

The coral bugs, genus *Halovelie* Bergroth (Hemiptera, Veliidae).

I. History, classification, and taxonomy of species except the *H. malaya*-group

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Marine bugs of the genus *Halovelie* Bergroth inhabit intertidal coral reefs and rocky coasts along the continents and larger islands bordering the Red Sea, Indian Ocean, and western Pacific Ocean as well as on island groups and atolls in these areas. A historical review of the study of the genus is presented and different views upon its classification discussed. The genus *Halovelie* is redescribed together with its type species, *H. maritima* Bergroth, and four other previously known species. Fifteen new species are described: *H. carolinensis* sp.n. (Caroline Islands), *H. halophila* sp.n. (Sumbawa, Sabah), *H. corallia* sp.n. (Papua New Guinea, Australia: Queensland), *H. esakii* sp.n. (Solomon Islands, Irian New Guinea, Moluccas, Sulawesi, Sumbawa, Palau Islands, Philippines), *H. polhemi* sp.n. (Australia: Northern Territory), *H. solomon* sp.n. (Solomon Islands), *H. novoguineensis* sp.n. (Papua New Guinea), *H. fosteri* sp.n. (Fiji Islands), *H. tongaensis* sp.n. (Tonga Islands), *H. heron* sp.n. (Australia: S. Queensland), *H. fijiensis* sp.n. (Fiji Islands), *H. inflexa* sp.n. (Sudan, Red Sea), *H. annemariae* sp.n. (Solomon Islands, Papua New Guinea), *H. lannae* sp.n. (Java, Singapore, West Malaysia, Sabah, Philippines), and *H. wallacei* sp.n. (Sulawesi, Sumbawa). Two names are synonymized: *H. marianarum* Usinger syn.n. (= *H. bergrothi* Esaki) and *H. danae* Herring syn.n. (= *H. bergrothi* Esaki). The following species are removed from the genus *Halovelie*: *H. papuensis* Esaki, *H. loyaltiensis* China, and *H. (Colpoveia) angulana* Polhemus. A key to the species is included. The taxonomy of the *H. malaya*-group will be presented in Part II of this work together with the cladistics, ecology, biology, and biogeography of the genus.

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About 80 species of semiaquatic bugs (Hemiptera, Gerromorpha), representing four families and six subfamilies, inhabit the marine environment, chiefly the nearshore areas of tropical seas with a strong tidal influence (Andersen & Polhemus 1976; Andersen 1982). The majority of these marine species occurs in the Indo-Pacific area, along the continents and larger islands bordering the Red Sea, the Indian Ocean, and the western Pacific Ocean, as well as on island groups or atolls in these areas. The most familiar group is the sea skaters, genus *Halobates* Eschscholtz (Gerridae), the species of which are widely distributed in intertidal habitats in the Indo-Pacific area (Herring 1961; Cheng 1985). In comparison with the sea skaters, other groups of marine Gerromorpha have been much less explored.

Marine gerromorphans represent a unique life form among insects. As a rule, they inhabit the water surface like their freshwater relatives, the waterstriders. The adults are always wingless and therefore unable to disperse by flight. They are confined to coastal habitats which means that a land mass of any size is a major obstacle to their distribution. On the other hand, they may disperse easily along the coast, along chains of islands, and perhaps even across stretches of sea water. One would expect that such insects have a unique history of evolution and geographical distribution. Unravelling the taxonomy, phylogeny, and biogeography of marine waterstriders could be an interesting supplement to the prevailing studies of land insects.

This study of the marine waterstriders belonging to the subfamily Haloveliinae (Veliidae) was under-

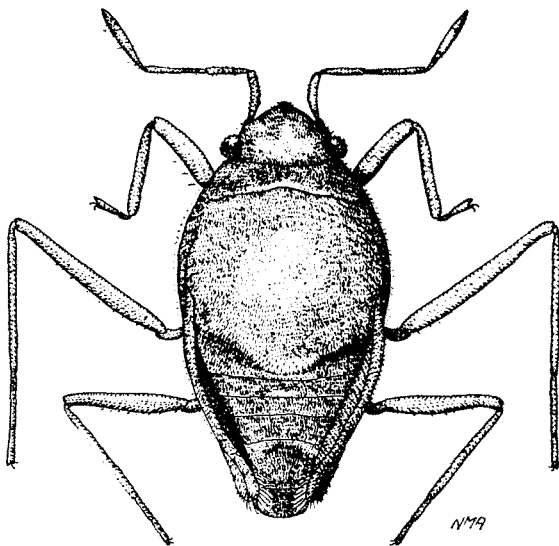


Fig. 1. *Halovelgia maritima* Bergroth, female paralectotype, Cartier Island, Timor Sea.

taken because material accumulated during the past ten years suggested that these groups have radiated extensively in habitats of intertidal coral, rocky, and mangrove coasts, especially in the Indo-Malayan, Papuan and Australian subregions. The number of undescribed species recognized in the material available has increased to the order of 50, which should be compared with a number of 12 previously described species.

In the present work, a new concept of the genus *Halovelgia* Bergroth (1893) is presented. As a result it is necessary to transfer a few *Halovelgia* species to the genus *Xenobates* Esaki (1927) and to erect a new genus for *Halovelgia papuensis* Esaki (1926a) which will be described in a forthcoming paper (Andersen *in prep.*). In addition to the 9 described species, 23 species of *Halovelgia* are described as new to science, and two names are synonymized.

Halovelgia-species are small insects, rarely more than 2 mm long, with long and slender middle legs. They are usually dark coloured but appear greyish or silverish owing to their densely pubescent body. Most species inhabit the intertidal zone of coral reefs. It is therefore suggested that they are given the trivial name *coral bugs*.

The present work is divided in two parts. In Part I (the present one), the genus *Halovelgia* Bergroth is redescribed together with previously known and new species except those belonging to the *H. malaya* Esaki-group. In Part II, the species belonging to the

H. malaya-group will be described, the results of a cladistic analysis of relationships between all species of *Halovelgia* will be presented, our knowledge of their ecology and biology reviewed, and the historical biogeography of the genus analysed and discussed.

HISTORY

The genus *Halovelgia* was established by the Finnish hemipterist E. Bergroth in 1893. He described the only included species, *H. maritima* from several specimens collected by the British entomologist J.J. Walker under blocks of coral, below the high water mark, on the small Cartier Island in the Timor Sea, c. 250 km NW. of Australia. Bergroth cites Walker's (1891: 235) account of the circumstances of his capture of these curious marine bugs. Bergroth's remarks (1893: 278) "Judging by the habits of this insect, it has presumably no winged form, as the use of wings to it seems rather problematical. The dense velvety clothing of the body makes it possibly capable of retaining air and breathing for some time, even when submerged at high water", clearly indicate that he, at least intuitively, recognized that his new genus and species was quite unique, both in structure and biology. Bergroth states (l.c.): "The nearest ally to *Halovelgia* is the genus *Microvelia*, Westw?", and thereby placed the genus in the family Veliidae.

The second species, *Halovelvia amphibia*, was described by Bergroth in 1906, from Zanzibar, East Africa. He remarks (1906: 70; translated from German): "Of this genus has Dr. Voeltzkow found a new species on the island Zanzibar which has the same way of life as *H. maritima* Bergr. It lives on the beach beneath stones and stays during high tide under water, during low tide on dry land."

Bergroth's descriptions of his two species of *Halovelvia* were in Latin, adequate but not detailed enough to make the species recognizable. In 1924, Esaki recorded *H. maritima* from Japan (Province of Sagami, Honshu), Okinawa, and from Formosa. He redescribed the species and gave the first illustrations of *Halovelvia*. He also provided the first detailed observations on the habitat, food, locomotory, and sexual behaviour of these insects.

Hale (1926) recorded *H. maritima* from Pelsart Islands, Western Australia, redescribing and illustrating adults as well as nymphs. He recognized and illustrated the grasping comb of the male fore tibiae (a typical veliid character), but incorrectly described the fore tarsi as three-segmented.

While both Bergroth and Hale placed *Halovelvia* in the family Veliidae, Esaki (1924a) transferred the genus to the family Gerridae (l.c., p. 29) "The four-jointed rostrum, the unusually long distance between the bases of the anterior and two posterior pairs of legs, and the posterior femur which extends beyond the end of the abdomen certainly place this insect in the Gerridae and not in the Veliidae." In his report on the waterstriders of the gerrid subfamily Halobatinae of the Hungarian National Museum, Esaki (1926a) described three new species of *Halovelvia*. He also gave the first key to the genus, now comprising five species. One of the new species, *H. septentrionalis*, was described upon specimens from Japan, etc., first identified as *H. maritima* by Esaki (1924a). Esaki (1926a) communicated personally with Bergroth on several questions concerning *Halovelvia* and also states (l.c., p. 162) that he had examined the types of *H. maritima* and *amphibia* in Bergroth's collection. Esaki (1930), while describing another new species, *H. malaya*, established the subfamily Haloveliinae for the genera *Xenobates*, *Strongylovelvia* Esaki (1924b), *Entomovelvia* Esaki (1930), and *Halovelvia* Bergroth. He also gave a check-list to species.

Usinger (1946), while describing a new species, *H. marianarum*, commented upon the systematic position of *Halovelvia*. He agreed with Bergroth and Hale in that the genus belongs in the Veliidae. He

further states (l.c., p. 100) "The lateral thoracic scent glands of the Veliidae are distinct and functional (judging by small globules of hardened exudate at the openings in some specimens) in *Halovelvia*, whereas gerrids have a single scent gland opening (omphalium) at the middle of the metasternum."

In a report on the marine Hemiptera of the Monte Bello Islands (Western Australia), China (1957) added two new species and gave a revised key to the species of *Halovelvia*. China discussed the systematic position of *Halovelvia* at length, with reference to previous views. He discarded the use of tarsal segmentation, presence of a fore tibial comb in male, number of rostral segments, presence of a median, longitudinal groove on vertex, and a lateral channel to the metathoracic scent gland, as distinguishing characters for the Veliidae and Gerridae for the reason that these characters were too variable within both families. He (op.cit., pp. 351-352) examined and compared the structure of the male genitalia in *Halovelvia* and the ocean skaters, *Halobates* Eschscholtz, especially the various sclerotized pieces of the distended aedeagus. The result of China's discussion was a revised couplet in the key to the families of Gerroidea (= Gerromorpha) in China & Usinger (1949) and speculations about the phylogenetic significance of the apparent intermediate nature of the Haloveliinae. However, several of China's observations were incorrect (e.g., parameres always reduced in the Gerridae, lateral scent channels absent in *Halovelvia*).

Nevertheless, Poisson (1956) while describing a new species, *H. pauliani*, used about the same arguments to establish a separate family, the Haloveliidae, intermediate between the Veliidae and Gerridae. Andersen (1982: 177-182) showed that this view was unjustified and his cladistic analysis of relationships between the subfamilies of Veliidae, gave evidence to support a hypothesis of the Haloveliinae as sister group of the Microveliinae.

Additional new species of *Halovelvia* have been described by Herring (1958) and Polhemus (1982). Finally, Kellen (1959) gave a comprehensive account on the biology of *H. marianarum* Usinger in Samoa, including observations on the behaviour of the insects in relation to the tidal cycle, ways of locomotion, sexual behaviour, feeding, and both embryonic and nymphal development. Andersen & Polhemus (1976) reviewed the present knowledge of the biology and distribution of *Halovelvia*.

Table 1. Statistics for measurements of 10 males of *Halovelia bergrothi* Esaki from New Georgia, Solomon Islands. Measurements in micrometer units, 10 units = 125 μm . (S.D., standard deviation; C.V., coefficient of variation).

	Mean	Range	S.D.	C.V.
Total length	121.2	118-124	1.93	1.59
Body width	63.3	62-65	1.06	1.67
Anten. segm. 1	23.4	22-25	0.97	4.13
Anten. segm. 2	16.3	16-17	0.48	2.96
Anten. segm. 3	16.2	15-17	0.63	3.90
Anten. segm. 4	20.2	20-21	0.63	3.13
Fore femur	38.2	36-40	1.32	3.45
Fore tibia	34.1	33-36	0.99	2.92
Fore tarsus	15.0	14-16	0.47	3.14
Middle femur	90.7	88-94	1.77	1.95
Middle tibia	85.5	83-89	2.37	2.77
Middle tarsus	65.6	62-70	2.50	3.82
Hind femur	47.4	46-49	1.26	2.67
Hind tibia	39.2	38-41	1.23	3.14
Hind tarsus	18.3	17-19	0.82	4.50

MATERIAL AND METHODS

More than 4,000 specimens of *Halovelia* were examined during the present study. The material belongs to the institutions and collections listed as depositories below. Type material of the species of *Halovelia*, including the synonymized species, has been studied, with the exception of *H. malaya* Esaki and *pauliani* Poisson. Before 1975, material of *Halovelia* was quite rare and usually limited to unique specimens or series of specimens from few localities. The Hungarian National Museum, Budapest, contains most of the material published by Esaki (1926a). Other valuable materials are present in the Bernice P. Bishop Museum, Honolulu, the British Museum (Natural History), London, and the Zoological Museum, University of Copenhagen, the latter containing the material collected during the Danish "Dana", "Galathea", and "Noona Dan" expeditions.

Within the past two decades, the search for marine waterstriders has been greatly intensified. By understanding the habit and habitats of the marine semiaquatic bugs, Dr Lanna Cheng and her husband, Dr Ralph A. Lewin, from Scripps Oceanographic Institution, La Jolla, have been able to collect far more specimens of *Halovelia* and allied groups than previously known from places like Singapore, Australia, the Fiji, Solomon, and Palau Islands, and in the Seychelles. Dr W.A. Foster, Cambridge, has provided valuable material from the Fiji and Tonga Islands. Finally, Drs John T. Polhemus and Dan A. Polhemus, on expeditions sponsored by the National Geographic Society, have

gathered abundant material of marine haloveliines from a large number of localities throughout the Indo-Malayan archipelago, Papua New Guinea, New Caledonia, and Australia. The present study would be most incomplete without the efforts of the above mentioned persons.

In the lists of material examined for each species, the localities are arranged alphabetically for each major area. These areas are chiefly geographically rather than politically determined. This means that the numerous islands which constitute Indonesia are listed in their geographical context, e.g., Kalimantan under Borneo and Irian Jaya under Irian New Guinea, and that separate headings are given for Sulawesi (Celebes), the Moluccas (Maluku), and the Lesser Sunda Islands (Nusa Tenggara Barat). East Malaysia (Sarawak, Sabah) is listed under Borneo.

Marine haloveliines are preferably killed and preserved in 70% ethyl alcohol which is also the best way of storing them although specimens usually becomes more or less discolored when stored in alcohol for many years. It is therefore advisable to dry mount synoptic series of samples as done during the present study.

Most examinations were performed using a LEITZ stereo microscope. Due to the minute size of the insects studied, magnifications of 100-150x were frequently used. The problem of getting enough light on the object at such high magnifications was solved by using a VOLPI fiberglass lamp. Measurements were taken with an eyepiece micrometer. Except as indicated, all relative measure-

ments are given in micrometer units, 10 units equal 125 μm . Some structural details required examination in a Reichert ZETOPAN research microscope with interference contrast equipment (after Nomarski), at magnifications above 200x. Scanning Electron Micrographs were taken with the JEOL JSM-840 at the Zoological Museum, University of Copenhagen.

The morphological terminology follows Andersen (1982). Most taxonomic features are identified in Figs. 2-19. As a rule, absolute measurements (total length and maximum width of body) are given to show the range of variation of each species. Relative measurements are only given for one specimen of each sex, usually the holotype and a paratype of the opposite sex. Statistics for the variability of the length of antennal and leg segments are presented in Table 1 based upon measurements of 10 males of *Halovelvia bergrothi* Esaki.

In order to examine the male genitalia, whole specimens or the detached genital segments were transferred into a few drops of lactic acid (50% aqueous solution) which has a macerating and softening effect (eventually after gentle heating). The male claspers and phallic organ were exposed with the aid of fine dissecting needles and forceps. Following examination, the genitalia were stored in a plastic microvial containing glycerine, which was pinned with the specimen. Examination of the female gynatrial complex requires treatment with Chlorazol Black E which dyes otherwise transparent structures.

List of depositories

(The abbreviations given below have been used in the lists of material examined and throughout the text).

- ANIC Australian National Insect Collection, CSIRO, Canberra.
- AMNH American Museum of Natural History, New York.
- BPBM Bernice P. Bishop Museum, Honolulu.
- BMNH British Museum (Natural History), London.
- CUMZ University Museum of Zoology, Cambridge.
- HNM Hungarian National Museum, Budapest.
- IRSN Institut Royal des Sciences Naturelle, Brussels.
- JTPC John T. Polhemus Collection, Englewood, Colorado.
- MHNP Museum Histoire Naturelle, Paris.
- RML Rijksmuseum van Natuurlijke Historie, Leiden.
- UQ Entomology Department, University of Queensland, Brisbane.
- USNM U.S. National Museum of Natural History, Washington, D.C.

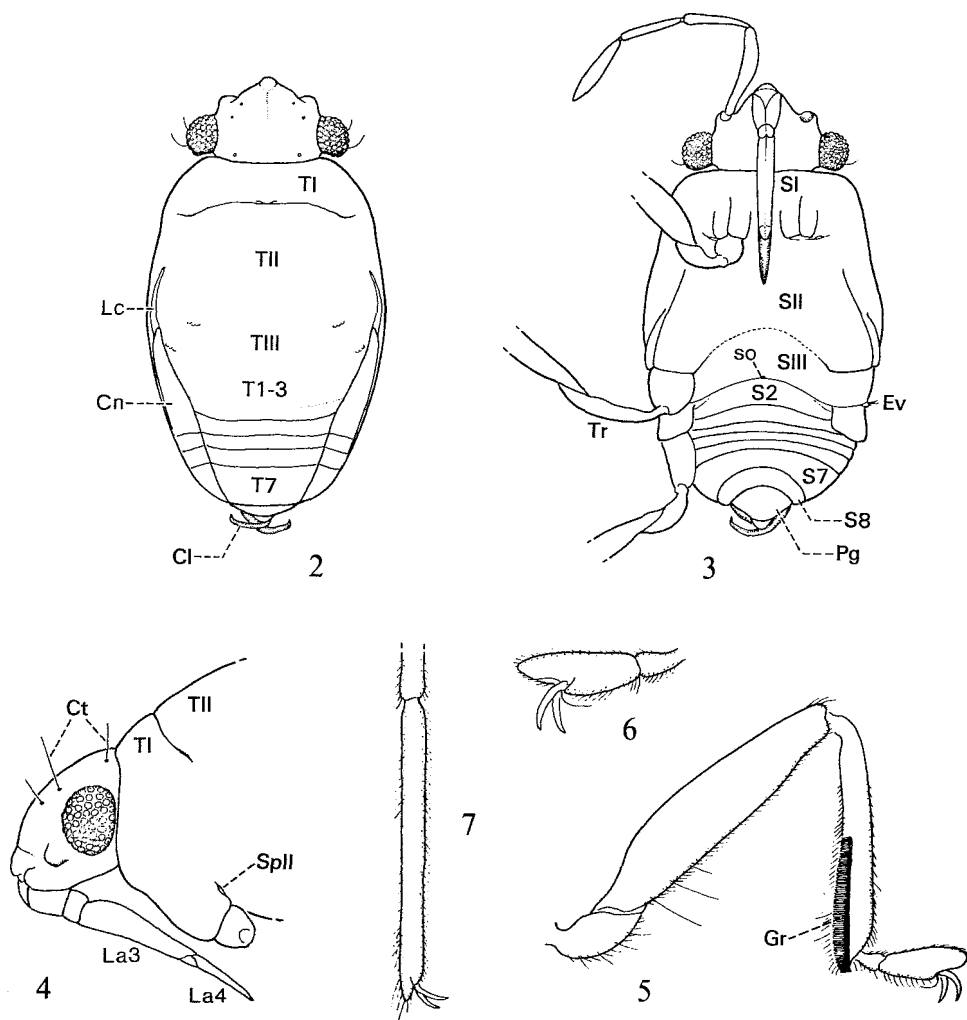
ZMUC Zoological Museum, University of Copenhagen.
ZMUH Zoological Museum, University of Helsinki.

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The material upon which this study is based was gratefully borrowed from or donated by the following persons and institutions: Dr R.T. Schuh (AMNH); Mr W.R. Dolling (BMNH); the late Dr W.C. Gagné (BPBM); Dr T. Vasarhelyi (HNM); Dr J. Van Stalle (IRSN); Dr J. Carayon and Mlle D. Pluot (MHNP), Drs P.H. van Doesburg and J. van Tol (RML), Mrs M.A. Schneider (UQ), Drs R.C. Froeschner and the late J.L. Herring (USNM); Dr A. Jansson (ZMUH). I am much indebted to Dr L. Cheng, La Jolla, and Dr W.A. Foster, Cambridge for sending me much valuable material, and especially to Dr J.T. Polhemus, Englewood, Colorado, for placing his large collection of marine haloveliines at my disposal, for giving me access to his valuable field notes, and for his kind hospitality during my stay in Englewood, Colorado. Dr G.F. Gross, Adelaide, and Mr I. Lansbury, Oxford, assisted in locating critical material. My colleagues, Mr M. Andersen, Dr G. Høpner-Petersen, and Dr C. Nielsen, added valuable material from Phuket Island, Thailand. Mr M. Stoltze and Mr J. Strange supplied specimens from Tanzania, and Dr H. Mori from Japan.

Dr J.T. Polhemus, Englewood, Colorado, read and criticized an earlier version of the manuscript. The paper has been improved by his valuable comments, for which I am most grateful. I am indebted to Mrs Eva Bonde, Mr Gert Brovad, and Mr Bent W. Rasmussen, at the Zoological Museum, Copenhagen, for technical assistance.

