypt, Afghanistan, Mozambique, Australia, Tasmania, Japan, North America and Chile. It was not previously reported from Hawaii. I have also examined specimens in the Bishop Museum collection from Marotiri, Tubuae and Raivave (Austral Is).

*Hawaiian records.* KURE I: 30.III.1915, Captain Brown. KAUAI: Halemanu, on bark of *Alphitonia* and *Konwila*, 22.VI.1932, O.H.S.; same locality, on bark, 6.VII.1932, O.H.S.

#### Family PSOQUILLIDAE Pearman, 1936

*Characteristics.* Ocelli lacking; wings reduced at least to some extent, but with veins; antenna of more than 20 segments; not with scales.

### Genus *Psoquilla* Hagen

*Psoquilla* Hagen, 1865: 123.

*Heteropsocus* Verrill, 1902: 817 (nec Kolbe, 1884).

#### *Psoquilla marginepunctata* Hagen

*Psoquilla marginepunctata* Hagen, 1865: 123.—Williams, 1932: 8.—Zimmerman, 1948b: 226.—Thornton & Woo, 1973: 19.

*Heteropsocus dispar* Verrill, 1902: 818.

*Distribution.* KAUAI, OAHU, probably accidental introduction, although possibly natural immigrant; occasional.

This species also occurs in Europe (stored products), Angola, Congo, West Africa, Malaya, Hong Kong, Taiwan, Bermuda, North America, Paraguay, Brazil, and the Galapagos Is. It has been taken in air trappings near the Philippines (Thornton 1964a) but it commonly occurs in stored food in houses, and it is likely that it was introduced to Hawaii accidentally in this way.

*Hawaiian records.* KAUAI: chicken faeces, 5.I.1945, Major Webb. OAHU: Kaimuki, in carton of bran, 3.VII.1918, O.H.S.; same locality, 11.IX.18, O.H.S.; Kualoa, *Albizia*, I.1925, G. A. McElDowney; Honolulu, VI.1943, mouldy boards of rotten fruit box. E.C.Z.

### Family PSYLLIPSOCIDAE Enderlein, 1911

*Characteristics.* Wings often reduced; hind tibia and tarsus together longer than abdomen; head long, vertical; antenna with more than 20 segments; scales lacking.

This family is represented in Hawaii by 2 genera, each represented by a single species.

A key is provided by Zimmerman (1948b).

#### Genus **Psocathropos** Ribaga

*Psocathropos* Ribaga, 1899: 156.

*Psocinella* Banks, 1900: 431.

*Axinopsocus* Enderlein, 1903c: 2.

*Vulturops* Townsend, 1912: 267.

#### **Psocathropos lachlani** Ribaga

*Psocathropos lachlani* Ribaga, 1899: 158.—Williams 1932: 8.—Zimmerman 1948b: 231.

*Distribution.* OAHU, accidental introduction; occasional. This small household species has been recorded from East Africa and Europe (hot house records). Zimmerman (1948b) reported it on books and moldy boots in Honolulu.

*Hawaiian records.* OAHU, all from the town of Honolulu: 1.III.1915, O.H.S.; 6.XI.1919; 14.I.1924, O.H.S.; 18.II.1925, O.H.S.; in house, 21.I.1927, O.H.S.; on book, 26.I.1933; III.1939, E.C.Z.; XI.1939, E.C.Z.; 15.V.1943, E.C.Z.; in laboratory, 10.V.1963, G. Byers.

#### Genus **Psyllipsocus** Selys-Longchamps

*Psyllipsocus* Selys-Longchamps, 1872: 145.

*Nymphopsocus* Enderlein, 1903b: 76.

*Ocellatoria* Weber, 1907: 190.

*Fita* Navas, 1913: 332.

*Fabrella* Lacroix, 1915: 194.

The Hawaiian representative of this genus is classified in the subgenus *Parempheria* (see Thornton 1962b).

#### **Psyllipsocus (Parempheria) minutissimus** (Enderlein)

*Parempheria minutissima* Enderlein, 1920: 458.—Takahashi, 1938: 11.—Gurney, 1943: 203.—Thornton, 1962b: 442.

*Psyllipsocus minutissimus* (End.): Zimmerman, 1948b: 231.

*Psyllipsocus (Parempheria) minutissimus*: Thornton, 1962b: 499.

*Distribution.* OAHU, accidental introduction; rare. This household species has also been recorded from Taiwan.

The pubescence on the wing margins is not shown in Zimmerman's figure.

*Hawaiian records.* OAHU: Koolau Mts, 1915, D.T.F.; Punaluu, in moulds on bottle in cupboard, 24.X.1943, E.C.Z.

### Family LIPOSCOLIDAE Pearman, 1936

*Characteristics.* Body dorsoventrally flat; prothorax trilobed, meso- and metathorax fused; hind femora swollen; apterous, or with rudimentary wings with venation much reduced; antennae with 15 segments, those of flagellum ringed.

#### Genus *Liposcelis* Motschulsky

*Liposcelis* Motschulsky, 1852: 19.

*Termes* Muller, 1776: 184 (nec Linné, 1758).

*Trogium* auct. nec Illiger, 1798: 500.

*Atropos* auct. nec Leach, 1815: 139.

*Troctes* auct. nec Burmeister, 1839: 773-75. (See Broadhead, 1950.)

Two species of this genus occur in Hawaii. One, a pale insect, is probably *L. divinatorius* (Muller), described by Zimmerman and recorded as widespread.

*Hawaiian records since Zimmerman's work.* OAHU: University Campus, 7.IX.1957, A.M.N.; 19.VI.1963. HAWAII: Kukuihaele, fallen rice bird nest in cane, 21.XI.1962.

The second species, with a dark band across the abdomen, has not previously been reported and is unidentified.

*Hawaiian records.* OAHU: University Campus, 7.IX.1957, A.M.N. HAWAII: Kukuihaele, fallen rice bird nest in cane, 2.XI.1962.

### Family PACHYTROCTIDAE Pearman, 1936

*Characteristics.* Body globular; femora not swollen, integument often sculptured; compound eyes always fairly large and hemispherical; meso- and metathorax always separated; apterous or winged; antennae of 15 segments, those of flagellum ringed; pterostigma present in fore wing but undifferentiated.

#### Genus *Tapinella* Enderlein

*Tapinella* Enderlein, 1908b: 772.

#### *Tapinella formosana* Enderlein

*Tapinella formosana* Enderlein, 1908b: 774.—Menon, 1942: 32.

*Psylloneura williamsi* Banks, 1931: 439.—Williams, 1931: 371.—Zimmerman, 1948b: 230; 1957: 179.

*Distribution.* KAUAI, OAHU, LANAI, MAUI, accidental introduction; frequent.

As pointed out by Pearman (Zimmerman 1957), the Hawaiian species belongs to *Tapinella*. Moreover, it cannot be separated by the descriptions from *T. formosana* from India and Taiwan. The species also occurs on Saipan and Tinian in the Marianas. In Hawaii it seems to be particularly associated with sugar cane, and possibly was introduced in this way.

*Hawaiian records.* KAUAI: Kokee, 10.IX.1957, A.M.N. OAHU: Ewa, III.1918 (Banks 1931); Waialua, sugar cane, 29.I.1929, F.X.W.; Honolulu, H.S.P.A. Exp. Stn, old sugar cane, 20,25.XI.1929, F.X.W.; Honolulu, 15.VII.1955, J.W.B.; University of Hawaii, 7.IX.1957, A.M.N. LANAI: Lanai City, 22.IX.1957, A.M.N. MAUI: Kepaniwai Park, 16.IX.1957, A.M.N.; Lahaina, sugar cane, 15.V.1963.

## Family CAECILIIDAE Pearman, 1936

*Characteristics.* Head relatively short and wide; venation complete, areola postica free from media; veins and wing margins setose; tarsi 2-segmented; ♀ gonapophyses reduced.

This family is represented by 2 genera, 1 of which has not been found outside Hawaii. They are readily distinguishable by reference to Zimmerman (1948b).

Genus **Hageniola** Banks

*Hageniola* Banks, 1931: 438.

**Hageniola solitaria** Banks

FIG. 26

*Hageniola solitaria* Banks, 1931: 438.—Williams, 1931: 371.—Zimmerman, 1948b: 232.

*Distribution.* OAHU, a single specimen.

I have dissected the type specimen of this species in the Harvard Museum of Comparative Zoology. The genitalia (FIG. 26) confirm Zimmerman's placement of the species in the Caeciliidae. It has not been recorded from outside Hawaii.

*Hawaiian record.* OAHU: [no locality] sugar cane, I.1917, F.X.W. (Zimmerman 1948b).

Genus **Caecilius** Curtis

*Caecilius* Curtis, 1837: 648 (see Mockford 1965b).

KEY TO HAWAIIAN SPECIES OF *Caecilius*

1. Eyes round, clypeus and frons without median black mark ..... 2  
Eyes elongate, clypeus and frons with fairly wide median black mark .. **casarum**
2. Fore wing hyaline, except anal cell fuscous; thorax not wholly dark ...  **analis**  
Fore wing dark, hyaline areas very small; thorax wholly dark brown to  
black ..... **badiostigma**

**Caecilius analis** Banks

*Caecilius analis* Banks, 1931: 437.—Williams, 1931: 371.—Swezey & Williams, 1932: 190.—Zimmerman, 1948b: 232.—Davis, 1952: 85.—Zimmerman, 1948b: 232.—Thornton et al., 1972: 82.

*Distribution.* KAUAI, OAHU, MOLOKAI, LANAI, MAUI, HAWAII, possibly indigenous; common. This species is stated by Zimmerman to occur in the Marquesas. It also occurs in the Carolines (Ponape, Kusaie), Marianas (Rota, Pagan, Saipan, Tinian), Marshalls (Arno, Lae, Lib, Ailinglapalap) and I have seen specimens from Samoa, Malaya and Hong Kong.