A grant from the Danish Natural Science Research Council enabled me to spend three weeks at the Phuket Marine Biological Center, Thailand, collecting and studying the biology of marine waterstriders. I am grateful to the Director and staff of the PMBC, and to the Danish supervisor of the center, Dr J. Hylleberg, for the excellent working facilities offered during my stay in Phuket. Other grants from the Danish Natural Science Research Council enabled me to visit the American Museum of Natural History, New York, the U.S. National Museum of Natural History, Washington, D.C., and the J.T. Polhemus collection, Englewood, Colorado.



Figs. 2-7. *Halovelvia bergrothi* Esaki. 2. Male, dorsal view; antennae and legs removed. 3. Male, ventral view; left antennae and legs removed. 4. Lateral view of female head and prothorax; antennae and fore leg except coxa removed. 5. Left fore leg of male. 6. Fore tarsus. 7. Distal segment of middle tarsus. Abbreviations: Cl, clasper; Cn, abdominal connexivum; Ct, cephalic trichobothria; Ev, lateral evaporatorium of scent channel; Gr, grasping comb of male fore tibia; La3, La4, labial (rostral) segments 3 and 4; Lc, lateral cleft of meso-metanotum; Pg, pygophore (segment 9) of male; S2, S7, S8, abdominal sterni 2, 7, and 8; SI, SII, SIII, pro-, meso-, and metasternum; so, scent orifice; SpII, mesothoracic spiracle; T1-3, T7, abdominal terga 1-3 and 7; TI, TII, TIII, pro-, meso-, and metanotum.

CLASSIFICATION

There have been disagreements about the systematic position of the genus *Halovelvia* Bergroth and allied genera. Bergroth himself (1893) considered *Halovelvia*'s nearest allied to be the genus *Microvelia* Westwood, thereby placing his genus in the large gerromorphan family Veliidae. Hale (1926) sup-

ported this view by demonstrating the presence of a specialized comb on the male fore tibiae of *Halovelvia* shared by the Australian species of *Microvelia*. Despite this, Esaki (1924a, 1926a) transferred the latter genus to the other large gerromorphan family, the Gerridae, on the basis of the four-segmented rostrum (incorrectly supposed to be three-segment-

ed in the Veliidae; see Fig. 4), the long distance between the points of insertion of the fore legs and the middle and hind legs, and the long hind femur, characters which he claimed placed *Halovelvia* in the Gerridae and not in the Veliidae. Esaki (1930) erected a separate subfamily, the Haloveliinae, for the genera *Halovelvia*, *Strongylovelvia* Esaki (1924b), *Xenobates* Esaki (1927), and *Entomovelvia* Esaki (1930). This subfamily was raised to family rank by Poisson (1956).

China & Usinger (1949) separated the Veliidae from the Gerridae on the shorter middle femora of veliids and the presence of a median longitudinal groove on the veliid head, said to be absent in gerrids. However, since the middle femora are long and the median groove is obsolete on the head of *Halovelvia*, this genus should be placed in the Gerridae according to China & Usinger's definition. In a revised key, China (1957) separated the two families on a combination of characters including some features of the male genitalia (claspers large and vesica membranous in veliids), but none of these characters is diagnostic. China (op.cit.) failed to observe the lateral scent channels on the metasternum of *Halovelvia* present in all veliids (and some gerrids). Usinger (1946) took these structures as evidence for this genus belonging to the Veliidae (although his suggestion that the scent orifices were situated laterally on metathorax is incorrect). Although the Haloveliinae were placed in the family Veliidae both by China & Usinger (1949) and China (1957), it was also suggested that this subfamily lies at the base of the Gerridae in their evolution from the more primitive Veliidae (China 1957: 352). Andersen (1982: 179), however, did not find any evidence to support such a hypothesis.

The major cause of confusion about the systematic position of *Halovelvia* and allied genera is the difficulties in separating the two large families of the Gerromorpha, the Veliidae and Gerridae. Andersen (1982) analysed and discussed this problem in detail. The ground plan of each family was reconstructed, i.e., the set of most plesiomorphic character states observed among the members of the family. This revealed a number of character states which could be used, as synapomorphies, to support the hypothesis of monophyly for each of the two families. For the Veliidae these character states were (using the original character numbers in Andersen 1982, table 12): 43, egg with several micropyles; 44, head deflected in front of eyes; 45, male front tibia with grasping comb. Similarly for

the Gerridae: 46, embryonic egg burster frontal; 47, ocelli absent; 48, four pairs of cephalic trichobothria; 49, mesothorax prolonged, coxal axes of middle and hind legs horizontal; 50, tarsi with two segments, basal segment comprised of the fused primitive first and second segments.

Because of homoplasious evolution (convergence, reversal) some subordinate groups of each family do not show *all* of the postulated synapomorphies. The Haloveliinae are particularly illustrative of this principle. At least some species of *Halovelvia* have eggs with only one micropyle; most haloveliine genera lack the male grasping comb; no haloveliine has ocelli; all haloveliines have a more or less prolonged mesothorax, horizontal middle and hind coxae, and two-segmented tarsi. Thus, judged by these characters alone the Haloveliinae should be included in the Gerridae. Some of these characters, however, are secondarily modified within either the Veliidae or the Gerridae. For instance, some gerrids (Ptilomerinae, Halobatinae) have eggs with several micropyles; only one genus of veliids (*Ocellovelvia*) has ocelli; several veliids beside the haloveliines have two-segmented tarsi, etc.

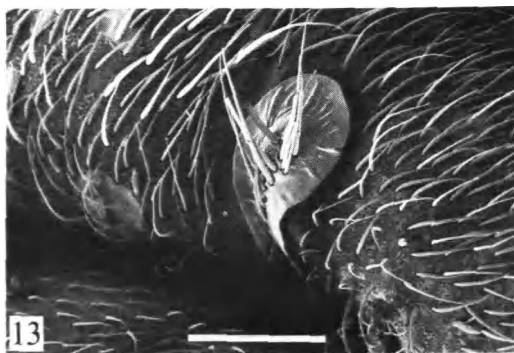
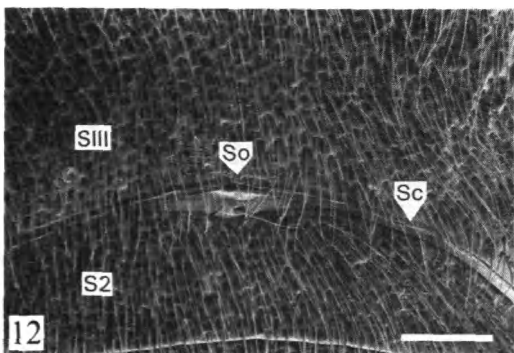
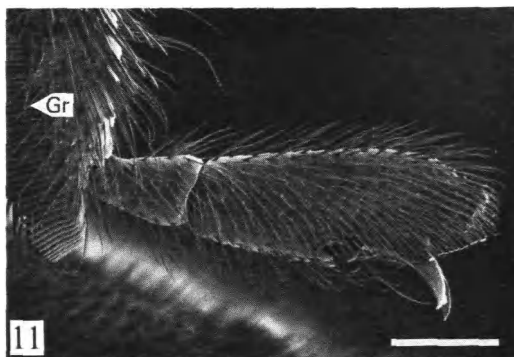
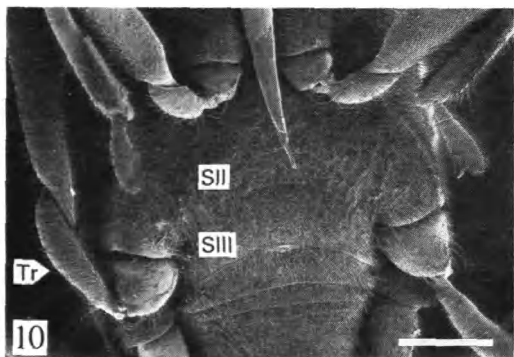
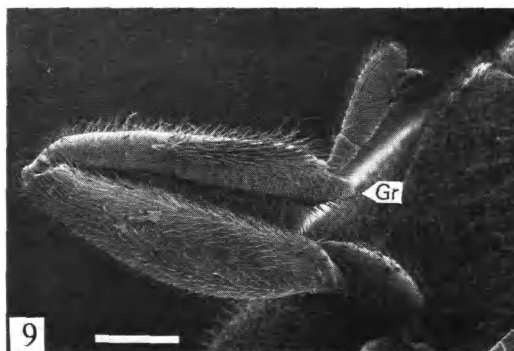
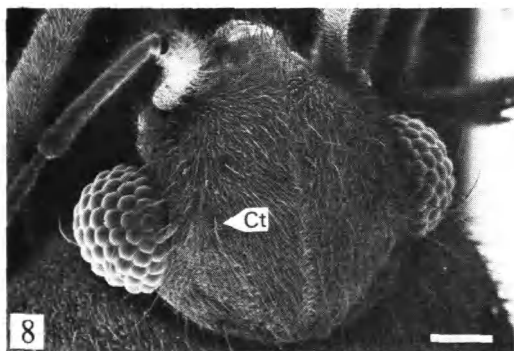
There are, however, a number of characters shared by the genera of Haloveliinae and Veliidae which strongly corroborates the hypothesis of these taxa belonging to the same monophyletic group. These are:

- 1) Head capsule deflected in front of the eyes. This state is quite distinct in *Entomovelvia doveri* Esaki (Andersen 1982: fig. 265) and species of *Strongylovelvia*, less so in species of *Halovelvia* (Fig. 4). Most veliids have more or less deflected head capsules while gerrids usually have a more or less porrect head capsule, with a long free ventral region.

- 2) Fore tibiae of male with a row of short spines forming a grasping comb. Such a comb is present in *Halovelvia* (Figs. 5 and 9, Gr), absent in the other haloveliine genera. It is found in most veliids but never observed in any gerrid.

- 3) Hind femora distinctly thickened, at least in basal parts, always much shorter than middle femora. Most veliids, including the haloveliines, have short and distinctly incrassate hind femora while the hind femora of gerrids usually are long and almost invariably more slender than their middle femora.

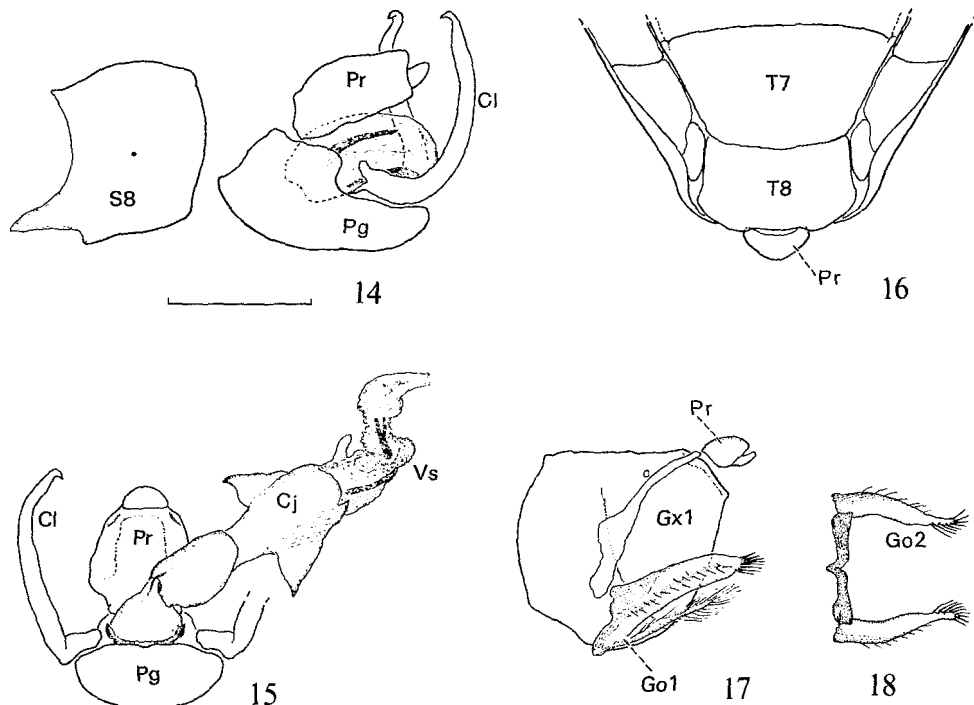
- 4) Embryonic egg burster median and clypeal. This structure is the typical one found in the Veliidae. The embryonic egg burster of the Gerridae is



Figs. 8-13. *Halovelvia bergrothi* Esaki. Scanning Electron Photomicrographs. 8. Head of female, dorsal view; scale 100 μm . 9. Left fore leg of male with tibial grasping comb; scale 100 μm . 10. Thorax and basal abdomen of male, ventral view; scale 200 μm . 11. Tarsus of male fore leg; scale 50 μm . 12. Metasternum of male with scent orifice and lateral scent channels; scale 50 μm . 13. Evaporatorium of lateral scent channel; scale 50 μm . Abbreviations: Ct, cephalic trichobothrium; Gr, tibial grasping comb; S2, abdominal sternum 2; SII, SIII, meso- and metasternum; Sc, scent channel; So, scent orifice; Tr, trochanter.

median, frontal and knifelike (Andersen 1982). Kellen (1959: figs. 7a-c) illustrates the egg burster of the prolarva of *Halovelvia marianarum* Usinger. It is almost identical in structure to that found, e.g., in *Microvelia* (Cobben 1968: fig. 55).

Andersen (1982: 179-182, fig. 357) depicted the Haloveliinae as sister-group of the Microveliinae. This hypothesis was supported by the following synapomorphies (using the original character numbers in Andersen 1982, table 10): 7, salivary pump



Figs. 14-18. *Halovelvia bergrothi* Esaki. 14. Male genital segments in lateral view, pygophore pulled out of segment 8; scale 200 μ m. 15. Male pygophore with inflated phallus in caudal view, right clasper cut off; same scale. 16. Female abdominal end, dorsal view. 17. First gonocoxa and gonapophysis of right side, lateral view; same scale as above. 18. Second gonapophyses, dorsal view. Abbreviations: Cj, phallic conjunctivum; Cl, clasper; Go1, Go2, gonapophyses 1 and 2; Gx1, gonocoxa 1; Pg, pygophore (segment 9); Pr, proctiger; S8, abdominal sternum 8; T7, T8, abdominal terga 7 and 8; Vs, phallic vesica.

with distinct dark sclerite in dorsal wall; 8, middle and hind tarsi with two segments; basal segment formed by fusion of the primitive first and second segments; 9, fecundation canal with pump (see Fig. 19, FP).

The conclusion is that the Haloveliinae should be classified in the family Veliidae. The status of the haloveliines as a separate family as proposed by Poisson (1956) is rejected on the grounds that it will make the Veliidae a non-monophyletic group.

The subfamily Haloveliinae contains at present the genera *Halovelvia* Bergroth, *Strongylovelvia* Esaki, *Xenobates* Esaki, and *Entomovelvia* Esaki. The generic classification of the Haloveliinae will be reviewed in a forthcoming paper.

TAXONOMY

Genus *Halovelvia* Bergroth

Halovelvia Bergroth, 1893: 277 (description); Esaki 1924a:

29; Hale 1926: 202 (key), 203 (descriptive notes); Esaki 1926a: 157-159 (descriptive notes), 164 (key to species); Esaki 1930: 24 (check-list to species); China 1957: 350-352 (description), 356 (key to species); Andersen 1982: 133ff. (descriptive notes), 411 (list), 420 (key).

Type species: *Halovelvia maritima* Bergroth, 1893 (Fig. 1); by monotypy.

Description

Small or very small insects, always wingless (apterous). Body chiefly dark coloured, covered by a dense pubescence which is more or less greyish, especially on abdomen. Thoracic and abdominal dorsum without definite spots of silvery hairs.

Body usually subovate, length 1.7-2.0x (σ) or 2.0-2.6x (φ) greatest width. Head much shorter than wide, moderately deflected in front of eyes (Fig. 4); dorsal surface at most with an indistinct median groove and without pseudocellar pits (Figs. 2 and 8). Eyes globular but relatively small, width of

each eye less than 0.3x width of head between eyes. Antennae long and slender (Fig. 3), usually 0.6-0.8x total length; segment 1 usually subequal in length to head; segment 3 at most 1.3x length of segment 2.

Pronotum very short (Fig. 3, TI), usually only $\frac{1}{3}$ of head length in middle; dorsal suture between pro- and mesothorax usually obliterated laterally, rarely distinct throughout, reaching lateral margins of thorax; sutures between pro- and mesopleura lost (Fig. 4); sutures between mesonotum (TII) and metanotum (TIII) and between metanotum and basal abdominal terga (T1-3) obliterated, only marked by pairs of lateral pits; thoracic notum with lateral clefts (Fig. 2, Lc) extending forwards from connexiva. Prosternum very narrow (Fig. 3, SI), mesosternum (SII) and metasternum (SIII) widened due to the lateral displacement of meso- and metacetabula; suture between meso- and metasternum indistinct, suture between metasternum and abdominal sternum only retained laterally; the median scent orifice (so) situated in posterior part of metasternum; scent channels (Ev) extending laterally and obliquely backwards; lateral evaporatoria small, ovate, each with a tuft of long hairs (Fig. 13).

Middle legs much longer than fore and hind legs, all tarsi two-segmented. Fore trochanter of male not modified; male fore tibia with a grasping comb (Figs. 5 and 9, Gr) composed of a compact row of short spines along the inner margin (Fig. 10); second segment of fore tarsus much longer than first segment; claws long, falcate, preterminal; arolia bristlelike (Fig. 6). Trochanter of middle leg prolonged (Fig. 3, Tr), much longer than middle coxae; middle femur very long and slender, usually more than 0.6x (σ) or 0.5x (\varnothing) total length of insect, slightly thickened proximally; femur with short pubescence along anterior margin; tibia and tarsus very slender and long; tarsus 0.7-0.8x length of tibia; second tarsal segment 1.3-1.5x first segment; claws short, falcate, subterminal (Fig. 7). Hind coxae usually prolonged (Fig. 3, hind femur relatively short, slightly incrassate proximally; second tarsal segment 1.5-2.0x first segment, claws small.

Abdomen short with broadly rounded sides in male, relatively longer and usually with more straight sides in female; connexiva broad and obliquely inclined (σ), sometimes vertically raised or inflexed upon abdominal dorsum (\varnothing); abdominal terga 1-3 completely fused (Fig. 2, T1-3); terga 4-7 distinctly separated by intersegmental sutures, tergum 7 longest. Abdominal venter usually simple,

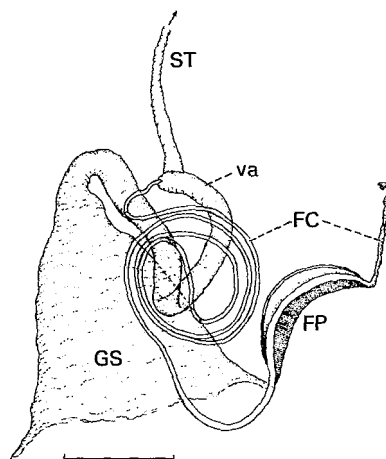


Fig. 19. *Halovelia bergrothi* Esaki. Female gynatrial complex, dorsal view; scale 100 μ m. Abbreviations: FC, fecundation canal; FP, fecundation pump; GS, gynatrial sac; ST, spermathecal tube; va, vermiform appendix.

segments shortened in male (Fig. 3); female abdomen with hind margin of sternum 7 produced in middle.

Male genital segments relatively large but withdrawn into pregenital abdomen and only slightly protruding from abdominal end (Fig. 3); segment 8 (S8) with a pair of large apodemes on anterior margin (Fig. 14); pygophore (Pg) subovate and simple; proctiger (Figs. 14-15, Pr) slightly widened proximally; claspers (Cl) large, symmetrically developed. Phallic conjunctivum (Cj) with lateral processes; vesica (Vs) with three dark sclerites, dorsal sclerite usually broad, proximally forked, lateral sclerites elongate.

Female genital segments clearly visible behind tergum 7 (Fig. 16); tergum 8 (T8) usually large; first gonocoxae subquadrate (Fig. 17, Gx1); first gonapophyses (Go1) apically with short spines and lateral lobes with hairlike outgrowths; second gonapophyses (Fig. 18, Go2) connected by sclerotized bridge; proctiger (Fig. 17, Pr) cone- or button-shaped. Female gynatrial complex (Fig. 19) with broad, distally narrowing gynatrial sac (GS), without distinct glandular areas; gynatrial sac on top with long vermiform appendix (va); fecundation canal (FC) long, with several loops, provided with large fecundation pump (FP); distal part of fecundation canal short and straight; spermathecal tube (ST) very long (description based upon *bergrothi*).

Species excluded from the genus *Halovelis* Bergroth*Halovelis papuensis* Esaki

Halovelis papuensis Esaki, 1926a: 160 (description; type area: Dregerhafen, New Guinea).

Note: Transferred to a new genus described in a forthcoming paper (Andersen *in prep.*).

Halovelis loyaltiensis China

Halovelis loyaltiensis China, 1957: 354-355 (description; type area: Loyalty Islands).

Note: Transferred to the genus *Xenobates* Esaki, 1927 (Andersen *in prep.*).

Halovelis (Colpovelis) angulana Polhemus

Halovelis (Colpovelis) angulana Polhemus, 1982: 7-9 (description; type area: Darwin, Northern Territory, Australia).

Note: Transferred to the genus *Xenobates* Esaki, 1927 (Andersen *in prep.*).

Key to the species of *Halovelis* Bergroth
(except the *H. malaya*-group)**Males** (male of 2. *amphibia* Bergroth unknown)

1. Antennal segment 3 distinctly longer than segment 2 (ratio 1.2:1 or more)..... 2
 - Antennal segment 3 subequal to or only slightly longer than segment 2 (ratio less than 1.2:1)..... 13
2. Eyes small, width of an eye distinctly less than 1/4 head width between eyes..... 3
 - Eyes larger, width of an eye subequal to or more than 1/4 head width between eyes..... 4
3. Clasper broad (Fig. 36). Cartier Island, Timor Sea..... 1. *maritima* Bergroth (p. 87)
 - Clasper slender (Fig. 37). Caroline Islands..... 3. *carolinensis* sp.n. (p. 90)
4. Abdominal venter with basal tumescence furnished with long hairs (Fig. 80)..... 5
 - Abdominal venter not modified as described above..... 8
5. Grasping comb of front tibia very short, only 1/6 tibial length. Front femora mostly pale. Fiji Islands..... 16. *fosteri* sp.n. (p. 113)
 - Grasping comb of front tibia longer, distinctly more than 1/6 tibial length. Front femora dark..... 6
6. Elongate ovate species, total length about 2.0x greatest width across thorax. Clasper slender (Fig. 89). Solomon Islands..... 14. *solomon* sp.n. (p. 110)
 - Broadly ovate species, total length less than 2.0x greatest width across thorax. Clasper stout (Fig. 84)..... 7
7. Small species, total length less than 1.5 mm. Australia: Northern Territory..... 13. *polhemi* sp.n. (p. 109)
 - Larger species, total length more than 1.5 mm. Solomon Is., Irian New Guinea, Moluccas, Celebes, Palau Islands, Philippines..... 12. *esakii* sp.n. (p. 107)
8. Grasping comb of fore tibia very short, less than 1/5 tibial length..... 9
 - Grasping comb of fore tibia longer, about 2/5 tibial length..... 10
9. Small species, total length less than 1.7 mm. Grasping comb of fore tibia only 1/6 tibial length. Queensland, Papua New Guinea..... 5. *corallia* sp.n. (p. 92)
 - Larger species, total length more than 1.9 mm. Grasping comb of fore tibia more than 1/6 tibial length. Sumbawa, Sabah..... 4. *halophila* sp.n. (p. 92)
10. Small species, total length less than 1.6 mm. Tonga Islands..... 17. *tongaensis* sp.n. (p. 115)
 - Larger species, total length more than 1.6 mm..... 11
11. Abdominal venter deeply depressed in middle. Clasper stout, with spatulate apical part (Fig. 98). Papua New Guinea..... 15. *novoguineensis* sp.n. (p. 112)
 - Abdominal venter not modified as above. Clasper very slender, with narrow and pointed apical part..... 12
12. Hind femur distinctly thicker than middle femur (Fig. 109). Clasper (Fig. 110). Solomon Islands, Papua New Guinea..... 18. *annemariae* sp.n. (p. 115)
 - Hind femur only slightly thicker than middle femur..... *H. malaya*-group
13. Claspers long and stout, dorso-ventrally flattened, distinctly protruding behind genital segment (Fig. 114). Grasping comb of fore tibia subequal to or less than 1/3 of tibial length..... 14
 - Claspers not as described above. Grasping comb distinctly more than 1/3 tibial length..... 15
14. Blade of clasper distinctly spatulate (Fig. 115). Grasping comb of fore tibia less than 1/3 tibial length. Java, Singapore, West Malaysia, Sabah, Philippines..... 19. *lannae* sp.n. (p. 116)
 - Blade of clasper not spatulate (Fig. 117). Grasping comb of fore tibia about 1/3 tibial length. Celebes, Sumbawa..... 20. *wallacei* sp.n. (p. 119)
15. Claspers relatively short (length less than half width of head across eyes), in resting position barely crossing each other above genital segment (Fig. 48)..... 16
 - Claspers very long (length subequal to or more than half width of head across eyes), in resting position distinctly crossing each other above genital segment (Figs. 45-46)..... 17
16. Clasper short and stout, with hook-shaped apex (Fig. 55). Fiji Islands..... 9. *fijiensis* sp.n. (p. 103)
 - Clasper long and slender, with simply pointed apex..... *H. malaya*-group
17. Abdominal venter with a basal tumescence furnished with long hairs. Japan, Ryukyu Islands, Taiwan..... 10. *septentrionalis* Esaki (p. 104)
 - Abdominal venter not modified as above..... 18
18. Clasper distally flattened with apex blunt (Fig. 75). Sudan, Red Sea..... 11. *inflexa* sp.n. (p. 106)

- Clasper distally not flattened, apex pointed or hook-shaped. 19
 - 19. Extreme apex of clasper almost straight (Fig. 54). Australia: S. Queensland. 8. *heron* sp.n. (p. 102)
 - Extreme apex of clasper hook-shaped (at least in some angles of view, Figs. 49-50, 52). 20
 - 20. Distal part of clasper rather abruptly turned mesad (Figs. 49-50). Vietnam, Philippines, Papua New Guinea, Solomon Islands, New Caledonia, Mariana Islands, Caroline Islands, Marshall Islands, Nauru, Samoa Islands. 6. *bergrothi* Esaki (p. 93)
 - Distal part of clasper smoothly curved (Fig. 52). (Australia, Papua New Guinea, New Caledonia, Loyalty Islands). 7. *hilli* China (p. 99)
- Females** (female of 8. *solomon* sp.n. unknown)
- 1. Antennal segment 3 distinctly longer than segment 2 (ratio 1.2:1 or more). 2
 - Antennal segment 3 subequal to or only slightly longer than segment 2 (ratio less than 1.2:1). 13
 - 2. Middle femur less than 0.5x total length of insect. 3
 - Middle femur equal to or more than 0.5x total length of insect. 7
 - 3. Eyes small, width of an eye distinctly less than ¼ head width between eyes. 4
 - Eyes larger, width of an eye subequal to or more than ¼ head width between eyes. 5
 - 4. Smaller species, total length less than 2.0 mm. Queensland, Papua New Guinea. 5. *corallia* sp.n. (p. 92)
 - Larger species, total length more than 2.0 mm. Sumbawa, Sabah. 4. *halophila* sp.n. (p. 92)
 - 5. Thoracic and basal abdominal dorsum with short, uniform pubescence. Zanzibar, Madagascar. 2. *amphibia* Bergroth (p. 88)
 - Posterior mesonotum, metanotum and basal abdominal terga with a patch of long pubescence. 6
 - 6. Proctiger not exposed behind tergum 8 (Fig. 21). Cartier Island, Timor Sea. 1. *maritima* Bergroth (p. 87)
 - Proctiger exposed behind tergum 8 (Fig. 26). Caroline Islands. 3. *carolinensis* sp.n. (p. 90)
 - 7. Fore femora, thoracic pleura, and connexiva pale. Fiji Islands. 16. *fosteri* sp.n. (p. 113)
 - Fore femora, thoracic pleura, and connexiva dark. 8
 - 8. Fusiform species, total length equal to or more than 2.2x greatest width across thorax. 9
 - Subovate species, total length less than 2.2x greatest width across thorax. 11
 - 9. Abdominal connexiva thickened in basal parts. *H. malaya*-group
 - Abdominal connexiva not thickened in basal parts. 10
 - 10. Thoracic dorsum raised in middle (Fig. 119), regularly depressed towards abdominal dorsum. Mesothorax laterally with long, suberect pubescence, but no distinct tufts of hairs. Solomon Islands, Papua New Guinea. 18. *annemariae* sp.n. (p. 115)
 - Thoracic dorsum raised throughout, abruptly depressed towards abdominal dorsum. Mesothorax laterally with distinct tufts of hairs. Papua New Guinea. 15. *novoguineensis* sp.n. (p. 112)
 - 11. Small species, total length less than 1.7 mm. Australia: Northern Territory. 13. *polhemi* sp.n. (p. 109)
 - Larger species, total length more than 1.7 mm. 12
 - 12. Thorax in lateral view (Fig. 108) strongly convex dorsally. Tonga Islands. 17. *tongaensis* sp.n. (p. 115)
 - Thorax in lateral view (Fig. 91) moderately convex dorsally. Solomon Islands, Irian New Guinea, Moluccas, Celebes, Palau Islands, Philippines. 12. *esakii* sp.n. (p. 107)
 - 13. Fusiform species, total length equal to or more than 2.2x greatest width across thorax. 14
 - Subovate species, total length less than 2.2x greatest width across thorax. 16
 - 14. Abdomen modified, broad at base but distinctly narrowed posteriorly. Connexiva thickened in basal parts, inflexed upon abdominal dorsum, at last in their distal parts. *H. malaya*-group
 - Abdomen not modified as described above, basally with subparallel sides. Connexiva erect throughout. 15
 - 15. Small species, total length equal to or less than 2.2 mm. Thoracic dorsum only moderately raised (Fig. 123). Sumbawa, Celebes. 20. *wallacei* sp.n. (p. 119)
 - Larger species, total length more than 2.2 mm. Thoracic dorsum distinctly raised (Fig. 121). Java, Singapore, West Malaysia, Sabah, Philippines. 19. *lannae* sp.n. (p. 116)
 - 16. Middle femur less than 0.6x total length of insect. Connexiva inflexed upon abdominal dorsum (Fig. 76). Sudan, Red Sea. 11. *inflexa* sp.n. (p. 106)
 - Middle femur at least 0.6x total length of insect, usually longer. Connexiva not inflexed upon abdominal dorsum. 17
 - 17. Thoracic dorsum not raised (Fig. 74). Japan, Ryukyu Islands, Taiwan. 10. *septentrionalis* Esaki (p. 104)
 - Thoracic dorsum distinctly raised (Figs. 58, 62, 65, 67). 18
 - 18. Greatest height of thoracic dorsum located distinctly before middle of mesonotum (Figs. 58-60). Vietnam, Philippines, Papua New Guinea, Solomon Islands, New Caledonia, Mariana Islands, Caroline Islands, Marshall Islands, Nauru, Samoa Islands. 6. *bergrothi* Esaki (p. 93)
 - Greatest height of thoracic dorsum located about or slightly before the middle of mesonotum (Figs. 62-63, 65, 67). 19
 - 19. Length about 2.0x greatest width across thorax. Australia, Papua New Guinea, New Caledonia, Loyalty Islands. 7. *hilli* China (p. 99)
 - Length about 1.8x greatest width across thorax. 20
 - 20. Basal abdominal terga with distinct patch of pale hairs. Australia: S. Queensland. 8. *heron* sp.n. (p. 102)

- Basal abdominal terga without distinct patch of pale hairs. Fiji Islands.
..... 9. *fijiensis* sp.n. (p. 103)

1. *Halovelvia maritima* Bergroth

Figs. 1, 20-22, 35-36.

Halovelvia maritima Bergroth, 1893: 277-278 (description; type area: Cartier Island, Timor Sea); Esaki 1930: 24 (check-list); China 1957: 255 (type designation, descriptive notes).

Type material examined: Lectotype ♂ (designation by China 1957: 255), labelled "Arafura Sea, 18/5/90, J.J. Walker", "Type", "Under blocks of coral below high water mark, Cartier I., Timor Sea, 100 miles from mainland, small island", "*Halovelvia maritima* Bergr., E.M.M. 1893, p. 277", and "Champion Coll. B.M. 1927-409", in the British Museum (Natural History), London. - *Paralectotypes*: 2♂♂ & 7♀♀ (on same card as lectotype), same data as lectotype (examined); 1♂ (on slide) labelled "*Halovelvia maritima* Bergr. ♂ paratype" and "Arafura Sea, Cartier Is., B.M.I." (BMNH); 2♂♂ & 1♀ (on slide), labelled "*Halovelvia maritima* Bergr. Paratypes 2♂♂ & 1♀" and "Cartier Is., Paratypes 1" (BMNH); 1♂ & 1♀, labelled "487 [= Cartier Islet, Arafura Sea, 18.5.90]", "Paratype", "N.W. Austr. 90-126 [= Pres. by J.J. Walker esq. Collected during the voyage of H.M.S. 'Penguin' by the donor]", "Under blocks of coral at half tide mark, common. J.J. Walker", and "*Halovelvia maritima* Bergr. E.M.M. 1893: 277" (BMNH).

Diagnosis: Recognized by the relatively small eyes, distinct, yellowish brown pronotal hind margin, a distinct patch of greyish pubescence on the female metanotum and basal abdominal terga, the relatively short middle legs, and the shape of male claspers.

Description

Size. ♂♂: length 1.68-1.72 mm, width 1.00-1.02 mm; ♀♀: length 2.12-2.20 mm, width 1.02-1.08 mm.

Colour. Black or dark brown with greyish pubescence which is longer and more dense on abdomen (♂), or on metanotum, basal abdominal terga and lateral abdomen (♀). Female connexiva terminated by long, whitish hairs. An obscure spot at base of head and hind margin of pronotum yellowish brown. Antennae and legs brownish.

Structural characters. Male (Fig. 20) ovate, total length almost 1.7x greatest width across thorax (138:82). Head length about 0.7x head width across (33:45); eye slightly less than 0.20x width of head between eyes (6:34). Relative lengths of antennal segments (1-4): 19:18:23:32; segment 1 much shorter than head length (19:33), not thicker than segment 4 (4:4); segment 3 distinctly longer than segment 2. Hind margin of pronotum distinct throughout. Relative lengths of leg segments (femur: tibia: tar-

sus): fore leg: 45:42:16; middle leg: 70:59:37; and hind leg: 49:47:23. Grasping comb relatively long, about 2/5 of tibial length (16:42); middle femur about 0.5x total length of insect (70:138); relative lengths of middle tarsal segments (1:2): 21:16; hind femur slightly thicker than middle femur (10:9). Abdominal venter slightly depressed beyond sternum 6, otherwise not modified. Genital segments as illustrated (Fig. 35); claspers relatively long, but only barely reaching each other dorsal to the genital capsule (Fig. 35); blade of each clasper (Fig. 36) vertically flattened, broad and almost straight, apex blunt. Vesical sclerites (Fig. 35).

Female (Figs. 1 and 21) subovate, length 2.0x greatest width across thorax (172:86). Head structure as in male except that antennal segment 1 is more slender; length of antennal segments (1-4): 20:18:25:32. Thoracic dorsum moderately raised, with greatest height in middle of mesonotum (Fig. 22), with suberect pubescence which is distinctly longer on metanotum and basal abdominal terga. Relative lengths of leg segments (femur:tibia:tarsus): fore leg: 43:41:16; middle leg: 71:60:37; hind leg: 52:47:23. Middle femur 0.4x total length of insect (70:172). Abdomen with subparallel sides basally, tapering in width posteriorly; metanotum and basal terga raised, depressed behind tergum 3; connexiva suberect throughout; hind corner of each connexivum furnished with long hairs; tergum 8 relatively long, deflected and concealing procitiger.

Distribution and habitat

Only known from the type locality, Cartier Island, an islet located in the Timor Sea, c. 250 km NW. of Australia. Walker (1891) describes the circumstances of his capture of these marine bugs (p. 235). "Cartier is a mere sand bank, less than half a mile in length, and destitute of even the smallest trace of vegetation, but it is surrounded by an extensive coral reef.", and "There was, of course, nothing to do on the Islet except to look for shells, of which I found a good many, and while looking for these I met with a very curious and interesting little Hemipteron (I fancy of the genus *Halobatoides*), inhabiting the sand beneath stones near low water mark, à la *Aepys*".

Discussion

Bergroth (1893: 277-278) did not state the number and sex of the specimens he examined, but senten-

ces of the original description indicate that he only described the female (e.g., "connexivo compresso-elevato" and "Long., 2 mm."). Through the courtesy of Mr. W.R. Dolling, British Museum (Natural History), London, I have been able to examine what appears to be the type series of *Halovelina maritima* Bergroth. It consists of 3 males, 7 females, and 1 large nymph mounted together on a large card where is also written "Arafura Sea, 18/5/90, J.J. Walker". At the level of one of the males there is a "T ♂" written in red. China (1957: 255) gave measurements of a "Type ♂" and illustrations of the male genitalia of *H. maritima* (his figs. 6a and b, the first one redrawn here as Fig. 35). I believe that the type indication as well as the attached type and paratype labels were placed on the type series by W.E. China. Although not published as such, this represents a (lecto)type designation and the other specimens of the type series thus become paralectotypes. Additional specimens in BMNH, including those mounted on slides (probably by China), also become paralectotypes. Esaki (1926a: 162) stated that he had seen 3 ♀ types in the Bergroth collection (now probably in the Zoological Museum, Helsinki) which I have not examined.

Hale (1926: 203-205) recorded *maritima* from Pelsart Islands, Western Australia and gave descriptive notes. However, it is far from certain that his specimens actually belong to this species. For instance, Hale's illustration of a male (op.cit., fig. 84a) shows the claspers as being very long, distinctly crossing each other. This points more to *H. hilli* China than to *maritima*. Unfortunately, I have not been able to examine the specimens from Pelsart Islands (in the South Australian Museum, Adelaide).

Esaki (1926a: 162) records this species from Dregerhafen, New Guinea. I have examined 2 ♀ ♀ (borrowed from the Hungarian National Museum, Budapest) identified by Esaki as *H. maritima* Bergroth. They belong to a new genus and species (Andersen *in prep.*).

Polhemus (1982: 9-10) recorded *maritima* from Darwin, Australia (Northern Territory) and compared it with *hilli*. However, Polhemus' species belongs to a new species, *H. polhemi* sp.n., described below.

2. *Halovelina amphibia* Bergroth

Figs. 23-24.

Halovelina amphibia Bergroth, 1906: 70 (description; type area: Zanzibar); Esaki 1930: 24 (check-list).

Type material examined: Lectotype ♀ (here designated), labelled "Zanzibar" and "Halovelina amphibia Bergr.", in the Zoological Museum, University of Helsinki.

Other material examined: MADAGASCAR: 1 ♀, 1 nymph, Diego Suarez Prov., rocky coast at Courrier Bay, 40 km NW. of Diego Suarez, CL 2279, XI-14-86, J.T. & D.A. Polhemus (JTPC).

Diagnosis: The female is recognized by the relatively small eyes, distinct, yellowish brown pronotal hind margin, and relatively short middle legs. It is separated from *maritima* Bergroth by the absence of a distinct patch of greyish pubescence on metanotum and basal abdominal terga, the evenly depressed abdominal tergum, and the obliquely raised connexiva which are not terminated by long, pale hairs.

Description

Size. ♀: length 2.05-2.23 mm, width 1.00-1.12 mm.

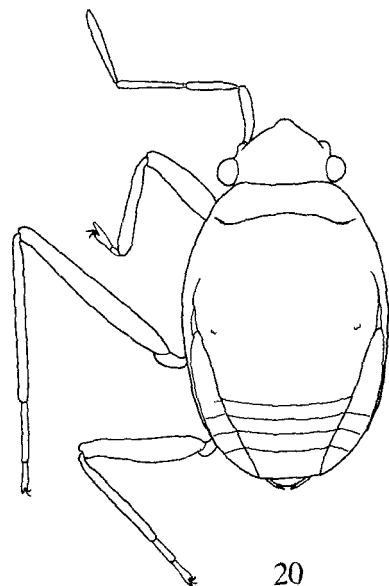
Colour. Dark brown with greyish pubescence covering most of thorax and abdomen but not forming a distinct patch. Head incl. antennae, pronotum, and legs yellowish brown (♀).

Structural characters. Male unknown.

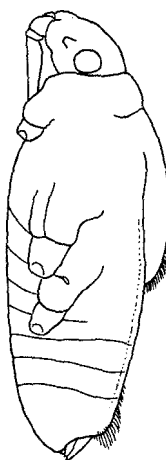
Female (Fig. 23) subovate, total length almost 2.0x greatest width across thorax (178:90). Head length about 0.8x head width across eyes (36:45); eyes relatively small, eye width about 0.20x width of head between eyes (7:32). Relative lengths of antennal segments (1-4): 22:20:26:31; segment 1 about 0.6x head length (22:36); segment 3 distinctly longer than segment 2. Pronotal hind margin distinct throughout, almost reaching lateral margins. Thoracic dorsum in lateral view (Fig. 24) only moderately raised, furnished with erect pubescence which is slightly longer on metanotum and basal abdominal tergum. Relative lengths of leg segments (femur: tibia:tarsus): fore leg: 44:41:18; middle leg: 71:62:44; and hind leg: 54:48:25; middle femur only about 0.4x total length of insect; relative lengths of middle tarsal segments (1-2): 24:20. Abdomen rather voluminous, in dorsal view (Fig. 23) with evenly rounded sides; abdominal terga evenly depressed; connexiva obliquely raised, each hind corner with short hairs; tergum 8 relatively short, exposing proctiger behind.

Distribution and habitat

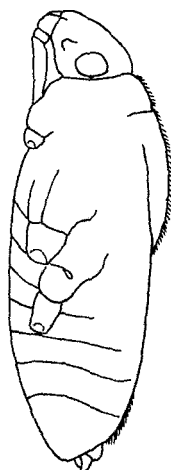
So far only known from the type locality, Zanzibar, Tanzania, and from a unique female specimen from northern Madagascar. This specimen was taken on a rocky coast at Courrier Bay, NW of Diego Suarez (Polhemus, field notes).