In Hawaii, *C. analis* is one of the commonest psocids, occurring in all months of the year. It has been taken as high as 2130 m (6500 ft), and occurs on both native and introduced plants; it is somewhat more common in the lowlands.

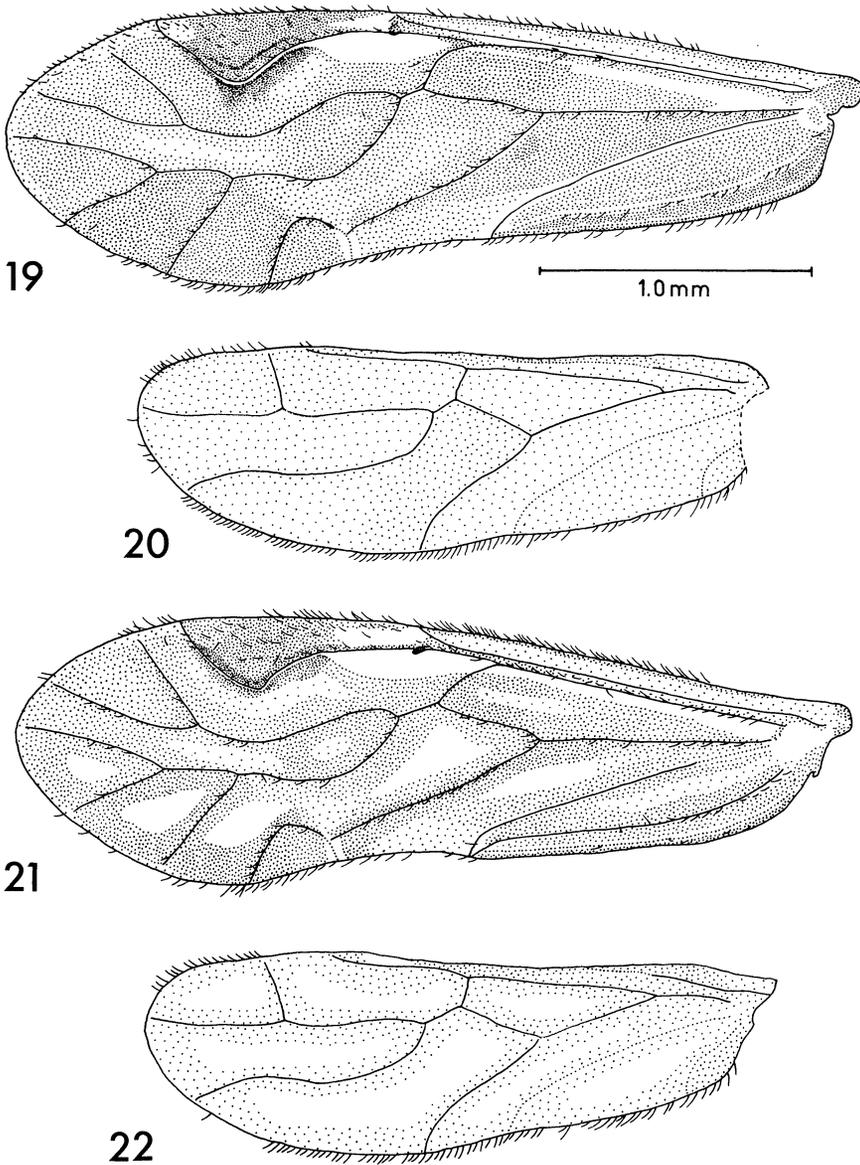


FIG. 19-22. *Caecilius badiostigma*: **19**, typical form fore wing; **20**, typical form hind wing; **21-22**, extreme pigment variation in another specimen. FIG. 19-22 to common scale.

*Hawaiian records.* KAUAI: Kaholuamanu, 1480 m (4500 ft), 8.V.1920; same locality, IV.1920; Halemanu, *Acacia koa*, 27.VI.1932, O.H.S.; Kawaikoi, *Elaeocarpus*, 18.VII.1932, O.H.S.; Kokee, 8.I.1944, N.H.L.K.; Lihue, 16.I.1944, N.H.L.K.; Nawiliwili, 17.I.1944, N.H.L.K.; Kokee, 10.IX.1957, A.M.N.; Kalalau Lookout, *Metrosideros*, 27.VII.1963; Kokee, *Araucaria*, 27.VII.1963; Kokee, nr Kawaikoi Stream, *Acacia koa*, 27.VII.1963; Kokee, nr Mohihi Stream, *Cryptomeria*, 27.VII.1963; Puu Ka Pele, 1200 m (3650 ft), *Acacia koa*, 29.VII.1963; Kokee Road, 520 m (1600 ft), 700 m (2100 ft), 850 m (2600 ft), 920 m (2800

ft), *Acacia koa*, 29.VII.1963; Mohihi Stream, *Straussia*, 30.VII.1963; Kokee Road, 1150 m (3500 ft), *Acacia koa*, 20.VII.1963; Kokee, 1220 m (3700 ft), *Acacia koa*, 1.VIII.1963; nr Camp Slogget, *Acacia koa*, 1.VIII.1963; Kalalau-Waimea divide, 1300 m (4000 ft), 26.XI.1963. OAHU: Mt Tantalus, 430 m (1300 ft), 18.XII.1904, 15.I.1905, W.M.G.; Oahu Sugar Company, III.1905; Waipio, sugar cane, 17.XII.1914; Nuuanu Pali, 29.X.1916, W.M.G.; Mt Kaala, 22.VII.1917, J.C. Bridwell; Lanihuli, 25.V.1919, O.H.S.; Waialai Iki, 28.XI.1919, E.H.B. Jr; Mt Olympus, 4.I.1920, E.H.B. Jr; Moanalua, "Ieie," 9.IV.1922, O.H.S.; Honolulu, 21.XII.1927, M. Maneki; H.S.P.A. Exp. Stn, sugar cane, 14.II.1929, F.X.W.; Honolulu, sugar cane, 30.II.1929 (parasitized by *Alaptus*); Honolulu, *Ficus*, 19.X.1929, O.H.S.; H.S.P.A. Exp. Stn, dry cane leaves, XI.1929, F.X.W.; Koko Head, "Pili" grass, 15.XII.1929, O.H.S.; Honolulu, sugar cane, XII.1929; Honolulu, 5.III.1930, O.H.S.; Waianae plantation, 27.IV.1932, O.H.S.; Manoa Val, *Citrus*, 4.I.1934, O.H.S.; Uauula, 17.III.1935, O.H.S.; Waimea, asparagus field, 18.V.1937, O.H.S.; Maunalani Heights, 5.III.1939, E.C.Z.; Koko Head, 5.XII.1939, E.C.Z.; Makua Val, 330 m (1000 ft), 22.II.1940, E.C.Z.; Mt Tantalus, *Metrosideros*, 19.III.1940, E.C.Z.; Konahuanui, 850–1000 m (2600–3000 ft), 9.V.1943, E.C.Z.; Honolulu, H.S.P.A. Exp. Stn, Bermuda grass, 2.VIII.1945, O.H.S.; Manoa Val, avocado leaf, screen, 11.III.1948, O.H.S.; Mt Kaala summit, 1300 m (4000 ft), drowned in basin, 11.IV.1948, H.S. Dybas; Puu Nui, 5.XI.1948, Mt Mori; Barbers Point, IV.1952, Ford; head of Kaluanui Val, 23.V.1951, D.E.H.; University of Hawaii, light trap, 30.III.1960, H. Tobo; Waikane, 7.IX.1957, E.L.M.; University of Hawaii, 7.IX.1957, A.M.N.; Moanalua Golf Course, 15.IX.1957, A.M.N.; Waimanalo, *Macadamia*, 22.IV.1963, *Macadamia* and *Acerola glabra*, 6.8.V.1963; Mt Tantalus, *Psidium guajava*, *Acacia koa*, and *Araucaria*, 20.IV.1963; Mt Tantalus, 600 m (1800 ft), *Acacia koa*, 22.II.1963; Mt Kaala, 600 m (1800 ft), *Metrosideros*, 14.III.1963; Waimanalo, *Macadamia*, 12.XI.1963; Mt Kaala, 620 m (1880 ft), 1000 m (3000 ft), 29.XII.1963; Pupukey, 500 m (1500 ft), 30.III.1963. MOLOKAI: Maunwainui Val, VII.1952, M. Tamashiro; Kahuaawi Gulch, VII.1952, D.E.H.; ridge above Kainalu Gulch, 1120 m (3400 ft), *Cheirodendron*, *Metrosideros*, 9.IV.1963; Dunbar's pasture, *Schinus terebinthifolius*, *Metrosideros*, 9.IV.1963; S of Pohakuloa, Halawa, *Cibotium*, 16.VII.1963; Halawa Val, N ridge, *Pelea*, dead fronds *Cibotium*, 16.VII.1963; summit Puu Kole Kole, 1280 m (3900 ft), *Juniperus*, 18.VII.1963; gulch nr Kole Kole cabin, *Cibotium*, 18.VII.1963; above Kamiloloa, 650 m (2000 ft), 780 m (2400 ft), 820 m (2500 ft), *Eucalyptus*, *Diospyros*, *Dodonaea*, respectively, 19.VII.1963; 1000 m (3000 ft), slope below Kaimoku flats, *Metrosideros*, 19.VII.1963, 1150 m (3500 ft), nr Kaimoku cabin, dead *Eucalyptus* leaves, *Cheirodendron*, 19.VII.1963; 130 m (400 ft), S of Hanalilililo, *Cheirodendron*, 19.VII.1963. LANAI: 600 m (1800 ft), 17.XII.1916, W.M.G.; 650 m (2000 ft), 7.XII.1916, W.M.G.; 820 m (2500 ft), 20.XII.1916, 12.I.1917, W.M.G.; 620 m (1900 ft), 25.I.1917, W.M.G.; Lanai City, 22.IX.1957, A.M.N. MAUI: Iao Val, *Metrosideros*, 8.VIII.1918, O.H.S.; Kailua, 15.VI.1920, E.H.B. Jr; 2300 m (7000 ft), Haleakala, *Acacia koa*, 27.VII.1929, R.R. Whitten; Kepaniwai Park, 16.IX.1957, A.M.N.; Iao Val, *Metrosideros*, 13.V.1963; 650 m (2000 ft), Haleakala, *Melia*, 13.V.1963; Kaupo Gap, 1250 m (3800 ft), Haleakala, *Acacia koa*, 24.VII.1963; upper Iao Val, *Metrosideros*, 17.IX.1963. HAWAII: Honaunau, VI.1914, J.G. Stokes; Kohala Mts, 24.V.1917, O.H.S.; Kilauea, *Metrosideros*, 26.VI.1917, O.H.S.; Papaikua, 1.III.1919, O.H.S.; S Kona, 11.VII.1919, O.H.S.; Kipuka Puauulu, *Pelea*, *Urera*, 9.X.1929, O.H.S.; Pipieko Forest Reserve, 1.V.1944, N.L.H.K.; Hualalai, 1960–2130 m (6000–6500 ft), 20.IV.1944, N.L.H.K.; Mauna Loa, 1650 m (5000 ft), 3.IX.1957, E.L.M.; Waimea, 5.IX.1957, 17.IX.1957, A.M.N.; Honokohau, 19.IX.1957, A.M.N.; Kipuka Puauulu, 20.IX.1957, A.M.N.; Waimea, *Tecoma*, 4.IX.1961; Halepula, N Kona, 650 m (2000 ft), lichen-covered *Diospyros*, 29.I.1963; Mauna Loa, 2200 m (6700 ft), *Acacia koa*, 30.I.1963; Kipuka Ki, *Pipturus*, *Acacia koa*, 30.I.1963; Mauna Loa, 2130 m (6500 ft), *Acacia koa*, 25.VI.1963; Kipuka Puauulu, *Acacia koa*, 25.VI.1963; Waimea, *Datura*, mango, 26,27.VI.1963; Kawaihae Uka, 1180 m (3600 ft), *Myoporum*, *Acacia koaia*, 26,27.VI.1963; Pahala, *Macadamia*, 12.XI.1963.