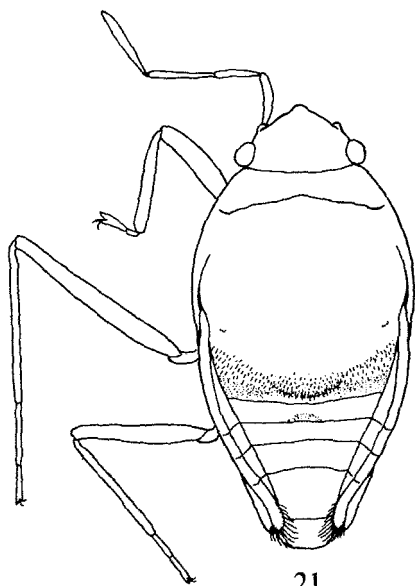
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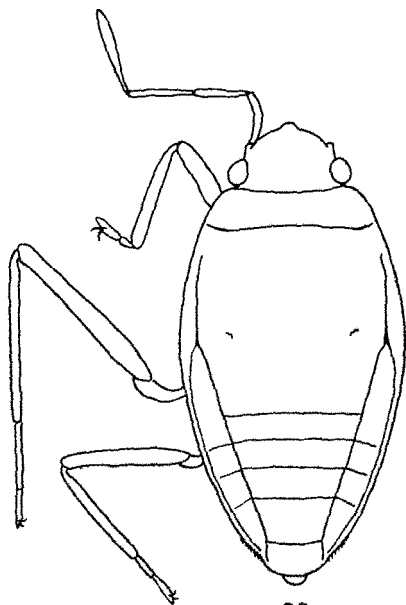
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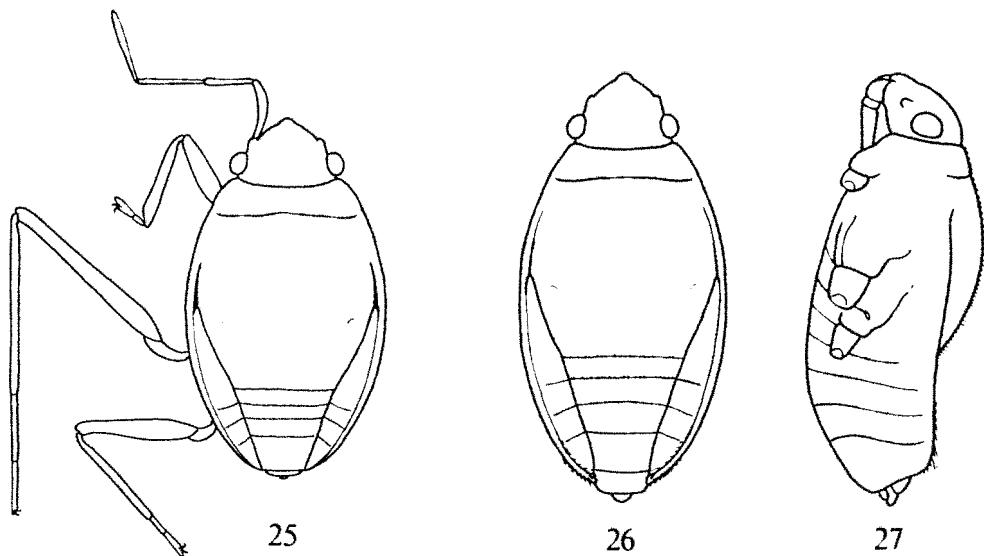


21



23

Figs. 20-24. 20-22. *Halovelia maritima* Bergroth. (20. Male, dorsal view. 21. Female, dorsal view. 22. Female body, lateral view). 23-24. *Halovelia amphibia* Bergroth. (23. Female, dorsal view. 24. Female body, lateral view).



Figs. 25-27. *Halovelvia carolinensis* sp.n. (25. Male, dorsal view. 26. Female body, dorsal view. 27. Female body, lateral view).

Discussion

Bergroth (1906: 70) did not state the number of specimens examined, but the original description indicates that he only examined the female sex (e.g., "Long. 2.2 mm"). Esaki (1926a: 162) examined 1 ♀ type in the Bergroth collection. Through the kindness of Dr. Antti Jansson, the Zoological Museum, University of Helsinki, I have been able to examine a female labelled "Zanzibar" and "*Halovelvia amphibia* Berg." It probably comes from the Bergroth collection and is most likely the type of that species. It has been selected as lectotype. The single female from Diego Suarez, Madagascar, matches the lectotype in most characters.

Esaki (op.cit.) identified some *Halovelvia* from Dregerhafen, New Guinea, as *amphibia*. I have examined 4 ♂ & 1 ♀ (from the Hungarian National Museum, Budapest) from this series. They belong to the species *Halovelvia annemariae* sp.n. described in the present paper. Specimens from the Palau Islands identified by Esaki (1937: 355) as *amphibia* probably also belong to another species (I have not seen these specimens). The key characters used by China (1957: 356) to distinguish *amphibia*, viz., head twice as long as pronotum, first antennal segment surpassing apex of head by $\frac{1}{2}$ its length, are not reliable.

3. *Halovelvia carolinensis* sp.n.

Figs. 25-27, 37.

Type area: Ifaluk Atoll, Caroline Islands.

Type material examined: Holotype ♂, CAROLINE ISLANDS: Ifaluk Atoll, N. end of Falarik Id., Oct. 1, 1953, # 937, Halobates from beneath rocks of é lang, middle of reef flat, transect c, living under rocks staying always in water and covered at most tides, Pacific Science Board, in the U.S. National Museum of Natural History, Washington, D.C. - Paratype: CAROLINE ISLANDS: 1 ♀, Utagal Woleai Atoll, 7-28-46, Tide Pool on Reef, Townes 1434 (USNM).

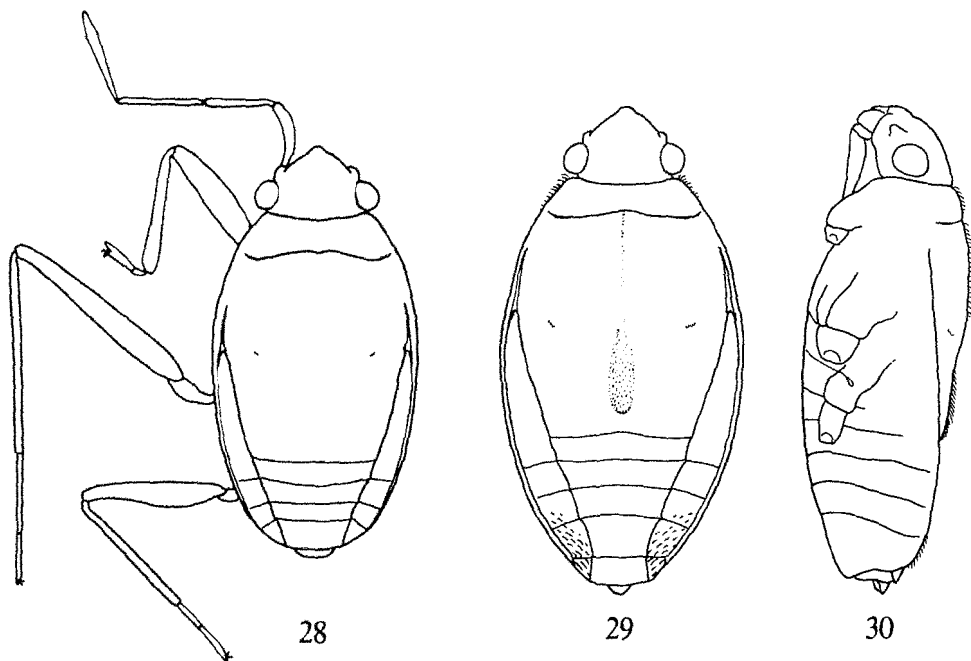
Diagnosis: Recognized by the brownish colour. Otherwise similar to *maritima* Bergroth but separated from this species by the shape of the male claspers and different pilosity of the female thoracic dorsum.

Etymology: Named for the type area, the Caroline Islands.

Description

Size. ♂: length 1.73 mm, width 0.95 mm; ♀: length 2.08 mm, width 1.00 mm.

Colour. Brownish with greyish pubescence on abdomen (♂) or posterior part of mesonotum, metanotum, and basal abdominal terga (♀). Female connexiva terminated by long, whitish hairs.



Figs. 28-30. *Haloveliea halophila* sp.n. (28. Male, dorsal view. 29. Female body, dorsal view. 30. Female body, lateral view).

Base of head, antennae, pronotum, and legs yellowish brown.

Structural characters. Male (Fig. 25) ovate, total length about 1.8x greatest width across thorax (138:77). Head length about 0.8x head width across (33:41); eyes relatively small, eye width only 1/5 width of head between eyes (6:30). Relative lengths of antennal segments (1-4): 24:20:25:30; segment 1 shorter than head length, not thicker than segment 4 (5:5); segment 3 distinctly longer than segment 2. Hind margin of pronotum distinct throughout. Relative lengths of leg segments (femur:tibia:tarsus): fore leg: 45:42:16; middle leg: 75:70:43; and hind leg: 48:44:21. Grasping comb about 1/3 tibial length (14:42); middle femur about 0.55x total length of insect (75:138); relative lengths of middle tarsal segments (1:2): 24:19; hind femur not thicker than middle femur (8:8). Abdominal venter not modified. Claspers relatively short, barely reaching each other dorsal to the genital capsule; blade of each clasper (Fig. 37) slender and straight, apex blunt.

Female (Fig. 26) subovate, length 2.1x greatest width across basal abdomen (164:80). Head struc-

ture as in male; length of antennal segments (1-4): 22:20:26:30. Thoracic dorsum in lateral view (Fig. 27) only moderately raised, furnished with short, suberect pubescence. Relative lengths of leg segments (femur:tibia:tarsus): fore leg: 46:40:19; middle leg: 76:70:47; and hind leg: 49:44:22. Middle femur about 0.45x total length. Abdomen in lateral view (Fig. 27) high, in dorsal view (Fig. 26) with broadly rounded sides; abdominal tergum of female paratype swollen, but the connexiva are probably normally more or less erect throughout; hind corner of each connexivum furnished with long hairs; tergum 8 relatively short, exposing proctiger behind.

Distribution

Recorded from the Ifaluk and Utagal Woleani Atolls, Caroline Islands.

Note: A female labelled "Marshall Is., Bikini Atoll, April 30 '46, No. R4381, J.P.E. Morrison" (USNM) may belong to this new species. Its length is 1.95 mm and width 0.92 mm. The colour is dark brownish with a large median patch of greyish

pubescence on posterior mesonotum. Relative lengths of antennal and leg segments as in the female paratype. Abdomen with erect connexiva which are slightly inflexed posteriorly. The examination of more material from the Marshall Islands is necessary to determine the status of this form.

4. *Halovelis halophila* sp.n.

Figs. 28-30, 38-39.

Type area: Sumbawa, Indonesia.

Type material examined: *Holotype* ♂, LESSER SUNDA ISLANDS: Sumbawa, Nusa Tenggara Barat Prov., coast 5 km E. of Nipa, 34 km NE. of Bima, CL 2176, X-21-85, J.T. & D.A. Polhemus, in the British Museum (Natural History), London, property of the Museum Zoologicum Bogoriense, Bogor, Indonesia. - *Paratypes:* 6 ♀ ♀, same locality and date (JTPC, ZMUC). BORNEO: 1 ♂ 1 ♀, Sabah, beaches 2 km NW of Kuala Penyu, 10 August 1983, G.F. Hevel & W.E. Steiner (USNM).

Diagnosis: Recognized by the relatively short middle femora of both sexes, the long antennal segment 3 which is distinctly longer than segment 2, the almost flattened, non-pilose thoracic and basal abdominal dorsum which has a median, shiny stripe. The males are separated from *maritima* Bergroth by the short grasping comb of fore tibiae, and small claspers.

Etymology: From halos (Greek) = salt, and philos = friend.

Description

Size. ♂ ♂: length 2.00 mm, width 0.96 mm; ♀ ♀: length 2.30-2.36 mm, width 1.15-1.18 mm.

Colour. Dark brown or black with greyish pubescence which is longer and more dense on abdomen; female with a median stripe of silverish hairs on metanotum and basal abdominal terga. Female connexiva terminated by dense, but rather short greyish pubescence. Base of head, antennae, posterior pronotum, and legs brownish.

Structural characters. Male (Fig. 28) broadly ovate, total length about 2.1x greatest width across thorax (160:77). Head length 0.75x head width across (33:44); eye width about 0.25x width of head between eyes (7:29). Antennae rather long, relative lengths of antennal segments (1-4): 26:26:32:37; segment 1 much shorter than head length, not thicker than segment 4 (5:5); segment 3 distinctly longer than segment 2. Hind margin of pronotum distinct throughout. Relative lengths of leg segments (femur: tibia:tarsus): fore leg: 52:49:20; middle leg: 82:77:49; and hind leg: 58:56:27. Grasping comb short, less than 1/5 tibial length (9:49); middle

femur about 0.5x total length of insect (82:160); relative lengths of middle tarsal segments (1:2): 29:20; hind femur slightly thicker than middle femur (10:9). Abdominal venter not modified. Claspers very short, barely reaching each other dorsal to the genital capsule; blade of each clasper (Fig. 38) slender and nearly straight, apex pointed; vesical sclerites (Fig. 39).

Female (Fig. 29) broadly subovate, length 2.0x greatest width across basal abdomen (189:94). Head structure as in male; length of antennal segments (1-4): 23:26:31:36. Thoracic dorsum in lateral view (Fig. 30) almost flattened, furnished with short, suberect pubescence which becomes longer in middle of metanotum and on basal abdominal terga. Relative lengths of leg segments (femur:tibia:tarsus): fore leg: 52:47:20; middle leg: 76:77:51; and hind leg: 58:57:28. Middle femur about 0.4x total length. Abdomen in lateral view (Fig. 30) high, in dorsal view (Fig. 29) with broadly rounded sides; connexiva obliquely raised throughout; hind corner of each connexivum furnished with short, dense pubescence; tergum 8 relatively short, exposing proctiger behind.

Distribution and habitat

Recorded from Sumbawa, Lesser Sunda Islands, and from Sabah, Borneo. Collected along exposed coral coast E. of Nipa, Sumbawa (Polhemus, field notes).

5. *Halovelis corallia* sp.n.

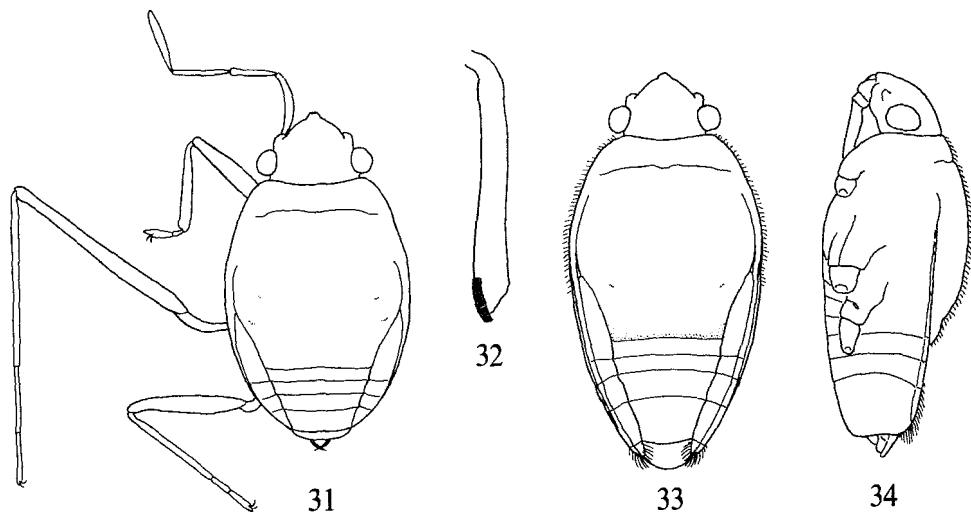
Figs. 31-34, 40-41.

Type area: Malupore Island, Papua New Guinea (Central Province).

Type material examined: *Holotype* ♂, PAPUA NEW GUINEA: Central Prov., Malupore Is., marine reserve station, CL 1839, IX-21-83, J.T. & D.A. Polhemus, in the B.P. Bishop Museum, Honolulu. - *Paratypes:* 1 ♂ 10 ♀ ♀, same locality and date as holotype (BPBM, JTPC, ZMUC); 2 ♀ ♀, Western Prov., Daru Island, CL 1771, IX-1-83, J.T. & D.A. Polhemus (JTPC). AUSTRALIA: 3 ♀ ♀, Sherrard I., N. Queensland, 13°S 143°36'E, 9.vi.1956, On reef, low tide, E.N. Marks & MacKerras (UQ).

Diagnosis: Recognized by the relatively short middle femora of both sexes, the long antennal segment 3 which is distinctly longer than segment 2, the very short male grasping comb, and the unmodified female thoracic dorsum. Separated from *halophila* sp.n. by its smaller size, relatively longer male clasper, more convex female thorax, etc.

Etymology: Named to describe the close association between corals and most species of *Halovelis*.



Figs. 31-34. *Halovelvia corallia* sp.n. (31. Male, dorsal view. 32. Left fore tibia of male. 33. Female body, dorsal view. 34. Female body, lateral view).

Description

Size. ♂♂: length 1.58-1.63 mm, width 0.89-0.94 mm; ♀♀: length 1.85-1.96 mm, width 0.92-0.95 mm.

Colour. Black or dark brownish with greyish pubescence which are longer and more distinctly greyish on abdomen. Female connexiva terminated by long, whitish hairs. Base of head yellowish brown. Antennae and legs brownish.

Structural characters. *Male* (Fig. 31) ovate, total length about 1.75x greatest width across thorax (128:73). Head length about 0.85x head width across (35:41); eye width about ¼ width of head between eyes (7:27). Relative lengths of antennal segments (1-4): 22:16:21:28; segment 1 much shorter than head, not thicker than segment 4 (4:4); segment 3 distinctly longer than segment 2. Hind margin of pronotum indistinct laterally. Relative lengths of leg segments (femur:tibia:tarsus): fore leg: 42:36:16; middle leg: 74:68:46; and hind leg: 43:39:18. Grasping comb very short (Fig. 32), about 1/6 tibial length (6:36); middle femur almost 0.6x total length; relative lengths of middle tarsal segments (1:2): 26:20; hind femur not thicker than middle femur (7:7). Abdominal venter not modified. Claspers relatively long, crossing each other dorsal to the genital capsule; blade of each clasper (Fig. 40) slender and straight, apex pointed; vesical sclerites (Fig. 41).

Female (Fig. 33) fusiform, length 2.0x greatest

width across thorax (148:74). Head structure as in male; length of antennal segments (1-4): 21:16:21:26. Thoracic dorsum in lateral view (Fig. 34) only moderately raised, furnished with short, erect pubescence. Relative lengths of leg segments (femur:tibia:tarsus): fore leg: 39:34:17; middle leg: 72:64:47; and hind leg: 44:39:19. Middle femur almost 0.5x total length. Abdomen in lateral view (Fig. 34) rather high, in dorsal view (Fig. 33) with broadly rounded sides; abdominal tergites depressed from segment 4 and backwards; connexiva erect throughout, their margins furnished with long suberect hairs which become longer towards abdominal end; tergum 8 relatively large, concealing proctiger.

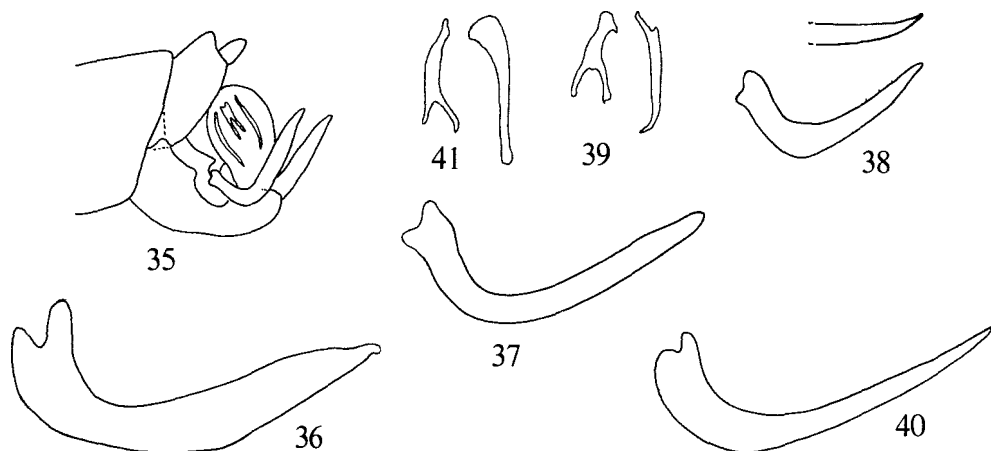
Distribution and habitat

Recorded from southern Papua New Guinea (Central Province) and northern Queensland, Australia. At Malupore Island marine research station, near Port Moresby, Papua New Guinea, this species was found among coral blocks in the high tidal zone (Polhemus, field notes).

6. *Halovelvia bergrothi* Esaki

Figs. 42-46, 49-51, 57-60.

Halovelvia bergrothi Esaki, 1926a: 161-162 (description; type area: Seleu, Berlinhafen, New Guinea); Esaki



Figs. 35-41. Male genitalia. 35-36. *Halovelonia maritima* Bergroth. (35. Genital segments (redrawn after China 1957, fig. 6a). 36. Left clasper). 37. *Halovelonia carolinensis* sp.n. Left clasper. 38-39. *Halovelonia halophila* sp.n. (38. Left clasper; dorsal aspect of blade above. 39. Vesical sclerites). 40-41. *Halovelonia corallia* sp.n. (40. Left clasper. 41. Vesical sclerites).

1930: 24 (check-list); Esaki 1937: 355-356 (records Rota, Mariana Islands and Palau Islands); China 1957: 356 (key).

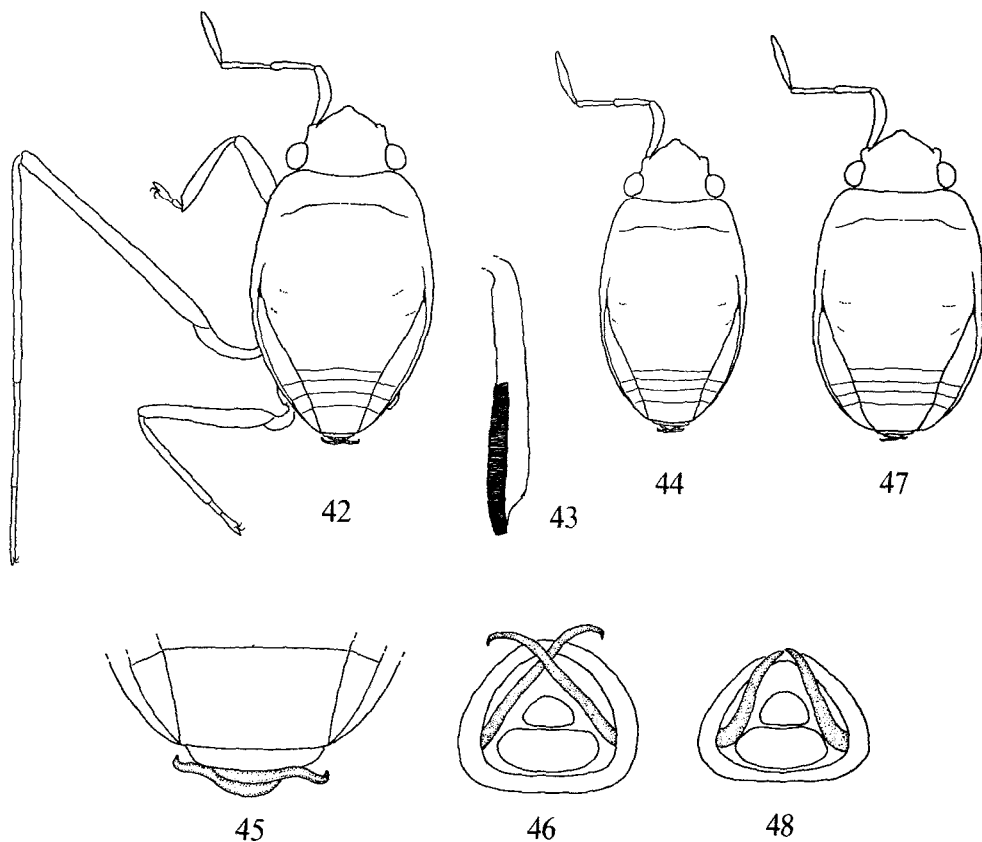
Halovelonia marianarum Usinger, 1946: 98-100 (description; type area: Guam, Mariana Islands); Usinger 1951: 320 (records Marshall Islands); China 1957: 356 (key); Kellen 1959: 53-62 (biology; records Samoa). **syn.n.**

Halovelonia danae Herring, 1958: 12-13 (description; type area: Nha Trang, Vietnam). **syn.n.**

Type material examined: *Halovelonia bergrothi* Esaki. *Lectotype* ♂ (here designated) labelled "N. Guinea, Biro 96", "Seleo, Berlinhaf", and "Halovelonia Bergrothi Esaki, det. T. Esaki", in the Hungarian National Museum, Budapest. - *Paralectotypes*: 6♂♂ 4♀♀ same data as lectotype (HNM, ZMUC). *Halovelonia marianarum* Usinger. *Holotype* ♂, *Allotype* ♀ (not examined), labelled "Finile, Guam", "V-28.36", "R.L. Usinger Collection", and "Halovelonia marianarum R.L. Usinger", in the B.P. Bishop Museum, Honolulu. - *Paratypes*: 35♂♂ and ♀♀ (1♂ 1♀ examined) same data as holotype (BPBM, JTPC); 9♂♂ and ♀♀ (not examined), Guam., Asanite Bay, June 25, 1936, R.L. Usinger (BPBM). *Halovelonia danae* Herring. *Holotype* ♂, *Allotype* ♀ labelled "St. 3710, Nha Trang, Cambodia, 15-V-1929", "surface. Anchorage, Cauda" [Dana Expedition], and "Halovelonia danae Jon L. Herring", in the Zoological Museum, University of Copenhagen. - *Paratypes*: 2♂ 3♀♀ (1♂ 2♀♀ examined), same data as holotype (USNM, ZMUC).

Other material examined: CAROLINE ISLANDS: 1♀, Ifaluk Atoll, N. end of Falarik Id., 1.xi.1953, Pacific Science Board (BPBM); 7♂♂ 10♀♀, Palau, Koror, 17.vi.1974, G. Boehlert (JTPC); 2♂♂ 1♀, Palau, site 4 (marine), 17.ix.1979, Lanna Cheng (ZMUC). MARIANA ISLANDS: 13♂♂ 14♀♀, Guam, Agana below Naval Hospital, among coral heads nr. shore of coral lagoon, 25 Jun. 1975, A.R. Gillogly (JTPC); 16♂♂ 16♀♀, Guam, Gabgab Bch. Orote Point, 30.i.1980, A.R. Gillogly

(JTPC); 13♂♂ 7♀♀, Guam, 5.ix.1979, rockpool by Marine Laboratory, Lanna Cheng (ZMUC); 1♂ 1♀, same locality, 6.xi.1979, from seagrass bed, Lanna Cheng (ZMUC); 22♂♂ 11♀♀, Guam, Pago Bay Cove, Univ. of Guam Marine Lab., 4.ix.1975, Dana Rowley (JTPC); 1♀, Rota, Sonson-Sabana, 4.ix.1937, Teiso Esaki (USNM); 1♀, Rota, Sonson-Taipingot, 6.ii.1936, Teiso Esaki (USNM). MARSHALL ISLANDS: 1♂, Arno Atoll, Bikarej Id., 14.vii.1950, Ira La Rivers (USNM); 1♀, Arno Atoll, Tagelib Id., 19.vi.1950, Ira La Rivers (USNM); 2♂♂ 2♀♀, Majuro, 27.vi.1950, Ira La Rivers (USNM). NAURU ISLAND: 2♂♂ 2♀♀, Nauru I, Central Pacific, 16.xi.1966, H.C. Chapman (BPBM); 1♀, same locality, 25.xi.1966, H.C. Chapman (BPBM); 12♂♂ 4♀♀, same locality, coral reefs at low tide, 19.xi.1966, H.C. Chapman (JTPC, ZMUC). NEW CALEDONIA: 1♂, Noumea, rocky coast, CL 1867, 27.ix.1983, J.T. & D.A. Polhemus (JTPC). PAPUA NEW GUINEA: 1♂, East Sepik Prov., Brandi Riv., nr. Wewak, CL 1796, IX-10-83, J.T. & D.A. Polhemus (JTPC); 3♂♂ 8♀♀, Prov. Madang, Laing Isl. Lagoon, May 1978, leg. J. Bouillon (IRSN). PHILIPPINES: 1♀, Port Binanga nr. Luzon, Albatross sta. 5105 (USNM); 1♀, Mindanao, Calian, Davao Prov., 17.vii.?, C.S. Clagg (AMNH); 67♂♂ 31♀♀, Palawan, Paduan Beach, 40 km. S. of Puerto Princesa, CL 2004, VII-25-85, J.T. & D.A. Polhemus (JTPC). SAMOAN ISLANDS: 6♂♂ 4♀♀, Savaii, Asau, UN/SPC 2022, Surface of tidal rock pool, 23.xii.1968, A.K. Walker (JTPC); 2♂♂ 1♀, Savaii, Aua, Operation Raleigh, 1.viii.1986, M. Richmond (ZMUC); 153♂♂ 132♀♀, Tutuila, Dec. 1957-March 1958, W.R. Kellen (BPBM); 24♂♂ 55♀♀, Tutuila, Pala Lagoon, CL 1515, 24.i.1978, J.T. & M.S. Polhemus (JTPC); 2♂♂ 1♀, Tutuila, E. of Pago Pago, low tide pools, Operation Raleigh, 28.vii.1986, W.A. Foster (ZMUC); 37♂♂ 34♀♀, Tutuila, Tafuna Lagoon, CL 1515, 24.i.1978, J.T. & M.S. Polhemus (JTPC); 19♂♂ 24♀♀, Upolu, Latofaga, CL 1511, 22.i.1978, J.T. & M.S. Polhemus (JTPC). SOLOMON ISLANDS: 4♂♂ 7♀♀, New Georgia, Kundukundu Islet, 6.iv.1983, Lanna Cheng



Figs. 42-48. 42-46. *Halovelgia bergrothi* Esaki. (42. Male, dorsal view (Papua New Guinea). 43. Left fore tibia of male. 44. Male body, dorsal view (Guam). 45. Male abdominal end, dorsal view. 46. Same, caudal view). 47. *Halovelgia heron* sp.n. Male body, dorsal view. 48. *Halovelgia fijiensis* sp.n. Male abdominal end, caudal view.

(ZMUC); 66♂♂ 45♀♀ (many in copula), and several nymphs, New Georgia, 3 km off Munda, outside lagoon, 27.iii.1983, Lanna Cheng (ZMUC); 189♂♂ 58♀♀ and several nymphs, same locality, inside lagoon, 4.iv.1983, Lanna Cheng (ZMUC); 35♂♂ 16♀♀, New Georgia, Munda, at light, 9.iv.1983, Lanna Cheng (ZMUC); 1♂ 1♀, New Georgia, Small Is. off Munda, 3.iv.1983, Lanna Cheng (ZMUC); 1♂ 1♀, New Georgia, Munda, 1900 shore, 24.iii.1983, Lanna Cheng (ZMUC); 6♂♂ 5♀♀, Three Sisters [Olu Malau Is.], Malau Lalo, 26.iv.1965, E.S. Brown (BMNH).

Diagnosis: Recognized by the large size difference between the sexes (male not exceeding 1.7 mm, female usually longer than 2.0 mm), the very long male grasping comb (3/7-4/7 tibial length), the distinctly raised female thorax which is highest in anterior part of mesonotum, and the very long male claspers which are distally bent with hook-shaped apices.

Description

a. Type specimens of H. bergrothi Esaki from Berlimhafen, Papua New Guinea:

Size. ♂♂: length 1.62-1.68 mm, width 0.80-0.88 mm; ♀♀: length 2.45-2.55 mm, width 1.15-1.28 mm.

Colour. Black with dense greyish pubescence which is longer and more distinctly grey on dorsal abdomen (♂); no distinct patches of greyish pubescence in female. Female connexiva terminated by short, whitish hairs. A large, transverse, yellowish brown spot at the base of head. Antenna and legs dark brownish to black, shiny.

Structural characters. Male (Fig. 42) ovate, length about 1.85x greatest width across thorax (129:70). Head length about 0.7x head width across

eyes (29:44); eye width about 0.25 width of head between eyes (7:30). Relative lengths of antennal segments (1-4): 23:16:17:20; segment 1 shorter than head, slightly thicker than segment 4 (5:4). Hind margin of pronotum indistinct laterally. Relative lengths of leg segments (femur:tibia:tarsus): fore leg: 43:36:15; middle leg: 96:88:68; and hind leg: 49:40:19; grasping comb (Fig. 43) very long, almost 4/7 length of fore tibia (21:36); middle femur about 0.75x total length; relative lengths of middle tarsal segments (1-2): 40:28; hind femur as thick as middle femur (8:8). Abdominal venter not modified. Claspers very long but rather stout, distinctly crossing each other dorsal to the genital segment (Figs. 45-46); blade of each clasper (Fig. 49) curved dorsad in lateral view, distal part more or less abruptly turned mesad, with hook-shaped apex; vesical sclerites (Fig. 51).

Female (Fig. 57) fusiform, length almost 2.0x greatest width across thorax (196:99). Head structure as in male; relative lengths of antennal segments (1-4): 29:22:23:26. Thoracic dorsum distinctly raised with greatest height in anterior half of mesonotum (Fig. 58); metanotum and basal abdominal terga flattened; thoracic dorsum furnished with short, erect pubescence which is slightly longer on pronotum, anterior and lateral parts of mesonotum. Relative lengths of leg segments (femur:tibia:tarsus): fore leg: 52:47:23; middle leg: 132:126:95; and hind leg: 66:58:27; middle femur almost 0.7x total length. Abdomen broad at base, tapering in width posteriorly, terga depressed from segment 4 and backwards; connexiva obliquely inclined to vertically raised; tergum 8 large, length slightly more than half of its width, exposing procitiger behind.

b. Specimens from Guam, Mariana Islands (including paratypes of H. marianarum Usinger):

Size. ♂♂: length 1.48-1.55 mm, width 0.75-0.78 mm; ♀♀: length 2.12-2.30 mm, width 1.08-1.18 mm.

Colour. As in the type specimens of *bergrothi* except that the female tergum 7-8 are brownish in most specimens.

Structural characters. Male (Fig. 44) length 1.9x greatest width across thorax (118:62). Head length about 0.75x head width across eyes (30:41). Relative lengths of antennal segments (1-4): 24:15:16:22. Grasping comb ½ length of fore tibia (16:32). Relative lengths of middle leg segments (femur:tibia:tarsus): 86:83:59; middle femur 0.73x total

length. Structure of claspers (Fig. 50) similar to that of *bergrothi*.

Female length 1.9x greatest width across thorax (176:91). Head structure as in male; relative lengths of antennal segments (1-4): 29:18:18:26. Thorax in lateral view (Fig. 59) strongly convex dorsally with greatest height in anterior half of mesonotum, degree of convexity slightly less than in *bergrothi*. Relative lengths of middle leg segments (femur:tibia:tarsus): 121:118:84; middle femur 0.69x total length. Abdominal structure as in *bergrothi*.

c. Type specimens of H. danae Herring from Nha Trang, Vietnam:

Size. ♂♂: length 1.45-1.48 mm, width 0.82-0.85 mm; ♀♀: length 2.28-2.42 mm, width 1.22-1.25 mm.

Colour. Reddish brown (see discussion) with greyish pubescence. Head between eyes, antennae, and legs yellowish brown. Otherwise as in *bergrothi*.

Structural characters. Male length 1.75x greatest width across thorax (116:66). Head length about 0.7x head width across eyes (28:41); relative lengths of antennal segments (1-4): 22:16:17:20. Relative lengths of leg segments (femur:tibia:tarsus): fore leg: 38:34:15; middle leg: 83:72:59; and hind leg: 46:38:19; grasping comb about 4/7 length of fore tibia (21:34); middle femur about 0.7x total length. Structure of claspers very similar to that of *bergrothi*, except that the distal part is more slender. Other characters as in *bergrothi*.

Female length 1.85x greatest width across thorax (182:98). Head structure as in male; relative lengths of antennal segments (1-4): 30:22:22:27. Thorax in lateral view (Fig. 60) strongly convex dorsally with greatest height in anterior half of mesonotum, degree of convexity less pronounced than in *bergrothi*, describing a more regular curve. Relative length of leg segments as in male; middle femur 0.6x total length (110:182). Abdominal structure as in *bergrothi*.

d. Specimens from other localities:

Size. Table 2 gives the variation in total length. The smallest individuals come from Tutuila, American Samoa, the largest from Palau, West Caroline Islands, the Solomon Islands, and the Philippines.

Colour. As in the type specimens of *bergrothi* except that the female connexiva and tergum 8 are reddish brown in some specimens.

Structural characters. Male length 1.8-1.9x

Table 2. Variation in *Halovelvia bergrothi* Esaki (incl. *marianarum* Usinger), *H. hilli* China, and *H. heron* sp.n., expressed as Range, Mean, and Standard Deviation (S.D.).

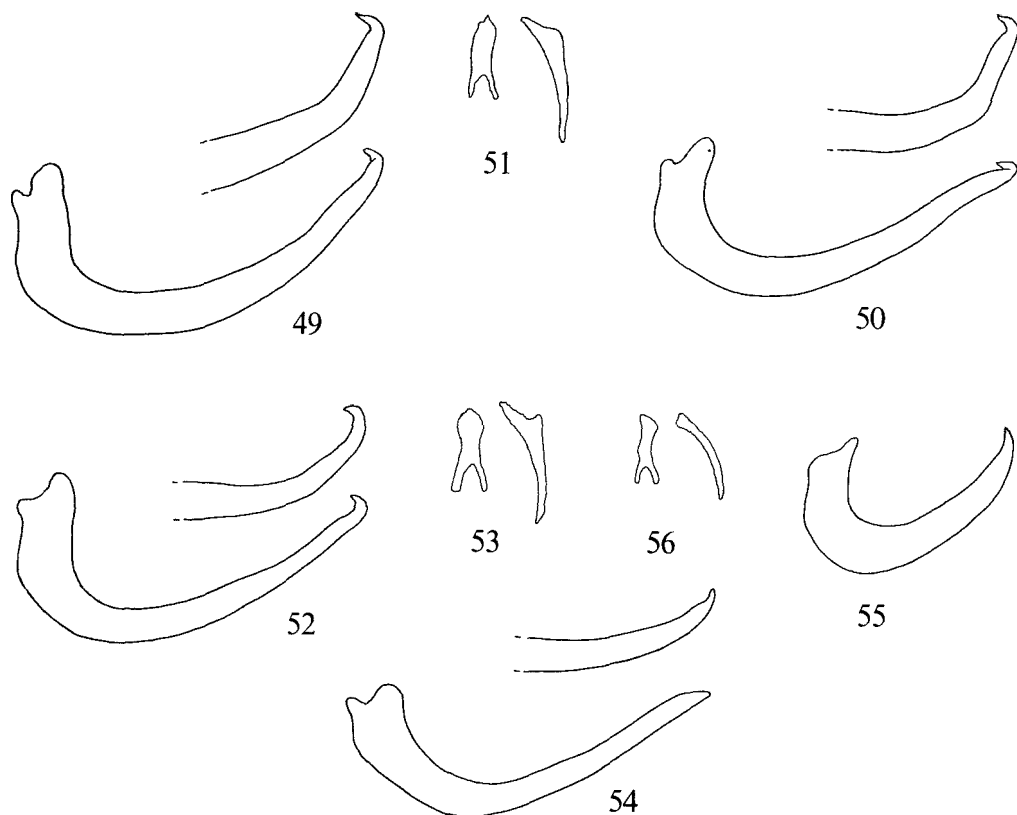
Locality	Total length (mm.)			Middle femur (% total length)			N
	Range	Mean	S.D.	Range	Mean	S.D.	
<i>Halovelia bergrothi</i> Esaki							
♂♂:							
Palawan, Philippines	1.63-1.80	1.70	0.007	67-72	70	2.37	5
Berlinhafen, Papua New Guinea	1.62-1.68	1.65	0.019	69-75	73	0.98	6
Palau, West Caroline Islands	1.55-1.60	1.58	0.021	77-80	79	1.14	5
New Georgia, Solomon Islands	1.50-1.58	1.55	0.024	73-77	76	1.25	10
Guam, Mariana Islands	1.48-1.55	1.50	0.032	69-75	72	2.59	5
Arno Atoll, Marshall Islands	1.50-1.52	1.50	0.014	68-69	68	0.58	3
Nauru Island, Central Pacific	1.42-1.50	1.48	0.028	66-68	67	0.71	5
Tutuila, American Samoa	1.38-1.40	1.38	0.011	64-71	68	2.59	5
♀♀:							
Palawan, Philippines	2.54-2.68	2.61	0.005	63-68	65	1.82	5
Berlinhafen, Papua New Guinea	2.45-2.55	2.50	0.043	65-68	67	1.50	4
Palau, West Caroline Islands	2.25-2.40	2.32	0.065	64-69	67	2.07	5
New Georgia, Solomon Islands	2.20-2.32	2.25	0.038	68-71	69	1.11	7
Guam, Mariana Islands	2.12-2.30	2.20	0.072	67-71	69	1.52	5
Arno Atoll, Marshall Islands	2.05-2.25	2.18	1.009	65-73	69	4.04	3
Nauru Island, Central Pacific	2.02-2.12	2.08	0.041	61-63	62	1.00	5
Tutuila, American Samoa	1.98-2.05	2.00	0.030	68-70	68	1.22	5
<i>Halovelia hilli</i> China							
♂♂:							
Prince of Wales I., Queensland	1.40-1.50	1.45	0.029	67-70	68	1.58	5
Daru I., Papua New Guinea	1.30-1.40	1.32	0.042	63-69	66	1.98	8
Darwin, Northern Territory	1.22-1.30	1.25	0.031	69-70	69	0.55	5
♀♀:							
Prince of Wales I., Queensland	2.05-2.25	2.15	0.070	60-64	62	1.52	5
Daru I., Papua New Guinea	1.92-2.00	1.98	0.044	60-63	61	1.16	8
Darwin, Northern Territory	1.75-1.82	1.80	0.028	62-66	64	1.41	6
<i>Halovelia heron</i> sp.n.							
♂♂:							
Heron I., Queensland	1.40-1.50	1.45	0.031	63-68	66	1.64	8
♀♀:							
Heron I., Queensland	1.92-2.02	1.98	0.035	58-64	60	2.00	8

greatest width across thorax. Head length 0.70-0.75x head width across eyes. Antennal segment 3 subequal to or slightly longer than segment 2. Grasping comb 3/7-3/5 length of fore tibia. Middle femur 0.68-0.73x total length (Table 2). Other characters as in *bergrothi*.

Female length 1.85-2.0x greatest width across thorax. Head incl. antennal structure as in male. Thorax in lateral view strongly convex dorsally with greatest height in anterior half of mesonotum, the degree of convexity varies, being less pronounced in smaller females. Middle femur 0.62-0.72x total length (Table 2), shortest in specimens from Nauru Island and New Caledonia. Other characters as in type specimens of *bergrothi*.

Distribution and habitat

Widely distributed from Indochina and the Philippines to Papuasias and New Caledonia, extending onto the islands of Micronesia and the Samoan Islands. Recorded from Papua New Guinea (East Sepik Province), Solomon Islands (New Georgia, Olu Malau Is.), New Caledonia, Philippines (Luzon, Mindanao, Palawan), Vietnam (South), Mariana Islands (Guam, Rota), Caroline Islands (Ifaluk Atoll, Palau), Marshall Islands (Arno, Majuro), Nauru Island, and Samoan Islands (Savaii, Tutuila, Upolu). Usinger (1946: 99) found *H. marianarum* Usinger in Guam, "near the rocky coral shore, usually within or around 3- or 4-foot coves or em-



Figs. 49-56. Male genitalia. 49-51. *Halovelie bergrothi* Esaki. (49. Left clasper; dorsal aspect of blade above (Papua New Guinea). 50. Same (Guam). 51. Vesical sclerites). 52-53. *Halovelie hilli* China. (52. Left clasper; dorsal aspect of blade above. 53. Vesical sclerites). 54. *Halovelie heron* sp.n. Left clasper; dorsal aspect of blade above. 55-56. *Halovelie fijien-sis* sp.n. (55. Left clasper. 56. Vesical sclerites).

bayments." Kellen (1959) found the same species inhabiting a restricted area on the edges of a shallow lagoon in the southern part of Tutuila, Samoa. The area was (op.cit., p. 53) "entirely bordered by mangroves, old lava beds, and numerous black volcanic rocks about a foot in diameter". There was no coral rocks in the area but the mouth of the lagoon was protected by a fringing reef. At Pacduan Beach, Palawan, the species was abundant on a rocky intertidal reef bordered by *Sonneratia* mangroves, amid coral rubble exposed at low tide (Polhemus, field notes).