### **Caecilius badiostigma** Okamoto

FIG. 19–25

*Caecilius badiostigma* Okamoto, 1910: 206.

*Further description.* ♀. *Coloration* (freshly killed, in alcohol). Head with hind part of vertex brown, rest of vertex light reddish brown, area round the ocelli extending laterally to antennal sockets and frons red. Clypeus with fairly pale reddish brown striae, genae pale reddish brown. Eyes black, ocelli pale, ocellar protuberance black. Maxillary palps pale brown. Antennal flagellum with 2 basal segments pale buff, segments 3 and 4 brown, remainder dark brown. Thoracic sclerites dark brown, almost black. Legs pale straw except coxae and apical tarsal segment slightly darker. Claws brown, except hyaline at apex. Fore

wing (FIG. 19) brown, darker posterior to vertex of pterostigma, always a distinct hyaline area near base of pterostigma and a smaller one at basal corner of areola postica; often an elongate hyaline window between *r* and *m*, and occasionally a hyaline area in all cells (FIG. 21); veins brown, bordered hyaline. Hind wing paler brown than fore wing (FIG. 20), veins brown, narrowly bordered hyaline, except *cu*<sub>2</sub> and *an* widely so. Abdomen uniform pink dorsally and ventrally, darkening to red laterally. *Morphology*. I.O.:D = 3.5:1. Head sclerites shining. Basal hind tarsal segment with 20 ctenidiobothria, Pearman's organ present. Thoracic sclerites shining. Subgenital plate and gonapophyses (FIG. 25, 23). A field of 22 trichobothria on each paraproct. Body length (in alcohol): 1.4-2.3 mm (10 specimens: average 1.88 mm).

♂. *Coloration* (freshly killed, in alcohol). As ♀ with following exceptions: frons and vertex red, hind edge of vertex dark brown, a red mark within a paler ring in middle of vertex; antenna concolorous dark brown, except basal flagellar segment paler basally. *Morphology*. I.O.:D = 1.0:1, eyes very large. Head sclerites shining. Basal hind tarsal segment with 24 ctenidiobothria, Pearman's organ present. Thoracic sclerites shining. Hypandrium simple, penis frame as FIG. 24. A hemispherical field of raised tubercles in middle of epiproct. Hemispherical field of 36 trichobothria on each paraproct.

Nymph recognizable on color and shining head.

*Distribution*. KAUAI, OAHU, MAUI, HAWAII, possibly indigenous; common. Also found in Japan. I have examined closely related forms in the Bishop Museum collection from Malaya and New Guinea.

*Specimens examined*. 5♂, 5♀, nymphs, OAHU: Mt Tantalus summit road, 650 m (2000 ft), 22.II.1963, *Acacia koa*, I.W.B. Thornton (BISHOP).

There is considerable variation in the intensity of pigmentation. Two males collected on 22.II.1963 were particularly lightly pigmented, and a female collected on the same date had a fore wing with vague hyaline areas in each main cell (FIG. 21); the hind wing was similarly lacking in pigment (FIG. 22).

This fairly large, dark-winged species was described from Japan and is fairly similar to *C. macrostigma* End. (Australia), *C. leuroceps* Thornton, Lee & Chui (Micronesia), and *C. pubes* End. (South America). The Hawaiian specimens differ from Okamoto's description in that the clypeus and labrum are pale reddish brown, certainly not black, and in the color of the antennae, but otherwise agree closely. From *C. macrostigma*, the Hawaiian species differs in wing pattern, lacking the hyaline areas on *m* + *cu*, *cu*<sub>2</sub> and at the *rs-m* junction. The head and legs of *C. pubes* are very dark brown and there are differences in wing pattern. *C. leuroceps* has a much less-patterned fore wing.

In Hawaii *C. badiostigma* has been found in all months but January and October. It occurs up to 1300 m (4000 ft), and is somewhat more common above 500 m (1500 ft) than in the lowlands; it is found on both native and introduced plants. This distribution probably reduces, and may result from, competition with the other 2 *Caecilius* species, which are commoner in the lowlands.

*Other Hawaiian records*. KAUAI: Kokee, 10.IX.1957, A.M.N.; Waimea Canyon Lookout, *Acacia koa*, 27.VII.1963; Kalalau Lookout, *Meirosideros*, 27.VIII.1963; Puu Ka Pele, 1200 m (3650 ft), *Acacia koa*, 29.VII.1963; Kokee Road, 920 m (2800 ft), 850 m (2600 ft), 680 m (2100 ft), *Acacia koa*, 29,30.VII.1963; Kumuwea trail, 30.VII.1963, D.E.H.: Kokee, dead and live branches *Acacia koa*, 1.VIII.1963; nr Camp Slogget, same habitat, 1.VIII.1963; Kokee, 1050 m (3200 ft), 26.XI.1963. OAHU: Halona Val, Waianae

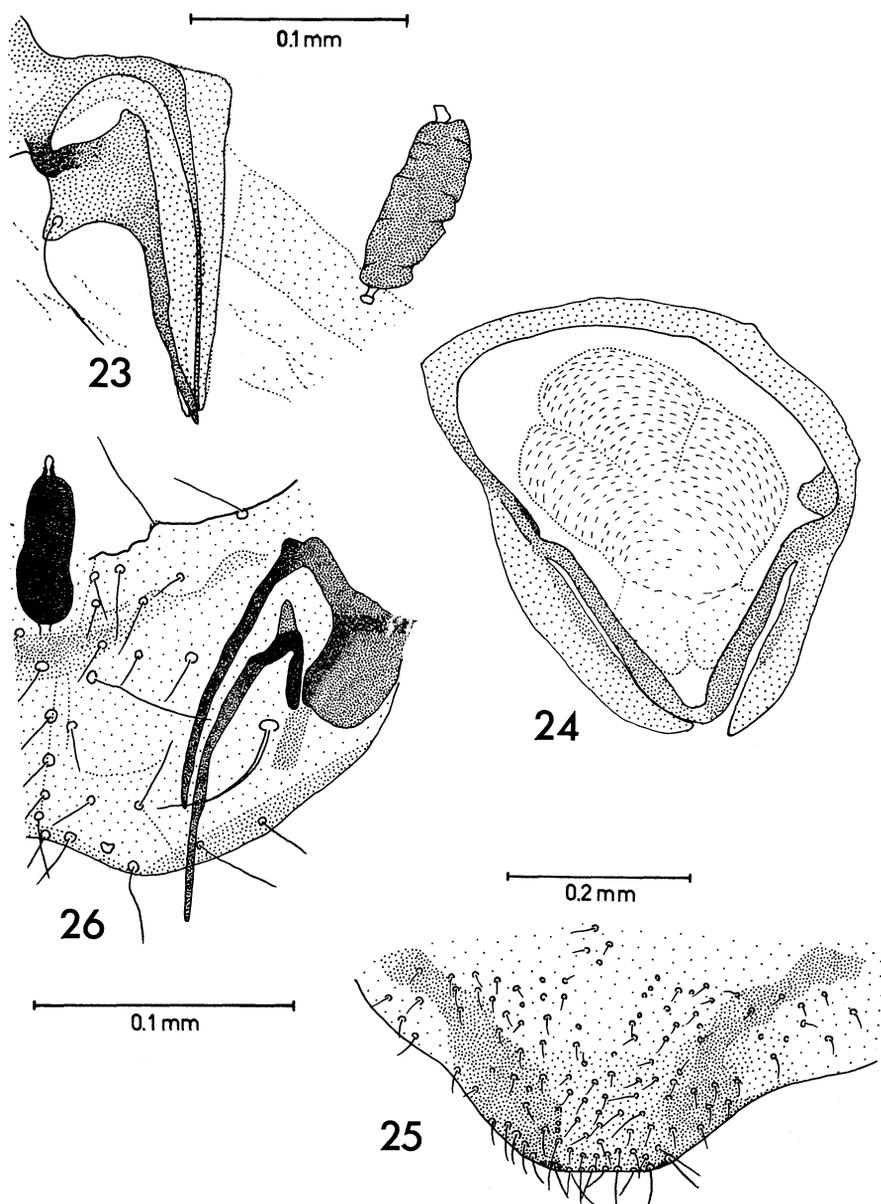


FIG. 23-26. 23-25, *Caecilius badiostigma*: 23, gonapophyses; 24, phallosome; 25, subgenital plate; 26, *Hageniola solitaria*, type specimen gonapophyses. FIG. 23 and 24 to common scale.