Discussion

a. The status of *Halovelie marianarum* Usinger. Usinger (1946) described *marianarum* from Guam,

Mariana Is., stating that it is closest to *bergrothi* Esaki, agreeing with that species in the subequal second and third antennal segments and in the strongly convex female mesonotum. From Esaki's (1926a) description and figures, Usinger found that (1946: 100): "*bergrothi* differs... in the longer meso- and metanota, front tarsus not shorter than half the length of tibia, first segment of middle tarsi one and one half times as long as second, and hind tarsus slightly longer than half the length of tibia". However, comparing the above descriptions of *bergrothi* and *marianarum*, these differences in relative measurements of leg segments are judged as insignificant or at most attributable to the effect of allometric growth differences between small and large individuals of the same species. The difference in absolute size between *bergrothi* and *mari-*

anarum is significant (Table 2), but so are the size differences between the type specimens of *bergrothi* and every other sample from the islands of the Pacific. The variation in the degree of convexity of the female thoracic dorsum (Figs. 57-60) is probably also an effect of size.

Since I have been unable to disclose any significant structural differences between specimens from different parts of the distributional range, it is concluded that *bergrothi* and *marianarum* belong to the same, widespread, and geographical variable species.

b. The status of *Halovelvia danae* Herring. The type locality (Nha Trang) is situated in present day Vietnam, not in Cambodia as stated on the labels of the type series. The unusual light colour of the type specimens may be an effect of storage in alcohol for a long period. Apart from the colour, the types of *H. danae* Herring are very similar to those of *bergrothi* Esaki. Herring (1958: 13) compared his species with the latter. He states that *bergrothi* is considerably larger, has hind tibiae nearly as long as the femora, has male front femora that are not incrassate, and has females that are strongly convex through the meso-metanotum. These differences are in my opinion not significant. The size of *danae* (especially ♀ ♀) falls well within the range of variation of *bergrothi* as now defined; the relative lengths of the hind femora and tibiae and the width of fore femora are not significantly different. Only the differences in the convexity of the female mesonotum sets *danae* apart from most specimens of *bergrothi*. In my opinion, however, this is insufficient to warrant a separate status for *danae*.

7. *Halovelvia hilli* China

Figs. 52-53, 61-63.

Halovelvia hilli China, 1957: 352-354, figs. 6e-h (description; type area: South Hermite, Monte Bello Islands); Polhemus 1982: 9 (records Australia, Northern Territory).

? *Halovelvia maritima* Bergroth; Hale 1926: 203-206 (descriptive notes; records Pelsart Islands, Western Australia); Hale 1935: 251 (records Garden Island, Western Australia).

Type material examined: Holotype ♂, [Western Australia], Monte Bello Is., S. Hermite., 21.x.1952, F.L. Hill, in the British Museum (Natural History), London. - *Paratypes:* 10♂♂ 8♀♀ (1♂ 2♀♀ examined), same locality and date as holotype (BMNH); 1♂, same locality, from mangrove swamp, viii.1952, G. Wedd (BMNH).

Other material examined: AUSTRALIA: 22♂♂ 34♀♀, Northern Territory, Darwin, East Point, CL 904, XII.10.77, J.T. Polhemus (JTPC, UQ, ZMUC); 9♂♂ 3♀♀, Queensland, Geoffroy Bay, Magnetic I., 15.vii.1976, Lanna Cheng (JTPC, ZMUC); 2♂♂ 2♀♀, Green I., off Cairns, N.Q., Reef pools at low tide, 23.vi.1956, E.N. Marks (UQ); 6♂♂ 9♀♀, Queensland, Low Isles, Great Barrier Reef, reef & shore pools, low tide, 8-23. viii.1954, E.N. Marks & M.J. MacKerras (UQ); 66♂♂ 67♀♀, Queensland, Prince of Wales Island, intertidal reef, CL 1769, VIII.30.83, J.T. & D.A. Polhemus (JTPC, ZMUC); 2♂♂ 2♀♀, N. Queensland, Sherrard I., 13°S 143°36'E, on reef, low tide, 9.vi.1956, E.N. Marks (UQ); 24♂♂ 24♀♀, Queensland, Somerset Bay, mangroves, CL 1763, VIII.28.83, J.T. & D.A. Polhemus (JTPC). LOYALTY ISLANDS: 2♀♀, Nlle Caledonie, Iles Loyalty, Mme Pruvot 1928 (MHN). NEW CALEDONIA: 1♂ 4♀♀, Noumea, rocky coast, CL 1867, 27.ix.1983, J.T. & D.A. Polhemus (JTPC). PAPUA NEW GUINEA: 19♂♂ 26♀♀, Western Prov., Daru Island, CL 1771, IX.1.83, J.T. & D.A. Polhemus (JTPC).

Diagnosis: Separated from *bergrothi* Esaki by the different shape of female thorax which is highest about or a little before the middle of mesonotum, the relatively shorter middle femora of both sexes, the slightly shorter male grasping comb (usually less than ½ tibial length), and more slender male claspers which are smoothly curved distally.

Description

a. *Paratypes of Halovelvia hilli* China from South Hermite, Monte Bello Islands, Western Australia:

Size. ♂♂: length 1.28-1.43 mm, width 0.75-0.83 mm; ♀♀: length 1.78-2.05 mm, width 0.95-1.08 mm.

Colour. Black or dark brown with greyish pubescence which is longer, denser and more distinctly grey on male abdomen. Female connexiva terminated by short, whitish hairs. A large yellowish brown spot at the base of head. Antennae and legs dark brownish to black.

Structural characters. Male ovate, length about 1.7x greatest width across thorax (114:67). Head length about 0.7x head width across eyes (30:41); eye width about 0.25x width of head between eyes (7:28). Relative lengths of antennal segments (1-4): 23:16:18:22; segment 1 distinctly shorter than head, slightly thicker than segment 4 (5:4). Hind margin of pronotum indistinct laterally. Relative lengths of leg segments (femur:tibia:tarsus): fore leg: 38:36:14; middle leg: 75:72:51; and hind leg: 45:38:19; grasping comb long, almost 2/5 length of fore tibia (14:36); middle femur about 0.65x total length; relative lengths of middle tarsal segments (1-2): 29:22; hind femur as thick as middle femur (7:7). Abdominal venter slightly depressed behind sternum 4.

Claspers very long and slender, distinctly crossing each other dorsal to the genital segment (as in Figs. 45-46); blade of each clasper curved dorsad in lateral view, distal part turned mesad, apex faintly hook-shaped (as in Fig. 52).

Female (Fig. 61) fusiform, length almost 2.0x greatest width across thorax (156:80). Head structure as in male; relative lengths of antennal segments (1-4): 30:20:23:25. Thoracic dorsum distinctly raised with greatest height about or slightly before middle of mesonotum (Fig. 62); metanotum and basal abdominal terga not flattened; thoracic notum furnished with erect pubescence which is slightly longer on mesonotum. Relative lengths of leg segments (femur:tibia:tarsus): fore leg: 45:38:20; middle leg: 94:88:65; and hind leg: 51:46:22; middle femur 0.6x total length. Abdomen broad at base, evenly tapering in width posteriorly; terga depressed from segment 4 and backwards; connexiva more or less obliquely raised throughout; tergum 8 short and wide, its length a little less than $\frac{1}{2}$ width, exposing proctiger behind.

b. Specimens from Queensland and Papua New Guinea:

Size. Table 2 gives the variation in total length. The smallest individuals come from Darwin, Northern Territory, the largest from Prince of Wales Island, Queensland.

Colour. As in the type specimens of *hilli* except that some females have a small, indistinct, median patch of greyish hairs on basal abdominal terga.

Structural characters. *Male* length 1.65-1.8x greatest width across thorax. Head length about 0.8x head width across eyes. Antennal segment 3 subequal to or slightly longer than segment 2. Grasping comb about or a little more than $\frac{3}{7}$ length of fore tibia. Middle femur 0.63-0.70x total length (Table 2), specimens from Daru Island, Papua New Guinea, have slightly (but significantly) shorter middle femora than specimens from Australian localities. Claspers (Fig. 52) as in paratypes, apex of each clasper faintly hook-shaped. Vesical sclerites (Fig. 53). Other characters as in the paratypes.

Female length 1.9-1.95x greatest width across thorax. Head incl. antennal structure as in male. Thorax in lateral view (Fig. 63) less convex dorsally than in paratypes, with greatest height placed a little before middle; pubescence of thoracic and basal abdominal dorsum much the same as in paratypes except that the pubescence of the posterior parts

usually are shorter. Middle femur 0.60-0.66x total length (Table 2). Other characters as in the paratypes.

c. Specimens from New Caledonia and Loyalty Islands:

Size. ♂: length 1.45 mm, width 0.85 mm; ♀: length 1.98-2.05 mm, width 1.00-1.10 mm.

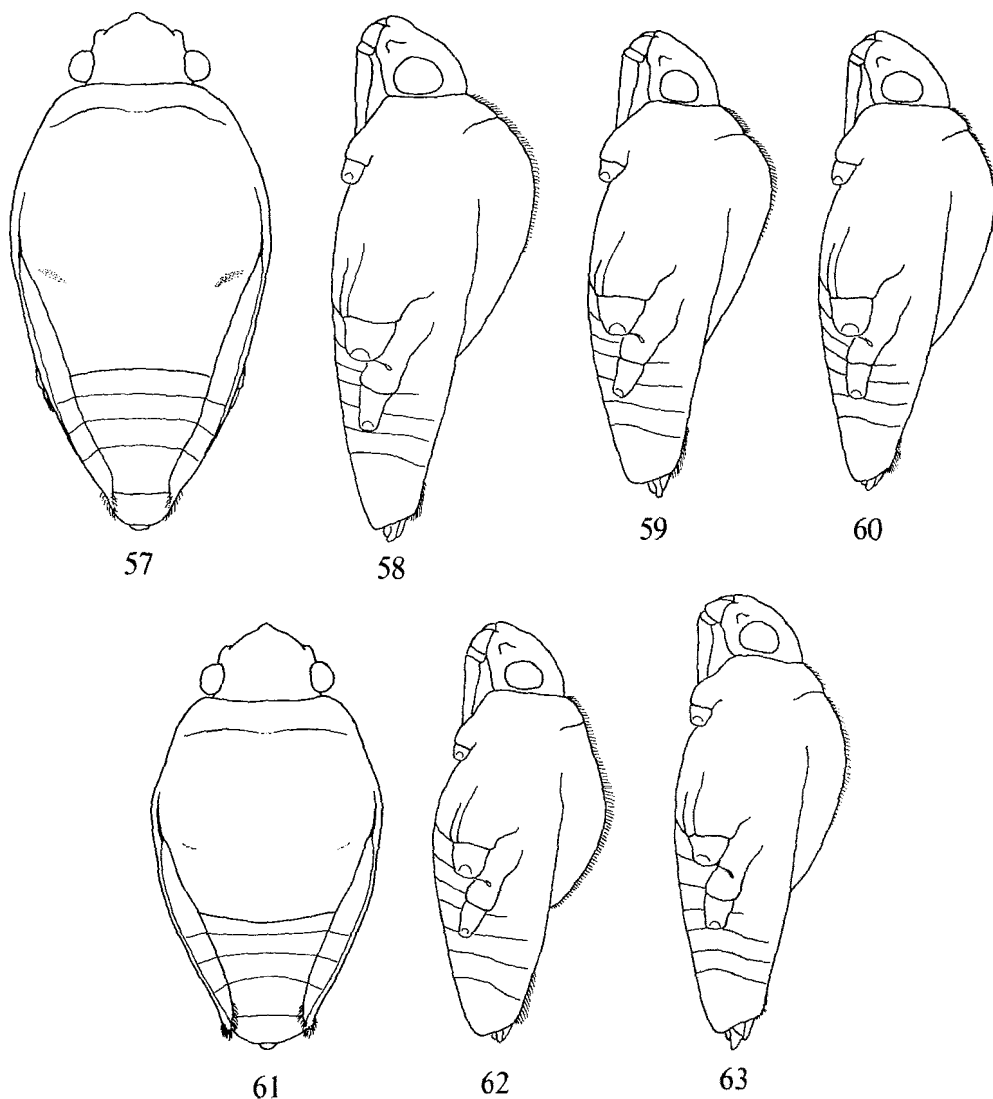
Colour. As in the type specimens of *hilli* except that the females have a larger, median patch of greyish hairs on posterior thoracic dorsum and basal abdominal terga.

Structural characters. *Male* structure chiefly as in paratypes. Grasping comb longer, more than $\frac{1}{2}$ length of fore tibia (19:35). Middle femur 0.64x total length. Claspers as in paratypes.

Female length 1.85-1.9x greatest width across thorax. Thorax in lateral view strongly convex with greatest height in middle; pubescence of thoracic and basal abdominal dorsum much the same as in paratypes except that the pubescence of the middle part is longer. Middle femur 0.60x total length. Basal abdominal terga slightly depressed on each side. Other characters as in paratypes.

Distribution and habitat

Probably widely distributed along the east, north-west, and west coasts of Australia, extending to southern New Guinea and New Caledonia. Recorded from Northern Territory, Queensland, and Western Australia (Hale 1926, 1935), Papua New Guinea (Western Province), New Caledonia, and Loyalty Islands. Polhemus (1982: 9) collected the species on East Point Reef near Darwin, Northern Territory, Australia, and writes: "This species...were taken from tide pools among large shoulder-high boulders. The most productive pools were considerably above the tidal level where *Hermatobates hadoni* Carpenter was abundant;," and "Certain sheltered localities under overhanging rock, and particular sites along more exposed rock surfaces were favored by these bugs;." Also abundant on intertidal reef off Prince of Wales Island, Torres Strait, northern Queensland, described as (Polhemus, field notes): "reef of dead coral exposed at low tide, rough and blocky with pools and channels at various levels, connected by small streams and falls of salt water."



Figs. 57-63. 57-60. *Haloveliea bergrothi* Esaki. (57. Female body, dorsal view. 58. Female body, lateral view (Papua New Guinea). 59. Same (Guam). 60. Same (Vietnam)). 61-63. *Haloveliea hilli* China. (61. Female body, dorsal view. 62. Female body, lateral view (West Australia). 63. Same (Queensland)).

Discussion

China (1957) states that this species is closely allied to *H. septentrionalis* Esaki, but differs (p. 354) "in having the second antennal segment slightly shorter than the third in both sexes, in the rostrum extending distinctly beyond the anterior coxae especially in the male and in having the posterior femur less than two-thirds the length of the intermediate one".

None of these characters are significant when larger samples of both species are compared and many specimens fail to key out in China's key (p. 356) because the second antennal segment is not distinctly shorter than third (always less than 0.85:1).

China (op.cit.) also states that the male claspers are not crossed but directed anteriad in *hilli*. This may be true only for males which have their genital

segments extended, while the claspers are crossing each other dorsally (like in Fig. 46) if the genital segments are withdrawn into the pregenital abdomen.

China (op.cit.) did not compare his new species with neither *bergrothi* Esaki nor *marianarum* Usinger. Nevertheless, these forms are very similar to each other, especially when the wide range of variation in *bergrothi* (as here defined) is considered. Generally, *hilli* is a smaller species than *bergrothi* (Table 2), especially when only males are considered. This size difference is statistically significant when only samples from Australia (*hilli*), Papua New Guinea (*hilli*, *bergrothi*), and Solomon Islands (*bergrothi*) are compared. The difference in the relative lengths of middle femora are even more significant. Also the dorsal structure of the female thorax and basal abdomen is different. Females of *hilli* (Figs. 62-63) have their dorsal convexity most pronounced at or a little before the middle of mesonotum while in females of *bergrothi* (Figs. 58-60), the dorsal convexity is displaced towards the anterior part of mesonotum. The length of the male grasping comb of *hilli* rarely exceeds $\frac{1}{2}$ tibial length (usually just about $\frac{3}{7}$ tibial length). The male claspers of *hilli* (Fig. 52) are more slender and the distal part of each is smoothly curved, not abruptly turned mesad as in *bergrothi* (Fig. 49).

The geographical variation of *hilli* is described above and in Table 2. The smallest individuals come from Darwin, Northern Territory. Female specimens from this locality and from each side of the Torres Strait (northern Queensland and Daru Island, Papua New Guinea) are less convex dorsally than females from the Monte Bello Islands (Western Australia) and islands of the Great Barrier Reef (Sherrard I., Low Isles, Green I., and Magnetic I.). The females from New Caledonia are quite similar to those from the Great Barrier Reef. Further collections of *Halovelgia* from the islands of the Coral Sea between Australia and New Caledonia, may extend the distributional range of *hilli* (a single nymph is present from the Chesterfield Islands). Hale's (1926, 1935) records of *H. maritima* Bergroth from West Australia (Pelsart Islands, Garden Island off Fremantle) probably refer to *hilli* (I have been unable to study the specimens).

8. *Halovelgia heron* sp.n.

Figs. 47, 54, 64-65.

Type area: Heron Island, Australia, Queensland.

Type material examined: *Holotype* ♂, AUSTRALIA, Queensland, Heron Island, 16-20.xii.1967, S.R. Curtis, in the Entomology Department, University of Queensland, Brisbane. - *Paratypes*: 3♂♂ 10♀♀, same locality and date as holotype (UQ); 1♂, Queensland, Bedara Island, on seawater, 12.viii.1976, D.C. Geijskes (RML); 1♂ 3♀♀, Heron Island, 10.i.1965, B. Cantrell (UQ); 11♂♂ 1♀, Heron Island, 15.i.1965, B. Cantrell (UQ); 1♂ 3♀♀, Heron Island, 15.i.1965, T. Weir (UQ); 17♂♂ 7♀♀, Queensland, Heron Island, N. side of reef, intertidal rocks, 15-17.v.1976, Lanna Cheng (JTPC, ZMUC).

Diagnosis: Separated from *hilli* China by the extreme apex of the male clasper being almost straight, not hook-shaped, the stouter female body, and the female metanotum and basal abdominal terga being slightly raised and distinctly pubescent in middle.

Etymology: Named for the type locality, Heron Island.

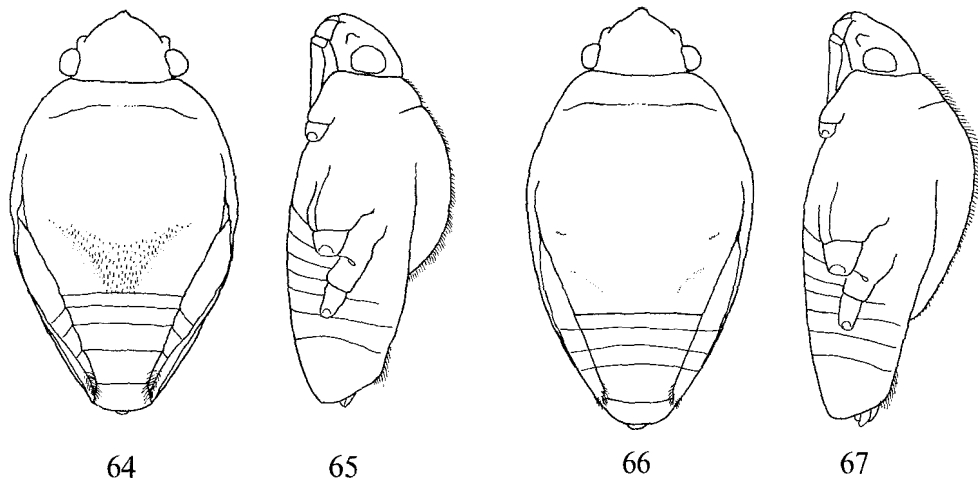
Description

Size. ♂♂: length 1.40-1.50 mm, width 0.84-0.89 mm; ♀♀: length 1.92-2.05 mm, width 1.08-1.12 mm.

Colour. Dark brownish with greyish pubescence which is denser and more distinctly grey on the male abdomen. Basal abdominal terga of female with a large, distinct, median patch of pale hairs. Female connexiva terminated by long, whitish hairs. A large yellowish brown spot at the base of head. Antennae and legs brownish.

Structural characters. *Male* (Fig. 47) ovate, length a little more than 1.7x greatest width across thorax (120:69). Head length about 0.75x head width across eyes (32:43); eye width about 0.25x width of head between eyes (7:29). Relative lengths of antennal segments (1-4): 23:16:18:21; segment 1 much shorter than head, slightly thicker than segment 4 (5:4). Hind margin of pronotum indistinct laterally. Relative lengths of leg segments (femur:tibia:tarsus): fore leg: 38:36:14; middle leg: 74:71:49; and hind leg: 45:38:18; grasping comb long, about $\frac{1}{2}$ length of fore tibia (18:36); middle femur slightly more than 0.6x total length; relative lengths of middle tarsal segments (1-2): 27:22; hind femur as thick as middle femur (7:7). Abdominal venter slightly depressed beyond sternum 4. Claspers very long and slender, distinctly crossing each other dorsal to the genital segment (as in Figs. 45-46); blade of each clasper curved dorsad in lateral view, distal part (Fig. 54) turned mesad, apex at most slightly curved; vesical sclerites as in *hilli*.