Range, *Osmanthus*, *Pisonia*, 12.III.1933, O.H.S.; Palikea, *Coprosma*, 18.VI.1938, O.H.S.; Palahua, *Acacia koa*, 6.V.1938, O.H.S.; Poamoho, mango, 1.III.1951, W. Mitchell; Poamoho, litchi, 2.III.1951, Y. Tanada; Mt Tantalus, IV.1954, D.E.H.; Aiea Heights, *Metrosideros*, 2.VIII.1961; Poamoho trail, *Acacia koa*, 29.VIII.1961; Mt Tantalus, 600 m (1800 ft), *Metrosideros*, 22.II.1963; Waimanalo, *Macadamia*, 8,15.V.1963; Mt Tantalus, *Acacia koa*, *Psidium guajava*, *Araucaria*, 20.VI.1963; Mt Kaala, 600 m (1800 ft), 29.XII.1963.

MAUI: upper Iao Val, 820 m (2500 ft), 17.IX.1963. HAWAII: Keaau Orchard, nr Oloa, XI.1956, H. Namba; Hilo, 30.VII.1957, A.M.N.; Waimea, 5,17.IX.1957, A.M.N.; Honokohau, 19.IX.1957, A.M.N.; Waimea, *Datura*, mango, 26,27.VI.1963; saddle between Mauna Kea and Kohala mts, dead *Eucalyptus*, *Juniperus*, 27.VI.1963; above Captain Cook, 400 m (1200 ft), 28.VI.1963; S Kona Agric. Exp. Stn. *Macadamia*, 28.VI.1963.

### **Caecilius casarum** Badonnel

*Caecilius casarum* Badonnel, 1931: 234.—Mockford, 1972: 327.—Thornton, 1981a: 40; 1981b: 116.  
*Caecilius palmarum* Mockford & Gurney, 1956: 361.

*Distribution.* OAHU, MAUI, accidental introduction; occasional. *C. casarum* was described from Mozambique. It has also been found in Hong Kong, New Guinea, Micronesia, Fiji, Tonga, Samoa, Easter I, southern United States and coastal areas of the New World tropics and subtropics. Probably it is spread by human commerce (Mockford 1966).

The eyes of this species are elongate kidney-shaped, and a dull orange-rust color in life. The basal 4 antennal segments are very pale straw, the rest gray, and there is a broad dark stripe down the middle of the frons and clypeus.

In Hawaii, it has been found from February to May and in September and November. It is confined to the lowlands, not having been found above 520 m (1600 ft), and is also very largely confined to introduced plants; it is thus possibly a more recent arrival than the other 2 species of *Caecilius*.

*Hawaiian records.* OAHU: Honolulu, 16.XI.1914; Mt Olympus, *Pelea*, 20.II.1937, E.C.Z.; University of Hawaii, 7.IX.1957, A.M.N.; Honolulu, 3.III.1963, D.E.H.; Waimanalo, *Macadamia*, *Acerola glabra*, 10.IV.1963, 22,29.IV.1963, 6,9.V.1963, C.R.; Waimanalo, *Macadamia*, 12.XI.1963. MAUI: Waihee, 9.VI.1919, E.H.B. Jr; Kepaniwai Park, 16.IX.1957, A.M.N.; Lahaina, sugar cane, 15.V.1963.

## Family ELIPSOCIDAE Pearman, 1936

*Characteristics.* Antenna 13-segmented; tarsi usually 3-segmented; fore wing venation complete in fully winged forms, *rs* and *m* usually fused, pterostigma free, areola postica usually free, margin and veins setose; hind wing with *rs* and *m* fused, usually setae on margin only between  $r_{2+3}$  and  $r_{4+5}$ . Female gonapophyses complete.

This family is extremely well represented in Hawaii, since it includes 2 of the large endemic species complexes, *Palistreptus* and *Kilauella*. There is, however, a single nonendemic species.

## Genus **Propsocus** McLachlan

*Propsocus* McLachlan, 1866: 352.  
*Tricladus* Enderlein, 1906a: 410. (See Smithers 1963: 889.)  
*Tricladellus* Enderlein, 1909: 273. (*Tricladus* preocc.)

### **Propsocus pulchripennis** (Perkins)

*Stenopsocus pulchripennis* Perkins, 1899: 83.—Zimmerman, 1948b: 250; 1957: 179.  
*Myopsocus nitens* Hickman, 1934: 85.

*Tricladellus nitens* (Hickman): Edwards, 1950: 113.—Smithers 1962: 262.

*Tricladellus nitens* var. *brachypterus* Edwards, 1950: 115.

*Propsocus pulchripennis* (Perkins): Badonnel, 1963: 330.—Smithers, 1963: 891.—Thornton, 1964a: 288.—New & Thornton, 1981: 163.

*Distribution.* MAUI, HAWAII, possibly indigenous; rare. This species is also recorded from Kenya, South Africa, Australia, Tasmania, and Chile, and a male was trapped alive from an airplane above New Zealand. I have also examined specimens in the Bishop Museum collection from New Zealand. The species thus has a widespread distribution in the Southern Hemisphere. In Hawaii, the species is apparently confined to the high volcanoes of East Maui and Hawaii and seems to be rare.

*Propsocus* (Australia, S Africa, Chile, Hawaii), *Pentacladus* End. (Australia) and *Spiropsocus* Smithers (Australia, New Zealand, Campbell I) are elipsocid genera of the subfamily Propsocinae which, like the Hawaiian *Kilauella* and *Palistreptus*, have vein  $cu_1$  in the hind wing reflected; furthermore, *Propsocus* is somewhat similar to *Kilauella* in male hypandrium. On several grounds, the Hawaiian endemic elipsocid complexes appear to be related to propsocines. If the Hawaiian *Kilauella-Palistreptus* line originated from this group of southern elipsocids, the presence of *Propsocus pulchripennis* in Hawaii may be the result of a second, more recent invasion. Another possibility is that it is a relic of the original colonizing population which has remained unchanged while over 160 *Kilauella* and *Palistreptus* species have evolved in Hawaii. A third possibility is that *P. pulchripennis* arose as an offshoot of the Hawaiian *Kilauella-Palistreptus* stock and spread from Hawaii around the Southern Hemisphere, giving rise to a minor development of the Propsocinae in the Australian Region, where several species occur. On balance, the first seems by far the most likely course of events.

Neither *P. pulchripennis* nor any related forms occur in Micronesia. The restricted range of the species in Hawaii suggests that it may be declining due to competition with more recent arrivals.

I have examined the mutilated type specimen of this species in the British Museum. The 2 macropterous specimens from Maui each show the areola postica fused with the media for a very short distance in 1 fore wing. In the type specimen, and in 1 wing of 1 of the Maui specimens, it is joined to the media by a crossvein. Such variations are described by Hickman (1934) and for *P. pallipes* (McL.) by Edwards (1950). The related genus *Pentacladus* also shows much variation of venation. Similar variations have also been noticed in the *macromaura* section of *Kilauella*.

*Hawaiian records.* MAUI: Haleakala, nr Puu Niauniau, 2130 m (6500 ft), 24.IV.1945, E.C.Z., 2 macropterous, 6 micropterous. HAWAII: Hualalai, 2620 m (8000 ft), R.C.L.P., 1 macropterous (type); Kipuka Puauulu, 1310 m (4000 ft), VII.1963, D.E.H., 2 macropterous.

#### Family LACHESILLIDAE Badonnel, 1955

*Characteristics.* Wings glabrous, venation complete; gonapophyses reduced; ♂ abdominal apex complex; tarsi 2-segmented.

### Genus **Lachesilla** Westwood

*Lachesilla* Westwood, 1840: 47. (See note in Badonnel 1943b: 102.)

*Pterodela* Kolbe, 1880: 118.

*Leptopsocus* Reuter, 1899: 5.

*Graphocaeilius* Enderlein, 1900: 155.

*Terracaeilius* Chapman, 1930: 343.

Two species are recorded from Hawaii; they are separable on fore wing pattern, that of *L. nubilis* having more obvious brown cloudiness about the vein apices, the areola postica and pterostigma.

#### **Lachesilla nubilis** (Aaron)

*Caecilius nubilis* Aaron, 1886: 13.

*Lachesilla nubilis* (Aaron): Chapman, 1930: 351.—Sommerman, 1946: 647.

*Distribution.* OAHU, possible natural immigrant; rare. North America.

The single specimen of this North American species differs from the type in that in the hind wing *rs* and *m* are joined by a crossvein, not fused. However, I have seen females from North America in Dr Mockford's collection with the hind wing venation in this atypical state.

*Hawaiian record.* OAHU: Waianae, on tomato, 25.II.1963.

#### **Lachesilla pedicularia** (Linné)

*Hemerobius pedicularius* Linné, 1758: 551.

*Hemerobius flavicans* Linné, 1758: 551.

*Termes fatidicum* Linné, 1758: 610. (See Gurney 1939.)

*Hemerobius abdominalis* Fabricius, 1775: 310.

*Psocus nigricans* Stephens, 1836: 127.

*Psocus binotatus* Rambur, 1842: 324.

*Leptopsocus exiguus* Reuter, 1899: 5.

*Lachesilla pedicularia* (L.) Chapman, 1930: 354.—Badonnel, 1943b: 102.—Sommerman, 1946: 650.

See Enderlein (1915: 16-19) for a fuller synonymy.

*Distribution.* OAHU, natural or accidental immigrant; occasional. Cosmopolitan.