Female (Fig. 64) subovate, length about 1.8x greatest width across thorax (155:86). Head structure as in male; relative lengths of antennal seg-



Figs. 64-67. 64-65. *Halovelvia heron* sp.n. (64. Female body, dorsal view. 65. Female body, lateral view). 66-67. *Halovelvia fijiensis* sp.n. (66. Female body, dorsal view. 67. Female body, lateral view).

ments (1-4): 28:20:21:27. Thoracic dorsum distinctly raised in middle of mesonotum (Fig. 65); thoracic and basal abdominal dorsum furnished with long, erect pubescence which is longer in the middle of posterior mesonotum, metanotum, and basal abdominal terga. Relative lengths of leg segments (femur:tibia:tarsus): fore leg: 47:42:20; middle leg: 95:88:61; and hind leg: 54:47:23; middle femur about 0.6x total length. Abdomen rather high in lateral view (Fig. 65); in dorsal view (Fig. 64) broad at base, subparallel in anterior parts, tapering in width posteriorly; terga slightly depressed basally on each side and from segment 4 and backwards; connexiva more or less obliquely inclined in anterior parts, almost vertically raised or slightly overturned in posterior parts; tergum 8 short and wide, its length a little less than $\frac{1}{2}$ width, barely exposing proctiger behind.

Distribution and habitat

So far only recorded from Bedara Island and Heron Island, southern Queensland, Australia. Collected among intertidal rocks on N. side of reef at Heron Island (Cheng *in litt.*).

Discussion

All specimens of *Halovelvia* from Heron Island (southern part of the Great Barrier Reef) are different from any specimen of *H. hilli* China examined

during the present study. The male claspers of these specimens (Fig. 54) have their extreme apices straight instead of hook-shaped as in *hilli* (Fig. 52). The females are stouter, their length being only 1.8x instead of 2.0x greatest width of body which is located at the basal connexival segments. These segments are widened and usually obliquely raised. The whole abdomen seems more voluminous (especially in lateral view) than in females of *hilli* (compare Figs. 65 and 62-63). The metanotum and basal abdominal terga are laterally impressed, forming a medial swelling furnished with long pubescence. The absolute size as well as the relative lengths of the middle femora are, however, not significantly different from those of *hilli* (Table 2).

I have decided to name the Heron Island specimens as a distinct species, *H. heron* sp.n., rather than a subspecies or geographical variant of *hilli*. First, there are no intermediate states in the characters used to separate *hilli* and the new species. Second, although no *Halovelvia* has been examined from localities between Heron Island and Magnetic Island to the north, it is very likely that the new species is sympatric with *hilli* somewhere in that area of the Great Barrier Reef. Only future collecting efforts can test this hypothesis.

9. Halovelvia fijiensis sp.n.

Figs. 48, 55-56, 66-67.

Type area: Viti Levu, Fiji Islands.

Type material: Holotype ♂, FIJI ISLANDS: Viti Levu, Suva, Navik Hotel Resort, rock pools at low tide, 28.vii.1978, Lanna Cheng, in the Zoological Museum, University of Copenhagen. - *Paratypes:* 82 ♂ 65 ♀, same locality and date as holotype (ZMUC); 2 ♂ 2 ♀, Gau, Sawaieke, low tide pools, 28.vi.1983, W.A. Foster (ZMUC); 2 ♂ 3 ♀, Lakeba, Tubov, 4.vii.1983, W.A. Foster (ZMUC); 7 ♂ 7 ♀, Lau Group, Moce I., Koroni Islet, on surface of sea, 4.vii.1977, K.A.J. Wise (JTPC); 5 ♂ 6 ♀, Vanua Levu, Naduri, 6.vii.1983, W.A. Foster (JTPC, ZMUC); 1 ♂ 2 ♀, Viti Levu, Suva, mangrove near USP marine lab., 13.iv.1976, Lanna Cheng (JTPC); 2 ♂ 2 ♀, Viti Levu, Vuda Pt., 12.vi.1983, W.A. Foster (ZMUC).

Diagnosis: Recognized by the short and stout male claspers. The females are separated from those of *heron* sp.n. by the absence of a distinct, median patch of pale hairs on basal abdominal terga and from females of *hilli* China by their relatively wider body shape.

Etymology: Named for the type area, the Fiji Islands.

Description

Size. ♂: length 1.35-1.40 mm, width 0.72-0.78 mm; ♀: length 1.98-2.05 mm, width 1.10-1.12 mm.

Colour. Black with greyish pubescence which is denser and more distinctly grey on the male abdomen. Female connexiva terminated by short, whitish hairs. A large, obscure, yellowish brown spot at the base of head. Antennae and legs dark brownish to black.

Structural characters. Male ovate, length about 1.9x greatest width across thorax (112:59). Head length 0.65x head width across eyes (26:39); eye width a little more than 0.25x width of head between eyes (7:26). Relative lengths of antennal segments (1-4): 22:14:15:21; segment 1 shorter than head, slightly thicker than segment 4 (5:4). Hind margin of pronotum indistinct laterally. Relative lengths of leg segments (femur:tibia:tarsus): fore leg: 36:33:14; middle leg: 75:72:53; and hind leg: 43:36:17; grasping comb about 3/7 length of fore tibia (14:33); middle femur about 0.65x total length; relative lengths of middle tarsal segments (1-2): 30:23; hind femur as thick as middle femur (6:6). Abdominal venter not modified. Claspers short and stout, barely reaching each other dorsal to the genital segment (Fig. 48); each clasper almost semi-circular with pointed and slightly hook-shaped apex (Fig. 55); vesical sclerites (Fig. 56).

Female (Fig. 66) subovate, length about 1.8x greatest width across thorax (163:90). Head structure as in male; relative lengths of antennal segments (1-4): 26:18:20:26. Thoracic dorsum distinct-

ly raised with greatest height slightly before middle of mesonotum (Fig. 67); pronotum and anterior part of mesonotum furnished with short, erect pubescence. Relative lengths of leg segments (femur:tibia:tarsus): fore leg: 48:41:20; middle leg: 101:99:75; and hind leg: 55:50:24; middle femur about 0.6x total length. Abdomen in dorsal view (Fig. 66) broad at base, tapering in width posteriorly; terga slightly depressed basally on each side and from segment 4 and backwards; connexiva obliquely inclined in anterior parts; tergum 8 short and wide, its length a little less than 1/2 width, exposing protigter behind.

Distribution and habitat

Endemic to the Fiji Islands. Recorded from Gau, Lau Group, Vanua Levu, and Viti Levu. Collected in large numbers on rock pools at low tide near Suva (Cheng *in litt.*); also found in mangroves near USP marine laboratory, Suva, Viti Levu (locality described by Foster & Treherne 1986).

10. *Halovelia septentrionalis* Esaki

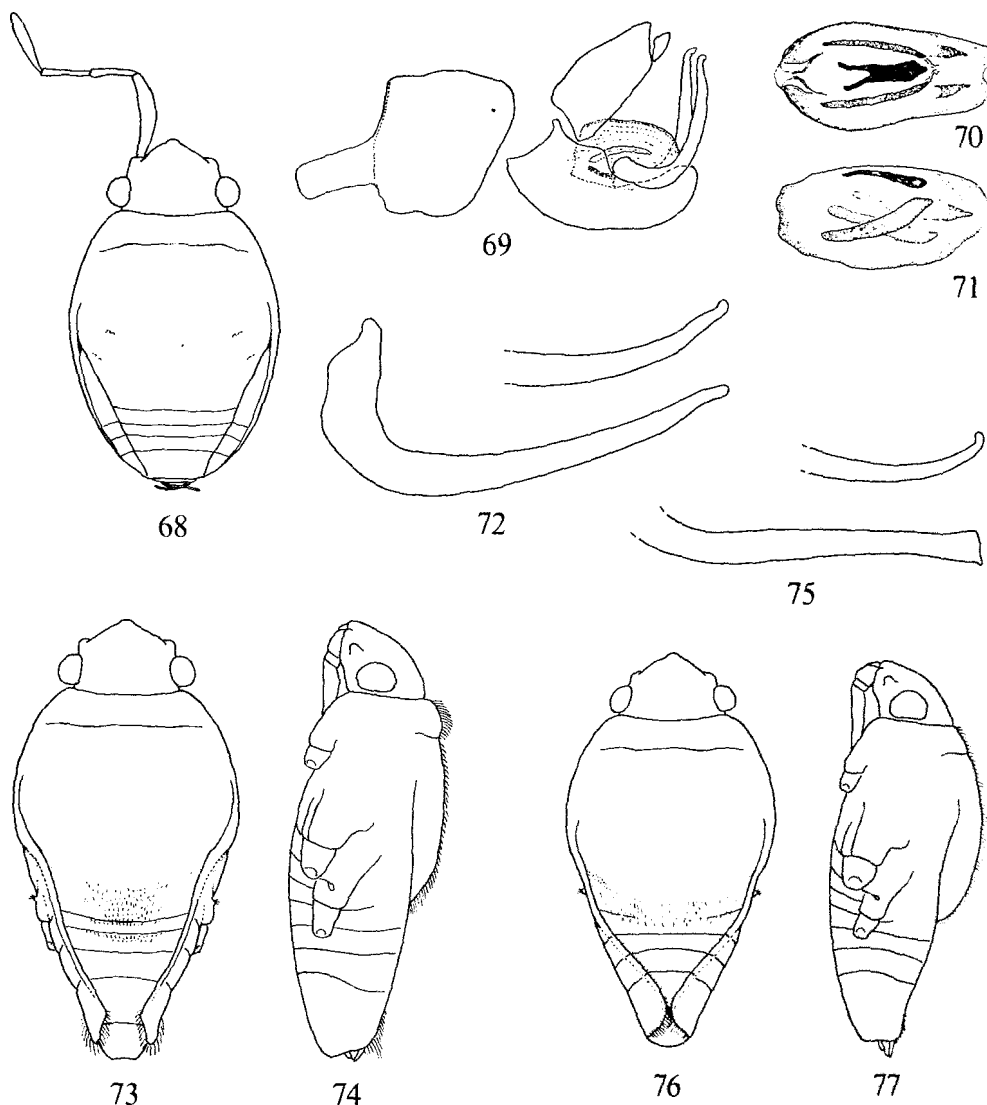
Figs. 68-74.

Halovelia maritima Bergroth; Esaki 1924: 30-32 (description, biology; records Honshu, Japan and Formosa).

Halovelia septentrionalis Esaki, 1926a: 162-164 (description; type locality: Misaki, Japan); Esaki 1926b: 183 (list; records Taiwan, Kashoto); Esaki 1930: 24 (check-list); Hoffmann 1941: 29-30 (list; records Okinawa); China 1957: 356 (key); Miyamoto 1964a: 149 (records Ryukyu Islands); Miyamoto 1964b: 206 (records South-West Islands).

Type material examined: Lectotype ♂ (here designated) labelled "Japonia, Matsumura", "Misaki pr. Tokyo", and "Halovelia septentrionalis Esaki, det. T. Esaki", in the Hungarian National Museum, Budapest. - *Paralectotypes:* 45 ♂ 39 ♀ (3 ♂ 4 ♀ examined), same locality as lectotype (HNM); 2 ♂ 1 ♀, Honshu, Misaki (Sagami), 11.vii.1923, Teiso Esaki (BMNH, USNM).

Other material examined: JAPAN: 1 ♂ 2 ♀, Shikshu, 27.vi.1966, C.E. Lee (JTPC); 3 ♂ 2 ♀, Tateyama, Shiba Pref., 15.iv.1981, H. Mori (ZMUC). TOKARA ISLANDS: 1 ♂ 1 ♀, Kotakarajima, 16.v.1934, Teiso Esaki (USNM); 2 ♂, Nakanoshima, 12.vii.1960, M. Sato (JTPC); 1 ♂ 3 ♀, Nakano-shima, 30.v.1962, M. Sato (JTPC); 1 ♂, Tokarajima, 16.v.1934, Teiso Esaki (BMNH); 1 ♂ 1 ♀, same locality, 29.v.1953, S. Miyamoto (USNM); 1 ♂ 1 ♀, Takara-jima, 27.v.1953, S. Miyamoto (JTPC); 10 ♂ 12 ♀, Takara-shima, 8.vi.1962, M. Sato (JTPC); RYUKYU ISLANDS: 4 ♀ ♀, Naha, Okinawa, July 20, 1945, F.G. Werner (AMNH); 4 ♂ 3 ♀, Iriomote-jima, 27.iii.1961, Y. Arita (JTPC).



Figs. 68-77. 68-74. *Halovelvia septentrionalis* Esaki. (68. Male body, dorsal view. 69. Male segment 8 and genital segments, lateral view. 70. Phallus, dorsal view. 71. Same, lateral view. 72. Left clasper; dorsal aspect of blade above. 73. Female body, dorsal view. 74. Female body, lateral view). 75-77. *Halovelvia inflexa* sp.n. (75. Blade of left clasper; dorsal aspect above. 76. Female body, dorsal view. 77. Female body, lateral view).

Diagnosis: Recognized by the basal tumescence of the male abdominal venter, long and slender male claspers, and the structure of the female dorsum.

Description

Size. ♂♂: length 1.55-1.70 mm, width 0.90-1.02

mm; ♀♀: length 2.10-2.28 mm, width 1.08-1.20 mm.

Colour. Black or dark brown with greyish pubescence which is longer and denser on abdomen (♂) or on basal abdominal terga and towards abdominal end (♀). Female connexiva terminated by long, whitish hairs. A transverse yellowish brown spot at

the base of head. Antenna and legs dark brownish to black.

Structural characters. Male (Fig. 68) ovate, length about 1.8x greatest width across thorax (134:80). Head length 0.7x head width across eyes (34:48); eye width about 0.25x width of head between eyes (8:32). Relative lengths of antennal segments (1-4): 30:18:20:26; segment 1 slightly shorter than head (30:34), slightly thicker than segment 4 (6:5). Hind margin of pronotum indistinct laterally. Relative lengths of leg segments (femur:tibia:tarsus): fore leg: 45:42:15; middle leg: 93:86:60; and hind leg: 52:44:18; grasping comb almost 2/5 length of fore tibia (16:42); middle femur about 0.7x total length; relative lengths of middle tarsal segments (1-2): 34:26; hind femur slightly thicker than middle femur (8:7). Base of abdominal venter with a broad tumescence furnished with very long pubescence. Genital segments as illustrated (Fig. 69); claspers very long and slender, distinctly crossing each other dorsal to the genital segment; blade of each clasper (Fig. 72) nearly straight in lateral view, evenly curved mesad in distal part, with apex blunt or slightly hook-shaped; phallus and vesical sclerites (Figs. 70-71).

Female (Fig. 73) subovate, length about 1.9x greatest width across thorax (182:95). Head structure as in male except that antennal segment 1 is more slender; relative lengths of antennal segments (1-4): 31:20:22:30. Thoracic dorsum moderately raised in middle (Fig. 74), furnished with erect pubescence which is distinctly longer on pronotum, metanotum, and basal abdominal terga. Relative lengths of leg segments (femur:tibia:tarsus): fore leg: 52:48:21; middle leg: 111:106:87; and hind leg: 58:53:25; middle femur 0.6x total length. Abdomen tapering in width posteriorly, terga depressed from segment 4 and backwards; connexiva erect, slightly inflexed upon abdominal dorsum distally; tergum 8 large, almost square, concealing proctiger.

Distribution and habitat

Recorded from Japan (Honshu), Tokara Islands, Ryukyu Islands (Okinawa; Miyamoto 1964a, 1964b, records Amami-Oshima; Miyako; Iriomote; and Ishigaki); and Taiwan (Esaki 1924a, 1926a, 1926b records Loochoo Islands; Tansui, N. Formosa; Koshun, S. Formosa; and Kashoto (Samasana Island), E. Formosa). Esaki (1924a: 32) found this species (identified as *H. maritima* Bergroth) abundantly "...on the surface of sea-water among the

rocks on the coast from June to September" in Misaki near Tokyo, Japan. In Tansui, northern Taiwan, they were found (op.cit., p. 33) "on the small pools and streams among the rocks near the coast exposed at ebb-tide."

Discussion

Esaki (1924a) first identified this species as *H. maritima* Bergroth, but after having examined types of the latter species, he (Esaki 1926a: 163) recognized it to be separate from that species. Esaki listed a number of characters to separate his new species from *maritima* as well as *bergrothi* Esaki. Some of these characters, e.g., "Legs comparatively much shorter and stouter" do not apply. China (1957: 355) gave measurements of a "paratype ♂" and illustrated the genitalia of *H. septentrionalis* Esaki (op.cit, figs. 6a, b). The key characters used by China (1957: 356) to separate this species from other *Halovelina*-species, viz., middle tibia and tarsus together subequal to thorax and abdomen in male and shorter in female, do not hold for the specimens examined by me. If the total length is used instead of the body length (excl. head), this character holds for the male, but not for the female. In China's table of measurements (op.cit., p. 355) he uses "body length", but the actual measurements (transformed to mm's) compared with his descriptions of species, clearly indicates that he measured the total length (incl. head).

11. Halovelina inflexa sp.n.

Figs. 75-77.

Type area: Sudan, Red Sea coast.

Type material examined: *Holotype* ♀, SUDAN: Suakin, 19-30.ix.1970, littoral terrestrial fauna, Cloudsley-Thompson, in the British Museum (Natural History), London. - *Paratype*: 1 ♂, same data as holotype (BMNH).

Diagnosis: Recognized by its small size, the long and slender male clasper with obtuse apex, and the female connexiva which are inflexed upon abdominal dorsum, almost overlapping each other distally.

Etymology: Named for the inflexed state of the female connexiva.

Description

Size. ♂: length 1.58 mm, width 0.90 mm; ♀: length 1.90 mm, width 1.02 mm.

Colour. Black with a greyish pubescence which is

longer and denser on abdominal dorsum (♂) or posterior mesonotum (♀). Female connexiva terminated by long, whitish hairs. An obscure brownish spot at base of head. Antennae and legs dark brownish.

Structural characters. Male ovate, length 1.75x greatest width across thorax (127:72). Head length about 0.7x head width across eyes (33:46); eye width a little more than 0.25x width of head between eyes (8:30). Antennae incomplete, relative lengths of antennal segments 1-2: 25:16; segment 1 much shorter than head, rather stout. Hind margin of pronotum indistinct in lateral parts. Relative lengths of leg segments (femur:tibia:tarsus): fore leg: 42:35:16; middle leg: 79:70:51; and hind leg: 43:35:19. Grasping comb about 1/3 length of fore tibia (12:35); middle femur lightly more than 0.6x total length; relative lengths of middle tarsal segments (1:2): 29:22; hind femur as thick as middle femur (7:7). Abdominal venter not modified. Claspers very long, distinctly crossing each other dorsal to the genital capsule; blade of each clasper (Fig. 75) slender and almost straight in lateral view with blunt apex, distally curved mesad in dorsal view with pointed apex.

Female (Fig. 76) subovate, length 1.85x greatest width across thorax (152:81). Head structure as in male except that antennal segment 1 is more slender; antennae incomplete, length of antennal segments (1-3): 23:18:19:?. Thoracic dorsum slightly raised in middle (Fig. 77), pubescence longer in posterior parts of mesonotum. Relative lengths of leg segments (femur:tibia:tarsus): fore leg: 44:37:17; middle leg: 81:76:54; hind leg: 44:38:19. Middle femur about 0.5x total length. Abdomen tapering in width posteriorly; abdominal terga depressed behind tergum 3; connexiva raised in basal parts, inflexed upon abdominal dorsum in distal parts, almost overlapping each other above tergum 7; tergum 8 produced and almost horizontal, concealing protigter.

Distribution

Only known from the type locality at the Red Sea coast of Sudan.

12. Halovelvia esakii sp.n.

Figs. 78-81, 83-86, 90-92.

Type area: Biak, Irian New Guinea.

Type material examined: Holotype ♂, IRIAN NEW GUINEA: Neth., Biak Airport, 19-24.v.1959, T.C. Maa, in the B.P. Bishop Museum, Honolulu. - **Paratypes:** 7 ♂ ♂ 8 ♀ ♀, same locality and date as holotype (BPBM). CAROLINE ISLANDS: 4 ♂ ♂ 4 ♀ ♀, Palau, Site 4 (marine), 17.ix.1979, Lanna Cheng (ZMUC); 2 ♂ ♂ 2 ♀ ♀, Palau, West Caroline Is., Site 2 (rock pools), 15.ix.1979, Lanna Cheng (ZMUC). LESSER SUNDA ISLANDS: 72 ♂ ♂ 34 ♀ ♀, Sumbawa, Nusa Tenggara Barat Prov., coast 5 km E. of Nipa, 34 km NE. of Bima, CL 2176, X-21-85, J.T. & D.A. Polhemus (JTTC). MOLUC-CAS: 13 ♂ ♂ 10 ♀ ♀, Ambon, Maluku Province, Waitaire, intertidal rocks, CL 2152, X-4-85, J.T. & D.A. Polhemus (JTTC). PHILIPPINES: 2 ♂ ♂ 1 ♀, Luzon, Zambales, Iba Beach (rocky), 13 May 1977, A.A. Barroso (JTTC); 4 ♂ ♂ 1 ♀, Mindanao, Zamboanga del Sur Prov., Santa Cruz Is. off Zamboanga, coral reef, CL 1997, VII-21-85, J.T. & D.A. Polhemus (JTTC); 41 ♂ ♂ 53 ♀ ♀, Mindoro, Mindoro Oriental Prov., offshore islet, Calapan, CL 1978, VII-13-85, J.T. & D.A. Polhemus (JTTC); 1 ♂, Palawan, Pacdian Beach, 40 km. S. of Puerto Princesa, CL 2004, VII-25-85, J.T. & D.A. Polhemus (JTTC); 3 ♂ ♂ 2 ♀ ♀, Palawan, Puerto Princesa, coral rubble, 1.ix.1984, Cambridge University Exp. (JTTC, ZMUC); 3 ♂ ♂ 5 ♀ ♀, Palawan, Sabang N. of Mt. Paul, 11-13.vi.1977, M. Sato (JTTC). SOLOMON ISLANDS: 2 ♂ ♂ 5 ♀ ♀, San Cristoval, Wainoni Mission, Coral reef pools in clusters of 20-30 individuals, 21.vii.1965, Roy. Soc. Exped. BM. 1966-1 (BMNH); 1 ♂, New Georgia, Munda, at light, 9.iv.1983, Lanna Cheng (ZMUC). SULAWESI: 42 ♂ ♂ 63 ♀ ♀, Sulawesi Tengah Province, coast at Sarombone, 29 km NE. of Palu, CL 2161, X-10-85, J.T. & D.A. Polhemus (JTTC); 3 ♂ ♂ 4 ♀ ♀, Sulawesi Utara Province, Cape Dadebo, 8 km W. of Malibago, CL 2112, mangroves behind reef, IX-8-85, J.T. & D.A. Polhemus (JTTC); 2 ♂ ♂ 2 ♀ ♀, same locality and date, CL 2112, intertidal reef, J.T. & D.A. Polhemus (JTTC); 33 ♂ ♂ 22 ♀ ♀, Sulawesi Utara Province, intertidal reef, 19 km NE. of Inobonto, CL 2105, IX-6-85, J.T. & D.A. Polhemus (JTTC).