This abundant species has been captured in aerial traps on ships near the Hawaiian Is on 2 occasions (Thornton 1964a; Thornton & Harrell 1965). It is known to swarm in great numbers (Gurney 1949) and has been taken in the air at high altitudes (Berlând 1935; Glick 1939; Obr 1948) but is also carried by commerce. Perkins sent specimens to Banks; 2 of them are labelled "*Kilauella* sp." in the collection at Harvard.

*Hawaiian records.* OAHU: Honolulu, R.C.L.P. (9 specimens); Universtiy of Hawaii, 7.IX.1957, A.M.N. (3 specimens); Nanakuli, flying downwind, 21.V.1969, B. Hocking (2 specimens).

### Family PERIPSOCIDAE Pearman, 1936

*Characteristics.* Usually fully winged, areola postica absent, pterostigma broadening subapically, rounded apically; *rs* and *m* of hind wing usually fused for a distance; aedeagal sclerites complex; 2 tarsal segments, claw with subapical tooth.

One genus, *Peripsocus*, is represented in Hawaii (3 species).

KEY TO HAWAIIAN SPECIES OF PERIPSOCIDAE

1. Fore wing uniform pale fuscous except stigmasac and pterostigma apically reddish brown; a distinct cream patch immediately anterior to ocellar protuberance; clypeus with cream medial area posteriorly ..... ***Peripsocus ferrugineus***  
Fore wing with cloudy fuscous markings not confined to pterostigma; no distinct cream patch immediately anterior to ocellar protuberance; clypeus without cream medial area posteriorly ..... 2
2. Clypeus shining; mesothoracic pronotum with very narrow, often indistinct median cream line; clypeal striae broad, continuous, distinct, extending posteriorly to clypeal suture, forming a well-marked color boundary there; fore wing 2.0 mm long or more ..... ***Peripsocus nitens***  
Clypeus not shining, mesothoracic pronotum with narrow median cream line; clypeal striae broken up, no well-marked color boundary at clypeal suture; fore wing less than 1.0 mm long ..... ***Peripsocus similis***

Genus ***Peripsocus*** Hagen

*Peripsocus* Hagen, 1866: 203.

*Peripsocopsis* Tillyard, 1923: 193.

***Peripsocus nitens*** Thornton & Wong

*Peripsocus nitens* Thornton & Wong, 1968: 129.—New & Thornton, 1981: 150.—Thornton & New 1981: 181.

*Distribution.* OAHU, MOLOKAI, MAUI, HAWAII, possibly indigenous; common. Occurs also in New Zealand, Robinson Crusoe I, and Chile (where females are frequently brachypterous).

This species, which has a close relative on the Galapagos (Thornton & Woo 1973), is found in Hawaii at heights up to 3130 m (9500 ft), the highest record for any psocid in Hawaii; it is apparently more numerous in the mountains on native trees than in the lowlands on introduced plants. It is thus exceptional among the nonendemic fauna; this ecological range removes it from serious competition with the 2 other species of *Peripsocus* (see below), which are predominantly lowland forms. It has been collected in most months of the year (all but March, April and November). Both sexes are present. The species has not yet been found on Kauai.

*Hawaiian records.* OAHU: Mt Tantalus, 650 m (2000 ft), 20.I.1931, F.X.W.; Kukuiala Val, *Hibiscus*, 16.VII.1933, O.H.S.; Moanalua Golf Course, 15.XI.1957, A.M.N.; Pupukea ridge trail, *Metrosideros*, 19.II.1963; Mt Kaala, 980–1150 m (3000–3500 ft), *Metrosideros*, 29.XII.1963; Pupukea, 500 m (1500 ft), 30.XII.1963. MOLOKAI: 820 m (2500 ft) above Kamiloloa, *Dodonaea*, 19.VII.1963. MAUI: Iao Val, 8.VIII.1918, O.H.S.; Haleakala, 650 m (2000 ft), *Melia* and *Eucalyptus*, 13.V.1963; Haiku, *Araucaria*, 13.V.1963; Haleakala, 3130 m (9500 ft), *Styphelia*, 20.IX.1963. HAWAII: Kilauea, 1320 m (4000 ft), 11.I.1917, W.M.G.; Kipuka Puauulu, Kilauea, *Pelea*, 12.X.1929, O.H.S.; Kipuka Puauulu, 1,2.IX.1957,

A.M.N. & E.L.M.; 20.IX.1957, A.M.N.; Mauna Loa, 1650 m (5000 ft), 3.IX.1957, E.L.M.; Kawaihae Uka, 1180 m (3600 ft), *Acacia koaia*, 29.I.1963; Kipuka Ki, Kilauea, *Schoenobia*, 30.I.1963; Kipuka Puaulu, *Dodonaea*, *Acacia koa*, 26.VI.1963; Saddle Road, nr Parker Ranch, 1650 m (5000 ft), *Dodonaea*, 26.I.1963; saddle between Mauna Kea and Kohala Mts, *Juniperus*, 26.VI.1963; Kawaihae Uka, 1150 m (3500 ft), dead and living *Myoporum*, 26.VI.1963; Waimea, 900 m (2700 ft), *Datura stramonium*, 27.VI.1963; Kawaihae Uka, 1150 m (3500 ft), dead *Acacia koaia*, dead *Myoporum*, 27.VI.1963; S Kona Agric. Exp. Stn, *Macadamia*, 28.VI.1963.

### **Peripsocus ferrugineus** Thornton & Wong

*Peripsocus ferrugineus* Thornton & Wong, 1968: 91-93.—Thornton et al. 1972: 107.—Thornton, 1981a: 46; 1981b: 120.

*Distribution.* KAUAI, OAHU, MOLOKAI, LANAI, MAUI, HAWAII, possibly accidentally introduced; frequent. This species is also found in the Marianas, Carolines, Fiji, Tonga, and Samoa.

In Hawaii it has been taken in all months except October, and is confined to the lowlands [below 650 m (2000 ft)], except for 1 record high on Haleakala on introduced plantation trees. In general, this species is not found on native trees. Both males and females have been collected.

*Hawaiian records.* KAUAI: Nawiliwili, 17.I.1944, N.H.L.K.; Hanapepe Val, *Dodonaea*, 11.IV.1963. OAHU: Honolulu, III.1930, O.H.S.; Pacific Heights, *Bobea*, O.H.S.; Honolulu, "mock orange" bark, 30.I.1944; upper Palolo Val, 14.VIII.1957, E.L.M.; Moanalua Golf Course, 15.XI.1957, A.M.N.; Mt Tantalus, 600 m (1800 ft), *Acacia koa* and *Psidium guajava*, 22.II.1963; Waimanalo, *Macadamia ternifolia* and *Acerola glabra*, 8,15.V.1963; Mt Tantalus, *Araucaria*, 20.VI.1963. MOLOKAI: Kainalu, 500 m (1500 ft), *Metrosideros*, *Wikstroemia*, and fern, 27.VII.1927, E.H.B. Jr. LANAI: Lanai City, 22.IX.1957, A.M.N. MAUI: Lower Iao Val, *Psidium guajava*, 13.V.1963; Haiku, *Araucaria excelsa* and *Casuarina*, 13.V.1963; Haleakala 2200 m (6700 ft), *Pinus ponderosa*, 14.V.1963; Waihee, *Prosopis chilensis*, 20.IX.1963. HAWAII: Saddle Road nr Hilo, 500 m (1500 ft), 29.VIII.1957, E.L.M.; Honokohau, 6.IX.1957, E.L.M. and 19.IX.1957, A.M.N.; nr Honokoa, *Macadamia*, C.R.

### **Peripsocus similis** Enderlein

*Peripsocus similis* End., 1903a: 290 (nec Badonnel, 1955).—Smithers, 1959: 274.—Thornton, 1959: 37; 1962a: 285; 1981a: 47; 1981b: 120.—Thornton & Wong, 1968: 22.

*Distribution.* KAUAI, OAHU, MOLOKAI, MAUI, HAWAII, accidental introduction or indigenous; common. Recorded also from Singapore, Hong Kong, Fiji and Tonga.

This species apparently lacks males and may be parthenogenetic. It occurs in almost all months, not yet having been recorded in March and August, and is found as high as 1150 m (3500 ft). Host plants include native and introduced trees, and this wider host preference may be a factor enabling it to coexist in the same areas as *P. ferrugineus*.

*Hawaiian records.* KAUAI: Waimea Val, 6.I.1944, N.L.H.K.; Hanapepe Val, *Dodonaea*, 11.IV.1963; Kokee, 26.XI.1963. OAHU: Palolo Val, 29.I.1922; Kaihikapu fish pond, 16.XII.1922, E.H.B. Jr; Mt Tantalus, *Euphorbia*, 28.X.1934, O.H.S.; Koko Crater, bred from *Xanthium*, XII.1939, E.C.Z.; Koko Head region, bred from "Ilima," XII.1939, E.C.Z.; University of Hawaii. 7.IX.1957, A.M.N.; Moanalua Golf Course, 15.IX.1957, A.M.N.; University of Hawaii, in laboratory, 25.II.1963; University campus, 19.VI.1963; Palikea, eastern Koolau Range, 720 m (2200 ft), 31.X.1963; Pupukea, western Koolaus, 500

m (1500 ft), *Acacia koa* and *Eucalyptus*, 30.XII.1963. MOLOKAI: Dunbar's pasture, 650 m (2000 ft), *Metrosideros*, 9.IV.1963; 650–820 m (2000–2500 ft) above Kamiloloa, *Acacia koa* and *Diospyros*, 19.VII.1963. MAUI: Haiku, *Araucaria*, 13.V.1963; Lahaina, *Prosopis chilensis*, 15.V.1963. HAWAII: Kamuela (Waimea), 5,17.IX.1953, A.M.N.; Honokohau, Kona, 6.IX.1957, E.L.M.; Kailua, Kona, 18.IX.1957, A.M.N.; Kawaihae Uka, 1150 m (3500 ft), dead *Acacia koaia*, 29.I.1963; Saddle Road, 1180 m (3600 ft), *Dodonaea*, 26.VI.1963; Kamuela (Waimea), 880 m (2700 ft), *Datura stramonium*, 26.VI.1963; road between Mauna Kea and Kohala Mts, *Juniperus*, 26.VI.1963; Kawaihae Uka, 1150 m (3500 ft), *Myoporum* and dead *Acacia koaia*, 26.VI.1963; Halepula, N Kona, 26.VI.1963; S Kona Agric. Exp. Stn, *Macadamia* and *Acerola glabra*, 28.VI.1963.

### Family ECTOPSOCIDAE Roesler, 1952

*Characteristics.* Fully winged or brachypterous, areola postica absent, pterostigma more or less rectangular; *rs* and *m* of hind wing joined by crossvein or point junction; 2 tarsal segments; aedeagal sclerites complex; claw without subapical tooth.

#### KEY TO HAWAIIAN SPECIES OF ECTOPSOCIDAE

1. Brachypterous, at most ♀ wings barely project beyond abdominal apex; venation usually reduced; tarsi without ctenidiobothria . . . **Ectopsocus richardsi**  
Wings normal in length; venation not reduced; tarsi normal . . . . . 2
2. Fore wings distinctly marked with extensive pigmented and hyaline areas . . . . . 3  
Fore wings uniformly hyaline, fuscous, or with indistinct paler areas only in marginal cells . . . . . 5
3. Veins of fore wing margined hyaline, pigmented areas largely discreet in each cell . . . . . **Ectopsocus spilotus**  
Veins of fore wing not bordered hyaline, pigmented areas extend over several cells without interruption . . . . . 4
4. Transverse hyaline band across fore wing near base; basal angle of cells *Cu*<sub>2</sub> and *An* dark; median oblique hyaline band barely extending into base of pterostigma, continous; pterostigma broader and rounded apically; apex of wing without marginal hyaline patches; head reddish-brown, thoracic terga paler . . . . . **Ectopsocus fullawayi**  
Base of cells *Cu*<sub>2</sub> and *An* hyaline, this hyaline patch not extending across wing transversely; median hyaline band always including basal ½ of pterostigma, interrupted; pterostigma not broader apically; apex of wing with 3 small hyaline patches; head and thoracic terga black **Ectopsocus perkinsi**
5. Fore wing hyaline, with dark spots on margin at end of each vein and at junction of *rs* and *m*; hind wing margin with 9 or more setae between ends of *rs* branches . . . . . **Ectopsocus meridionalis**  
Fore wing not as above; hind wing margin bare, or with less than 6 very fine setae between ends of *rs* branches . . . . . 6
6. Fore wing pale fuscous, vague semicircular paler areas in marginal cells; fore and hind wing margins bare . . . . . **Ectopsocus ornatoides**<sup>3</sup>

3. *Ectopsocus hawaiiensis* may be synonymous with 1 of these species. Enderlein states that the fore wing is hyaline and the margin bare.

- Fore wing uniform fuscous or pale fuscous with narrow cloudy margins to apical sections of  $m_2$ ,  $m_3$  and  $cu_1$ , apical margin of fore wing sparsely clothed with small fine setae . . . . . 7
7. Fore wing uniform fuscous, veins pale,  $m_2$ ,  $m_3$  and  $cu_1$  often margined cloudy brown apically; head and thorax pale yellowish brown; ♀ gonapophyses complete, ♂ without dorsal copulatory apparatus . . . **Ectopsocus maindroni**<sup>3</sup>  
Fore wing faintly fuscous, veins yellowish brown; head and thorax dorsally brown; ♀ gonapophyses incomplete, ♂ with obvious complex copulatory apparatus on dorsal surface of abdomen . . . . . **Ectopsocopsis cryptomeriae**<sup>3</sup>

### Genus **Ectopsocopsis** Badonnel

*Ectopsocopsis* Badonnel, 1955: 193.

#### **Ectopsocopsis cryptomeriae** (Enderlein)

*Ectopsocus cryptomeriae* End., 1907: 100 (nec Jentsch, 1939); 1908b: 771.—Okamoto, 1910: 189.—Banks, 1937: 267.—Takahashi, 1938: 13.

*Ectopsocopsis cryptomeriae* (End.): Badonnel, 1955: 185.—Thornton, 1962a: 294; 1964a: 288.—Mockford, 1965a: 115.—Thornton & Wong, 1968: 26.

*Ectopsocus pumilis* (Banks): Chapman, 1930: 380 (nec *Peripsocus pumilis* Banks, 1920).—Ball, 1931: 188.—Glick, 1939: 21.—Sommerman, 1942: 259; 1943: 53.—Gurney, 1950: 153.—Mockford, 1950: 199.

*Ectopsocopsis pumilis*: Badonnel, 1955: 185.—Mockford & Gurney, 1956: 364.—Mockford, 1961: 136.

*Ectopsocus lepnevae* Danks, 1955: 181; 1960: 32.

*Ectopsocopsis lepnevae* (Danks): Thornton, 1962a: 298.

*Distribution.* HAWAII, possibly accidental introduction; occasional. This species occurs in Europe (Botanical Gardens), Hong Kong, Malaya, Taiwan, Japan, the southern Marianas, Cuba and the United States, and was captured in ship's aerial nets near Japan and about 120 km SSE of Midway.

The species is associated with man's dwellings, and could have reached Hawaii via commerce.

*Hawaiian record.* HAWAII: Honokohau, 6.IV.1957, A.M.N.

### Genus **Ectopsocus** McLachlan

*Ectopsocus* McLachlan, 1899: 277.

*Micropsocus* Enderlein, 1901: 546.

*Chaetopsocus* Pearman, 1929: 105.

Mockford (1974: 148) states that *Ectopsocus titschacki* Jentsch has been recorded from Hawaii; this is not so.

#### **Ectopsocus fullawayi** Enderlein

*Ectopsocus fullawayi* End., 1913: 356; 1920: 453.—Fullaway, 1914: 22.—Banks, 1931: 438.—Zimmerman, 1948b: 234.—Swezey, 1954: 19.—Butler, 1961: 381.—Thornton & Wong, 1968: 132.—Mockford, 1972: 328.—Thornton et al., 1972: 102.—Thornton, 1981a: 43; 1981b: 117.

*Distribution.* LAYSAN, KAUAI, OAHU, MOLOKAI, LANAI, MAUI, HAWAII, probably indigenous; common. This species is known from Samoa, Tubuai (Austral Is), Pitcairn I, Easter I, Oeno, Henderson, Rapa, Mangareva, Fiji, Tonga, Laysan and Wake.

In Hawaii, it is largely confined to introduced plants in the lowlands, and so far has been collected in all months of the year except February and October.

*Hawaiian records.* LAYSAN: see Zimmerman (1948b); Butler (1961). KAUAI: Lihue, sweet potato, 2.V.1932; sugar cane, 8.VII.1942, McBryde; Lihue, 11.IV.1963; Kokee Road, *Dodonaea*, 11.IV.1963; Sleeping Giant, *Psidium guajava*, 13.IV.1963; Kalalau Val, nr shore, Java plum, 20,30.XI.1963. OAHU: Koko Crater; Mt Tantalus; Kewalo, 24.VII.1913; Manoa, *A. confusa*, 21.IX.1924, H.L. Lyons; Kailua, sugar cane, 26.III.1929, F.X.W.; Waimanalo, *Acacia* pods, 28.XII.1929; Wailua, smutty cane, 15.III.1930, O.H.S.; Haleauau, *Acacia koa*, 14.IX.1930, O.H.S.; Waimea, asparagus, 18.V.1937, O.H.S.; Waimanalo, dead *Macadamia* blossoms, 1.I.1963, *Macadamia*, 10.IV.1963, 6,8.V.1963, *Acerola glabra*, 6.V.1963; University of Hawaii, 19.VI.1963, 7.IX.1957, A.M.N.; Nuuanu Pali, 13.VIII.1957, E.L.M.; Mt Kaala, 610 m (1880 ft), 20.XII.1963. MOLOKAI: Mapulehu, 6.VI.1932, O.H.S. LANAI: Lanai City, 22.IX.1957, O.H.S.; 15.IX.1957, A.M.N. MAUI: Kepaniwai Park, 16.IX.1957, A.M.N. HAWAII: Kukuiahaela, fallen nest in cane, 21.XI.1962, G.E. Haas; Honokohau, Kona, 6,19.IX.1957, A.M.N.; Hilo, *Araucaria*, 6.IX.1961; Captain Cook, *Datura*, 28.VI.1963; S Kona Agr. Exp. Stn, *Macadamia*, *Acerola glabra*, 28.VI.1963.

### ***Ectopsocus hawaiiensis* Enderlein**

*Ectopsocus hawaiiensis* End., 1913: 356; 1920: 453.—Banks, 1931: 438.—Carter & Ho, 1932: 44.—Zimmerman, 1948b: 235.

*Distribution.* Recorded from OAHU. According to Zimmerman the species is also found in Guam and Samoa.

Specimens in the HSPA collection labelled *E. hawaiiensis* are actually *E. ornatoides* (see below). It is possible that all clear-winged species of *Ectopsocus* have been referred to this species in Hawaii. Enderlein provided no information on genitalic characters, and the type is not available for dissection.

### ***Ectopsocus maindroni* Badonnel**

*Ectopsocus maindroni* Badonnel, 1935a: 81; 1946: 180; 1948: 316; 1949: 43; 1955: 183.—Ball, 1943: 6.—Thornton 1962a: 299; 1962b: 453; 1964a: 286, 287; 1964b: 346.—Thornton et al., 1972: 102.—Thornton & Woo, 1973: 31.

*Ectopsocus cryptomeriae* Enderlein: Takahashi, 1938: 13.—Jentsch, 1939: 125 (nec Enderlein 1907).

*Distribution.* KAUAI, OAHU, probably accidental introduction; can be locally abundant. This species has a widespread distribution, being recorded from Arabia, Ivory Coast, Congo, Malaya, Hong Kong, Taiwan, Philippines, Japan, Marianas, Palau, Kusaie, Marshalls, Gilberts, Galapagos Is, Cuba, United States, Mexico, and England (warehouse, ship's hold). It has been captured in air traps on ships in the Indian Ocean (2×), near Malaya, and near Honolulu, although these captures may be the result of port infestations (Thornton 1964a).

In Honolulu it has been found in houses, one infestation being unusually heavy (Thornton 1964b). In 1962 a specimen was taken by a U.S. Department of Agriculture quarantine officer in Honolulu on material originating in Hong Kong.

The species evidently has a wide range of habitats, having been recorded from vegetation, drawers, walls, cupboards, moldy shoes and stored food in houses, the cavity of a wild fig, a young fish owl, and deep inside the Batu Caves, Malaysia.

It seems likely, from the habitats of the species, that it gained access to Hawaii by commerce rather than by natural air dispersal.

*Hawaiian records.* KAUAI: Kokee, 1180 m (3600 ft), bark of *Metrosideros*, 2.VI.1963. OAHU: Kailua, massive infestation on moldy shoes and inside walls of house, 5.X.1963; Honolulu, in house, 12.VI.1963, G.W. Byers; Honolulu, old dog biscuits, 5.XI.1963, C.R.; Honolulu, stored hominy (crushed maize), 10.X.1963, C.R.; Palikea, E Koolau Range, 720 m (2200 ft), *Metrosideros*, 31.X.1963.

### ***Ectopsocus spilotus* Thornton & Wong**

*Ectopsocus spilotus* Thornton & Wong, 1968: 107.—Thornton et al., 1972: 106.—Thornton, 1981a: 45; 1981b: 118.

*Distribution.* HAWAII, possibly accidental immigrant; occasional. This species occurs also in Samoa, Fiji, Tonga, and in the Marshall and Gilbert groups.

The fore wing pattern easily distinguishes *E. spilotus* from the other Hawaiian species of the genus. Males have yet to be found in Hawaii.

*Hawaiian record.* HAWAII: Captain Cook, *Datura* (in flower), 28.VI.1963.

### ***Ectopsocus meridionalis* Ribaga**

*Ectopsocus briggsi* McL. var. *meridionalis* Ribaga, 1904: 294.—Badonnel, 1943b: 100.

*Ectopsocus meridionalis* Rib.: Enderlein, 1907: 101.—Okamoto, 1910: 189.—Rosen, 1911: 8.—Takahashi, 1938: 12.—Jentsch, 1939: 119.—Ball, 1943: 4.—Badonnel, 1943b: 152; 1945: 4; 1946: 179; 1955: 185; 1963: 335.—Mockford, 1959: 262; 1961: 136.—Smithers, 1960b: 371.—Thornton, 1962a: 300.—Thornton & Wong, 1968: 28.—Thornton & Woo, 1973: 31.

*Ectopsocus californicus* (Banks): McLure, 1936: 113.—Sommerman, 1943: 53 [nec *Peripsocus californicus* Banks, 1903; *Ectopsocus californicus* (Banks) Chapman, 1930: 377].

*Ectopsocus parvulus* (Kolbe): Weber, 1931: 457 (nec *Peripsocus parvulus* Kolbe, 1882).

*Ectopsocus briggsi* McL.: Badonnel, 1931: 243; 1935b: 112; 1935c: 155; 1936: 101.

*Distribution.* MOLOKAI, HAWAII, accidental or natural introduction; occasional. This species has been reported from Europe, Morocco, Cameroons, Congo, Mozambique, Angola, Natal, Hong Kong, Taiwan, Japan, eastern United States, Mexico, Galapagos Is, Colombia and Chile.

A male of the related species *E. briggsi* was captured in ship's aerial nets some 200 km from the leeward islands of the Hawaiian chain (Thornton & Harrell 1965), and possibly this species will also be found in Hawaii. Mockford (1959) provides a useful key to the *briggsi* complex.

*Hawaiian records.* MOLOKAI: nr Kamoku cabin, 1150 m (3500 ft), dead *Eucalyptus* leaves, 19.VII.1963. HAWAII: Hilo, 30.VIII.1957, E.L.M.; Kipuka Puauulu, 1300 m (4000 ft), 1,2.IV.1957, A.M.N.; Kipuka Puauulu, 1300 m (4000 ft), 20.IX.1957; Honokohau, 500-650 m (1500-2000 ft), 6.IX.1957, E.L.M. & A.M.N.

**Ectopsocus ornatooides** Thornton & Wong

*Ectopsocus ornatooides* Thornton & Wong, 1968: 103.—Thornton et al., 1972: 105.—Thornton, 1981a: 44.

*Distribution.* OAHU, accidental introduction; occasional. It has also been found on the Bonins, Volcanos, Carolines, Marianas, Marshalls, Fiji and Samoa.

This species is possibly synonymous with *E. hawaiiensis*; specimens in the HSPA collection labelled *hawaiiensis* belong to this species, and the type of *E. hawaiiensis* is unfortunately not available for dissection.

*E. ornatooides* is closely related to *E. ornatus* Thornton, from Hong Kong.

In Hawaii the species is apparently confined to the area around Honolulu, occurring chiefly on introduced plants, and is possibly a recent arrival.

*Hawaiian records.* OAHU: Honolulu, *Ficus bengalensis*, 17.IV.1944; Honolulu, pods of pigeon pea, 6.IV.1944; Honolulu, *Ficus bengalensis*, 26.VIII.1950 and 3.X.1963; Palikea, E Koolau Range, 700 m (2200 ft) 31.X.1963; Waimanalo, *Macadamia*, *Acerola glabra*, 6,8.V.1963; *Metrosideros*, 31.X.1963.

**Ectopsocus perkinsi** Banks

*Ectopsocus perkinsi* Banks, 1931: 438.—Williams, 1931: 371.—Zimmerman, 1948b: 235.—Suehiro, 1960: 291.—Thornton & Wong, 1968: 118–20.—Thornton, 1981a: 44; 1981b: 118.

*Distribution.* KURE, MIDWAY, NIHOA, OAHU, HAWAII; possibly accidental introduction; occasional. This species also occurs on Tubuai, Samoa, Fiji and Tonga.

In Hawaii it is not nearly as common on the high islands as its close relative *E. fullawayi*, although it has been collected on more of the low leeward islands. It is confined to introduced plants in the lowlands.

*Hawaiian records.* KURE: 16 specimens in Bishop Museum collection, no other data. MIDWAY: 5 specimens, no data. NIHOA: 1 specimen, no data. OAHU: Honolulu, Woodlawn, about new garden compost, 22.I.1941, F.X.W.; Oahu Country Club, 14.IX.1957, A.M.N. HAWAII: Honokohau, 19.IX.1957, A.M.N.; Captain Cook, *Datura stramonium*, 28.VI.1963.

**Ectopsocus richardsi** (Pearman)

*Chaetopsocus richardsi* Pearman, 1929: 105.—Zimmerman, 1948b: 233.

*Ectopsocus richardsi* (Pearman): Pearman, 1942: 290; 1960: 248.—Thornton, 1962a: 300.—Thornton & Woo, 1973: 32.

*Distribution.* OAHU, MAUI, HAWAII, probably accidental introduction; occasional. This species has been recorded from a London wharf, Gold Coast, Tanganyika (on a rat), Hong Kong, the Galapagos Is, and North America.

In Hawaii it has been found in houses and also high on Haleakala, East Maui. It is often associated with commerce, and was possibly introduced to Hawaii in this way, although the population high on Haleakala, obviously quite a stable one, is somewhat puzzling.

*Hawaiian records.* OAHU: Honolulu, in package of beans from N America, J.S. Roza (Zimmerman 1948); Punaluu, on mould, 7.XI.1943, E.C.Z. MAUI: Haleakala, gulch nr Puu Niauniau, 1900 m (6200

ft), on bird's-claw fern, 16.VII.1919; nr Puu Niauniau, 24.VI.1945, E.C.Z. HAWAII: nr Humuula, *Acacia koa*, 3.VIII.1946, E.C.Z.

### Family HEMIPSOCIDAE Pearman, 1936

*Characteristics.* In fore wing *m* 2-branched, areola postica joined to *m* by crossvein, tarsi 2-segmented.

### Genus **Hemipsocus** Selys-Longchamps

*Hemipsocus* Selys-Longchamps, 1872: 146.

#### KEY TO SPECIES OF HEMIPSOCUS IN HAWAII

Setae on fore wing veins sited on distinct brown spots . . . . . **roseus**

Setae on fore wing veins not sited on distinct brown spots . . . . . **chloroticus**

### **Hemipsocus chloroticus** (Hagen)

*Psocus chloroticus* Hagen, 1858: 474; 1859: 200; 1866: 212.—McLachlan, 1872: 77.

*Hemipsocus chloroticus* (Hagen): Selys-Longchamps, 1872: 145 (nec Enderlein, 1903a: 234, 1908b: 767; nec Soehardjan & Hamann, 1959: 9).—Enderlein, 1915: 39.—Karny, 1932: 125.—Enderlein, 1926: 53.—Banks, 1937: 260; 1942: 25.—Tsutsumi, 1964: 118.—Thornton et al., 1972: 180.—Mockford, 1973: 319-20.

*Hemipsocus chloroticus* var. *stenostigmus* Banks, 1942: 25 [nec *Hemipsocus chloroticus* (Hagen) var. *luridus* Enderlein, 1903a: 235; nec Soehardjan, 1958: 30].

*Hemipsocus hyalinus* Enderlein, 1906b: 311.—Okamoto, 1907: 135.

*Distribution.* HAWAII, probably accidental introduction; rare. Previously recorded from Ceylon, Vietnam, Borneo, Java, Taiwan, Japan, Amami Is, Philippines, Guam, Carolines, Marshalls, southern Mexico, Guatemala and Florida; the species was found but once during 1963. Mockford (1973) records its introduction to Florida on orchid plants from Guatemala or India, and it is likely that this species is distributed accidentally through commerce.

*Hawaiian record.* HAWAII: 400 m (1200 ft) above Captain Cook, dead fronds of *Cibotium*, 28.VI.1963.

### **Hemipsocus roseus** (Hagen)

*Psocus roseus* Hagen, 1859: 203.

*Epipsocus roseus* (Hagen): McLachlan, 1872: 78.—Enderlein, 1903a: 256.

*Hemipsocus roseus* Banks, 1931: 438.—Williams, 1931: 373.—Sakimura & Linford, 1940: 431.—Zimmerman, 1948b: 236.—Banks, 1939: 136.—Kuwayama, 1961: 203.—Thornton, 1964a: 287.—Thornton, et al., 1972: 109.

*Distribution.* OAHU, LANAI, MAUI, probably introduced on sugar cane; locally common. This species is also reported from Ceylon, Thailand, the Philippines, Palau, Ponape, and Central America and the West Indies. On 2 occasions it has been trapped in ships' aerial nets near the Philippines (Thornton 1964a).

The other spotted-winged form of this genus in the Oriental Region, *H. luridus* End., apparently differs but slightly from this species; it is recorded from Malaya, Singapore, Sumatra, Java, Taiwan and Samoa, and I have collected it on Lombok.

The types are not available for study. I have examined spotted-winged *Hemipsocus* in the Bishop Museum collections from Saigon.

In Hawaii, *H. roseus* is a strictly lowland species and has been taken in November, January, February, March, and May and seems to be particularly associated with sugar cane; Williams (1931) regarded it as probably the commonest psocid in the cane fields of Oahu. It has also been recorded on pineapples on Lanai.

*Hawaiian records.* OAHU: southern Waianae Range, 9.XI.1919, O.H.S.; Honolulu, HSPA Agric. Exp. Stn, sugar cane, 29,31.I.1929, 6.II.1929, 14.II.1929, 12.III.1929, 19,20.IX.1929, F.X.W.; Honolulu, 15.V.1943, E.C.Z. LANAI: "on pineapples" (Sakimura & Linford 1940). MAUI: Lahaina, sugar cane, 15.V.1963.

#### Family PSEUDOCAECILIIDAE Pearman, 1936

*Characteristics.* Veins setose, pterostigma long, areola postica low and long, gonapophyses complete; tarsi 2-segmented.

#### Genus *Pseudocaecilius* Enderlein

*Pseudocaecilius* Enderlein, 1903a: 260.

#### KEY TO HAWAIIAN SPECIES OF PSEUDOCAECILIIDAE

- Fore wing with fuscous patches on areola postica, pterostigma, junction of *rs* and *m*, cells *Cu*<sub>2</sub> and *An*; vein *m* not strongly bent towards areola postica ..... ***Pseudocaecilius criniger***  
 Fore wing with areola postica hyaline, no fuscous patch on pterostigma or *rs-m* junction, vein apices cloudy, vein *m* strongly bent towards areola postica ..... ***Lobocaecilius monicus***

#### *Pseudocaecilius criniger* (Perkins)

*Elipsocus criniger* Perkins, 1899: 85.

*Pseudocaecilius criniger* (Perkins): Thornton et al., 1972: 112.—Thornton, 1981a: 48; 1981b: 123.

For full synonymy see Thornton & Woo (1973: 34).

*Distribution.* KAUAI, OAHU, MOLOKAI, LANAI, MAUI, HAWAII, possibly accidental introduction; frequent. Recorded also from tropical Africa, Mozambique, Madagascar, India, the Malay Peninsula, South China, Taiwan, Java, the Philippines, Bonins, Marianas, Carolines, Fiji, Tonga, and the Galapagos Is, it is possibly synonymous with *P. citricola* Ashmead (southern USA and Puerto Rico).

In Hawaii, *P. criniger* is very largely restricted to the lowlands and to introduced plants; it has been taken in January, March, April, July, and September to December inclusive.

*Hawaiian records.* KAUAI: 8.VII.1919, McBryde; Nawiliwili, 17.I.1944, N.L.H.K.; Waimea Val, 6.I.1944, N.L.H.K. OAHU: Ewa coral plain, 29.I.1922, O.H.S.; Ulupalakua, sooty mold on *Psidium guajava*, 12.XI.1924; Honolulu, *Ficus*, 19.X.1929, O.H.S.; Waimanalo, *Ficus*, 20.XI.1929, O.H.S.; Honolulu, *Ficus retusa*, 17.XII.1929, O.H.S.; Waialua, *Ficus*, 16.I.1930, O.H.S.; University of Hawaii, 7.IX.1957,

A.M.N. MOLOKAI: Hoolehua, 23.IX.1957, A.M.N. LANAI: 650 m (2000 ft), 5.XII.1916, W.M.G. MAUI: Waiakoa, lime, 29.IV.1945, E.C.Z. HAWAII: Kona, 650 m (2000 ft) (Perkin's type of *E. criniger*); Papaikau, 1.III.1919, O.H.S.; Keaau Orchard, nr Olaa, IX.1956, R. Namba; Honokohau, 19.IX.1957, A.M.N.

### Genus *Lobocaecilius* Lee & Thornton

*Lobocaecilius* Lee & Thornton, 1967: 12-13.

#### *Lobocaecilius monicus* Lee & Thornton

*Lobocaecilius monicus* Lee & Thornton, 1967: 86.

*Distribution.* KAUAI, OAHU, MOLOKAI, LANAI, MAUI, HAWAII, possibly indigenous. This species has not been recorded from anywhere other than Hawaii, and it is not represented in the Bishop Museum collections from other Pacific areas.

It has been collected in all months other than January and October, at elevations from sea level to 1320 m (4000 ft), on both introduced and native plants. It is certainly not restricted to the lowlands; it may be a relatively early arrival and possibly will prove to be endemic to Hawaii.

*Hawaiian records.* KAUAI: Halemanu, *Euphorbia*, 21.VIII.1921, O.H.S.; Nualolo, 1.IX.1921, O.H.S.; Halemanu, *Acacia koa*, 12.VIII.1925, O.H.S.; Kumuwela, *Pritchardia*, 1.VII.1932, O.H.S.; Mohihi Stream, 1150 m (3500 ft), VII.1963, D.E.H.; Halemanu Swamp, VIII.1953, D.E.H.; Waiakoali Val, 1200 m (3700 ft), VIII.1953, D.E.H.; Alakai Swamp, 22.VIII.1957; Kokee, 18-22.VIII.1957; Kalalau Lookout, 23.VIII.1957, E.L.M.; Kokee, 10.IX.1957, A.M.N.; Sleeping Giant, *Psidium guajava*, 13.IV.1963; Kokee, *Araucaria*, 27.VII.1963; Mohihi Stream, 29.VII.1963; Kokee Road, 820-980 m (2500-3000 ft), *Acacia koa*, 29.VII.1963; Kumuweia Trail, Kokee, *Acacia koa*, 29,30.VII.1963, 1.VIII.1963; nr Camp Slogget, *Acacia koa*, 1.VIII.1963; road between Kokee and Puu Ka Pele, *Acacia koa*, 1.VIII.1963; Mohihi Stream, *Cryptomeria* and *Straussia*, 30.VII.1963; Kalalau-Waimea divide, 1300 m (4000 ft), *Metrosideros*, 26.XI.1963; Kokee, 1050 m (3200 ft), *Acacia koa*, 26.XI.1963; beginning of Alakai Swamp trail, *Metrosideros*, 27.XI.1963. OAHU: Mt Kaala, fire-break trail, *Pisonia sandwicensis*, 11.II.1928, O.H.S.; Kamokuiki Val, *Antidesma*, 2.IV.1933, O.H.S.; Mt Tantalus, XII.1953, D.E.H.; Oahu Country Club, 30.VIII.1957, A.M.N.; University of Hawaii, 7.IX.1957, A.M.N.; Mt Tantalus, 600-650 m (1800-2000 ft), *Acacia koa*, *Metrosideros*, *Psidium guajava*, *Sadleria*, 22.II.1963; Mt Kaala, 650 m (2000 ft), *Metrosideros*, 14.III.1963; Waimanalo, *Macadamia*, 6.V.1963; Mt Tantalus, *Psidium guajava*, *Acacia koa*, 20.VI.1963. MOLOKAI: N ridge Hipuapua Gulch, *Metrosideros*, 15.VII.1963; N ridge Halawa Val, nr Kepookoholoa, dead fronds *Cibotium*, 16.VIII.1963; 650 m (2000 ft), above Kamiloloa, *Eucalyptus*, 19.VIII.1963; nr Kamoku cabin, 1150 m (3500 ft), dead *Eucalyptus* leaves, *Cheirodendron*, 19.VIII.1963; valley, 1320 m (4000 ft), S of Hanalilililo, *Metrosideros*, 19.VIII.1963. LANAI: Lanai City, 22.IX.1957, A.M.N. MAUI: Kepaniwai Park, 16.IX.1957, A.M.N. HAWAII: Hilo, 30.VIII.1957, E.L.M.; Kohala watershed reserve, 4.IX.1957, E.L.M.; Kamuela (Waimea), 5,17.IX.1957, A.M.N.; Honokohau, 19.IX.1957, A.M.N.; Kipuka Puaulu, 1.IX.1957, A.M.N.; upper Olaa Forest, 1320 m (4000 ft), VII.1956, D.E.H.; saddle between Mauna Kea and Kohala Mts, dead *Eucalyptus* leaves, *Juniperus*, 26.VI.1963; 400 m (1200 ft), above Captain Cook, dead and live fronds *Cibotium*, 28.VI.1963; S Kona Agric. Exp. Stn, *Macadamia*, 28.VI.1963; forest above Honokaa, 650 m (2000 ft), VIII.1963, D.E.H.; nr Honokaa, *Macadamia*, 13.XII.1963, C.R.; Pahala, *Macadamia*, 12.XII.1963, C.R.

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