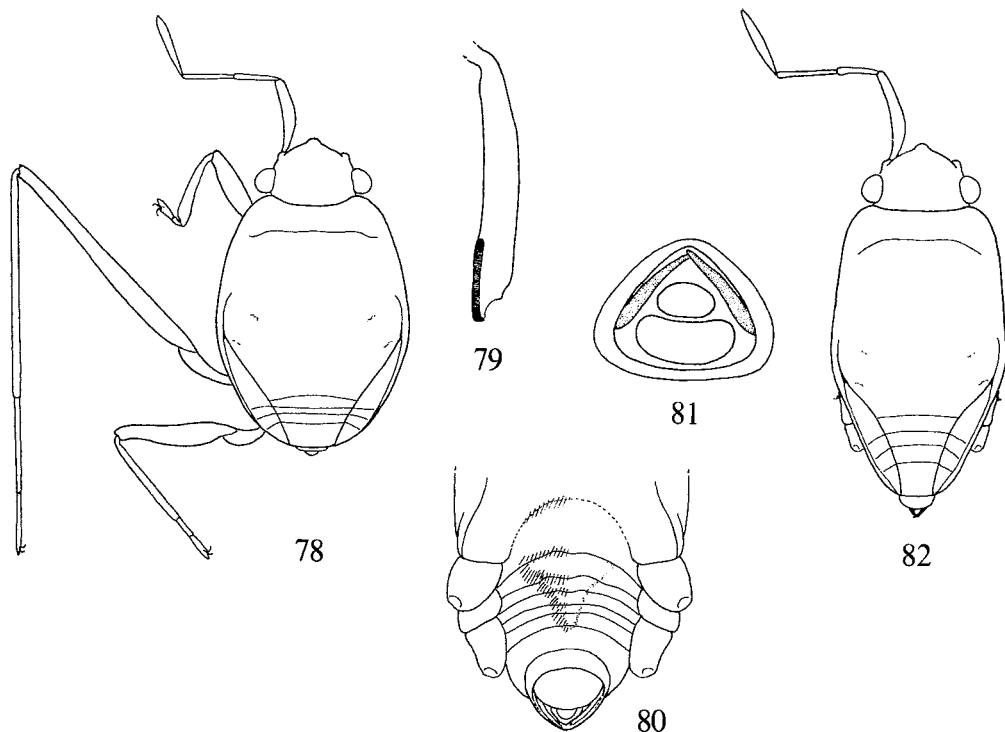
Diagnosis: Recognized by the long antennal segment 3 (more than 1.2x segment 2), base of male abdominal venter with broad tumescence, male clasper relatively short and stout with broad blade, female pronotum and anterior mesonotum with long, erect pubescence, and female metanotum and basal abdominal terga laterally impressed.

Etymology: Named in honour of Teiso Esaki, the founder of the taxonomy of the subfamily Haloveliinae.

Description

Size. ♂ ♂: length 1.45-1.60 mm, width 0.90-0.98 mm; ♀ ♀: length 1.75-1.93 mm, width 0.92-1.12 mm.

Colour. Black or dark brown with greyish pubescence on entire abdomen (♂) or forming definite markings on dorsum (♀) distributed as follows: lateral spots on mesonotum and an elongate median patch on metanotum and basal abdominal terga; an elongate glabrous and shiny spot in middle of the



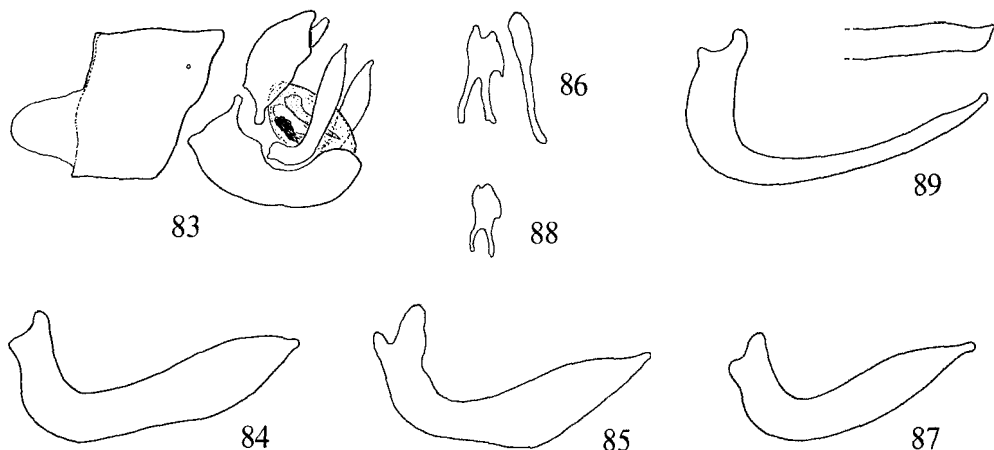
Figs. 78-82. 78-81. *Halovelie esakii* sp.n. (78. Male, dorsal view. 79. Left fore tibia of male. 80. Male abdomen, ventral view. 81. Male abdominal end, caudal view). 82. *Halovelie solomon* sp.n. Male body, dorsal view.

latter. Female connexiva terminated by long, whitish hairs. A large yellowish brown spot at the base of head. Antennae and legs dark brownish.

Structural characters. Male (Fig. 78) subovate, length 1.7x greatest width across thorax (123:72). Head length almost 0.6x head width across eyes (25:46); eye width about $\frac{1}{4}$ width of head between eyes (8:31). Relative lengths of antennal segments (1-4): 28:16:20:27; segment 1 only slightly shorter than head, rather stout, thicker than segment 4 (6:4); segment 3 distinctly longer than segment 2. Hind margin of pronotum indistinct in lateral parts. Relative lengths of leg segments (femur:tibia:tarsus): fore leg: 44:37:15; middle leg: 96:81:58; and hind leg: 49:40:18; grasping comb (Fig. 79) a little more than $\frac{2}{7}$ length of fore tibia (11:37); middle femur about 0.8x total length; relative lengths of middle tarsal segments (1-2): 36:22; hind femur slightly thicker than middle femur (9:8). Base of abdominal venter with a broad tumescence (Fig. 80) furnished with long pubescence. Genital

segments as illustrated (Fig. 83); claspers relatively short, barely reaching each other dorsal to the genital segment (Fig. 81); blade of each clasper (Figs. 84-85) broad, widened before pointed apex; vesical sclerites (Fig. 86).

Female (Figs. 90 and 92) subovate, length 1.85x greatest width across thorax (148:81). Head structure as in male except that antennal segment 1 is more slender; relative lengths of antennal segments (1-4): 26:16:21:28. Thoracic dorsum moderately raised in middle of mesonotum (Fig. 91), furnished with erect pubescence which is distinctly longer on pronotum, anterior mesonotum, and on metanotum. Relative lengths of leg segments (femur:tibia:tarsus): fore leg: 47:38:16; middle leg: 95:87:51; and hind leg: 50:42:17; middle femur 0.6x total length. Abdomen tapering in width posteriorly; metanotum and basal abdominal terga laterally impressed on each side of a median raised area, each impression usually with a median transverse ridge (Fig. 90); connexiva suberect, converging towards abdo-



Figs. 83-89. Male genitalia. 83-86. *Halovelvia esakii* sp.n. (83. Male genital segments, lateral view. 84. Left clasper (Biak). 85. Same (Sumbawa). 86. Vesical sclerites). 87-88. *Halovelvia polhemi* sp.n. (87. Left clasper. 88. Vesical sclerite). 89. *Halovelvia solomon* sp.n. Left clasper; dorsal aspect of blade above.

minimal end and sometimes inflexed upon abdominal dorsum; tergum 8 prolonged, deflected posteriorly to conceal proctiger.

Distribution and habitat

Widely distributed in the Malesian and Papuan subregions, east of Wallace's line. Recorded from the Solomon Islands (New Georgia, San Cristobal), Irian New Guinea (Biak), northern Moluccas (Ambon), Sulawesi (Sulawesi Utara and Tengah Provinces), Lesser Sunda Islands (Sumbawa), the West Caroline Islands (Palau), and the Philippines (Luzon, Mindanao, Mindoro, Palawan). The preferred type of habitat of this species seems to be intertidal coral reefs or rocky coasts strewn with coral blocks or rock boulders. At the coast at Sarombone, Sulawesi Tengah Province, it was taken in sheltered areas around a small man made mound of rock and coral rubble just offshore on an otherwise open coast; specimens aggregating in small protected pockets among rocks. On Ambon, Maluku Province, specimens were taken from shady places behind small sculptured rock ledges and boulders at river mouth forming a rocky bar at the sea. Freshwater was flowing out here and the *Halovelvia* were on strictly fresh water high above the low tide zone but evidently submerged at high tide. Specimens could not be found at low tide level around the big rocks on salty water. At Calapan,

Mindoro, this species was abundant in various localities on a boulder strewn and emergent rock shore (Polhemus, field notes).

Discussion

In this widely distributed species the modifications of the female dorsum vary between the samples examined. In females from the Solomons, Biak (Irian New Guinea), Ambon, Celebes, Sumbawa, Mindanao, and Mindoro, the lateral impressions on metanotum and basal abdominal terga are usually interrupted by a transverse ridge so that there seems to be two lateral impressions on each side of the median raised area (Fig. 90). In females from the Palau Islands and from Palawan the transverse ridge on each side of the basal abdominal terga is indistinct or obsolete (Fig. 92). The distribution of the patches of greyish pubescence of the female dorsum is also variable. Although these characters are rather constant among females from the same locality, the observed variation is not judged sufficient to warrant a taxonomic separation. The males show much less structural variation except in the relative width of the blade of the claspers (Figs. 84-85).

13. *Halovelvia polhemi* sp.n.

Figs. 87-88, 93-94.

Halovelgia (Halovelgia) maritima Bergroth; Polhemus 1982: 9-10 (descriptive notes; records Darwin, Australia, N.T.).

Type area: Darwin, Australia (Northern Territory).

Type material examined: Holotype ♀, AUSTRALIA: Northern Territory, Darwin, East Point, CL 904, 10.xii.1977, J.T. Polhemus, in the Australian National Insect Collection, CSIRO, Canberra. - *Paratypes:* 31 ♂♂ 22 ♀♀, same locality and date as holotype (ANIC, JTPC, UQ, ZMUC).

Diagnosis: Similar to *esakii* sp.n. but distinguished by its smaller size and female metanotum with only two lateral impressions, one on each side of a median raised area.

Etymology: Named after my colleague and friend, Dr John T. Polhemus, Englewood, Colorado, who collected this and numerous other *Halovelgia*-species.

Description

Size. ♂♂: length 1.32-1.43 mm, width 0.80-0.83 mm; ♀♀: length 1.55-1.63 mm, width 0.80-0.83 mm.

Colour. Black or dark brown with greyish pubescence on entire abdomen (♂) or forming definite markings on dorsum (♀) distributed as follows: lateral spots on mesonotum and a transverse patch on metanotum and basal abdominal terga except in middle; a small, elongate glabrous and shiny spot in middle of the latter. Female connexiva terminated by long, whitish hairs. A large yellowish brown spot at the base of head. Antenna and legs dark brownish.

Structural characters. Male subovate, length 1.7x greatest width across thorax (111:66). Head length 0.7x head width across eyes (29:41); eye width little more than ¼ width of head between eyes (8:26). Relative lengths of antennal segments (1-4): 25:16:20:26; segment 2 thus clearly shorter than segment 3; segment 1 slightly shorter than head, rather stout, thicker than segment 4 (5:4). Hind margin of pronotum indistinct in lateral parts. Relative lengths of leg segments (femur: tibia:tarsus): fore leg: 39:33:12; middle leg: 77:66:49; and hind leg: 44:36:18; grasping comb a little more than 2/7 length of fore tibia (10:33); middle femur about 0.7x total length; relative lengths of middle tarsal segments (1:2): 29:20; hind femur slightly thicker than middle femur (8:7). Base of abdominal sterna with a broad tumescence (as Fig. 80) furnished with long pubescence. Claspers relatively short and stout; blade of each clasper (Fig. 87) broad, slightly widened before pointed apex; dorsal vesical sclerite (Fig. 88).

Female (Fig. 93) subovate, length 1.95x greatest width across thorax (130:66). Head structure as in male except that antennal segment 1 is more slender; relative lengths of antennal segments (1-4): 24:15:19:25. Thoracic dorsum moderately raised in middle of mesonotum (Fig. 94), furnished with erect pubescence which is distinctly longer on pronotum, anterior mesonotum, and on metanotum; metanotum with lateral, shallow impressions. Relative lengths of leg segments (femur:tibia:tarsus): fore leg: 36:30:14; middle leg: 73:63:44; and hind leg: 41:34:17; middle femur 0.55x total length. Abdomen tapering in width posteriorly; abdominal terga distinctly depressed behind segment 3 (Fig. 93); connexiva suberect, converging towards abdominal end; tergum 8 prolonged, deflected posteriorly to conceal protiger.

Distribution and habitat

Australia (Northern Territory). Polhemus (1982: 9) describes the circumstances of his capture of this species at East Point Reef near Darwin. It was taken (together with *H. hilli* China) from reef pools among large shoulder-high boulders, especially in certain sheltered localities under overhanging rock, and particular sites along more exposed rock surfaces.

Discussion

Polhemus (1982: 9-10) identified the specimens examined by me as *H. maritima* Bergroth. However, the new species is separated from *maritima* by the same characters as *esakii*, viz., relatively larger eyes, longer middle femora, and different modifications of the female dorsum. Polhemus (l.c.) gave useful comparative notes on the new species and *H. hilli* China, which he collected together with it near Darwin, Australia (Northern Territory).

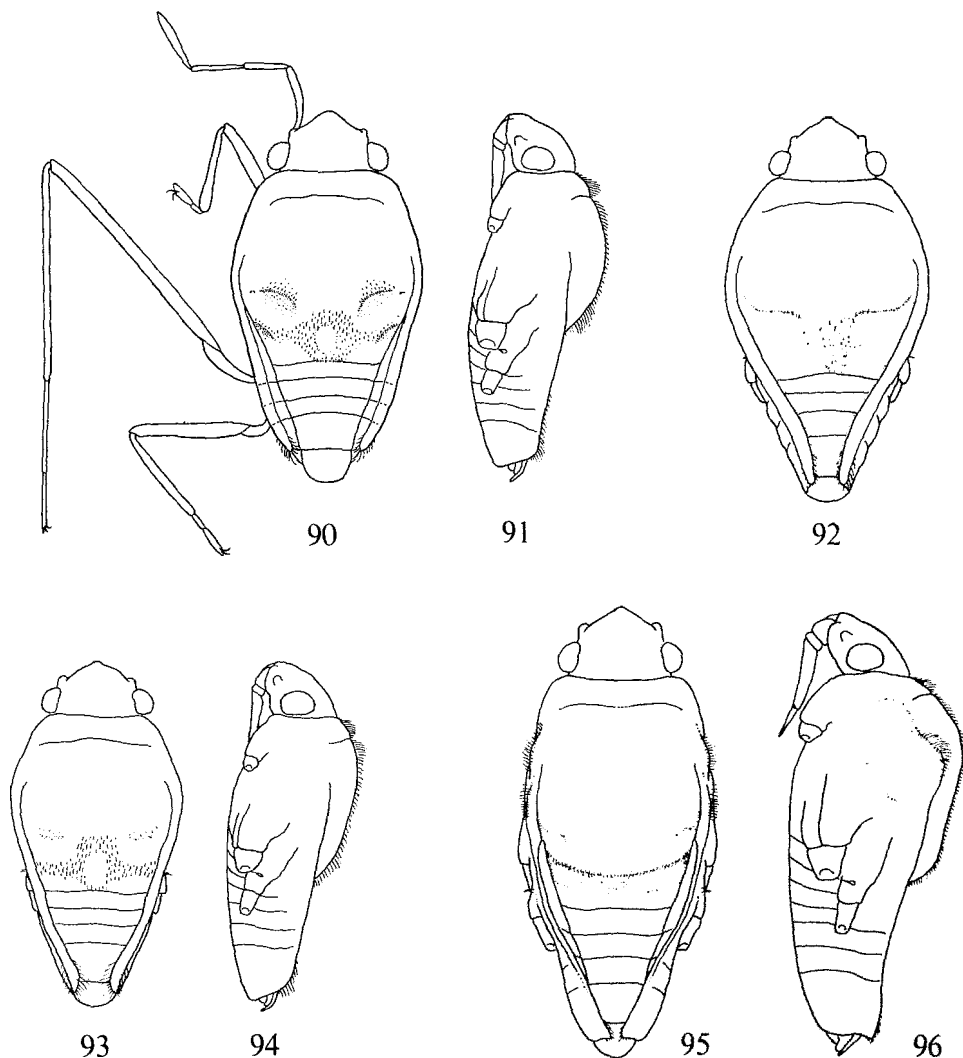
14. *Halovelgia solomon* sp.n.

Figs. 82, 89.

Type area: San Cristobal, Solomon Islands.

Type material examined: Holotype ♂, SOLOMON ISLANDS: San Cristobal, Star Harbour, 24.iv.1955, E.S. Brown, in the British Museum (Natural History), London. - *Paratype:* 1 ♂, same locality and date as holotype (BMNH).

Diagnosis: Recognized by the elongate body shape of male, relatively long antennal segment 3, and base of male abdominal venter with broad tumescence; the shape of claspers separates it from *esakii* sp.n.



Figs. 90-96. 90-92. *Halovelvia esakii* sp.n. (90. Female, dorsal view. 91. Female body, lateral view (Biak). 92. Female body, dorsal view (Palau)). 93-94. *Halovelvia polhemi* sp.n. (93. Female body, dorsal view. 94. Female body, lateral view). 95-96. *Halovelvia novoguineensis* sp.n. (95. Female body, dorsal view. 96. Female body, lateral view).

Etymology: Named for the type locality, the Solomon Islands.

Description

Size. ♂♂: length 1.78-1.80 mm, width 0.85-0.88 mm.

Colour. Black with greyish pubescence which is longer on abdominal dorsum (♂). A large, irregu-

lar yellowish brown spot at the base of head. Antennae and legs blackish brown, first antennal segment and all femora distinctly shiny.

Structural characters. **Male** (Fig. 82) elongate oval, length about 2.0x greatest width across thorax (144:70). Head length 0.65x head width across eyes (30:45); eyes rather small, slightly more than 0.2x interocular width (7:32). Relative lengths of antennal segments (1-4): 34:18:24:31; segment 1 distinctly

longer than head (34:30) and stout, thicker than segment 4 (5:4). Relative lengths of leg segments (femur:tibia:tarsus): fore leg: 51:42:17; middle leg: 129:118:93; hind leg: 63:47:19; grasping comb slightly more than $\frac{1}{3}$ of tibial length (17:47); middle femur 0.9x total length; relative lengths of middle tarsal segments (1-2): 53:40; hind femur distinctly thicker than middle femur (9:7). Base of abdominal venter with a broad tumescence furnished with long hairs. Claspers relatively short, barely crossing each other dorsal to the genital segment; blade of each clasper (Fig. 89) slender, slightly curved dorsad, straight and dorso-ventrally flattened with blunt apex; vesical sclerites not examined.

Female unknown.

Distribution

Only known from San Cristobal, Solomon Islands.

Discussion

Although only known from the two male types, these are so distinct from males of any other *Halovelina*-species that they undoubtedly belong to a separate species.

15. *Halovelina novoguineensis* sp.n.

Figs. 95-99.

Type area: Malupore Island, Papua New Guinea (Central Province).

Type material examined: *Holotype* ♂, PAPUA NEW GUINEA: Central Prov., Malupore Is., mar. res. station, CL 1839, IX-21-83, J.T. & D.A. Polhemus, in the B.P. Bishop Museum, Honolulu. - *Paratypes*: 55♂♂ 83♀♀, same locality and date as holotype (BPBM, JTPC, ZMUC).

Diagnosis: Recognized by the long antennal segment 3 (more than 1.2x segment 2), the depressed male abdominal venter, the long and stout male claspers, the anteriorly raised female thoracic dorsum, and the impressed mesopleura with tufts of hairs.

Etymology: Named for the type area, New Guinea.

Description

Size. ♂♂: length 1.80-1.93 mm, width 0.92-1.00 mm; ♀♀: length 2.08-2.18 mm, width 0.94-0.98 mm.

Colour. Black or dark brown with greyish pubescence which is longer and denser on abdominal dorsum (♂) or on posterior mesonotum and metano-

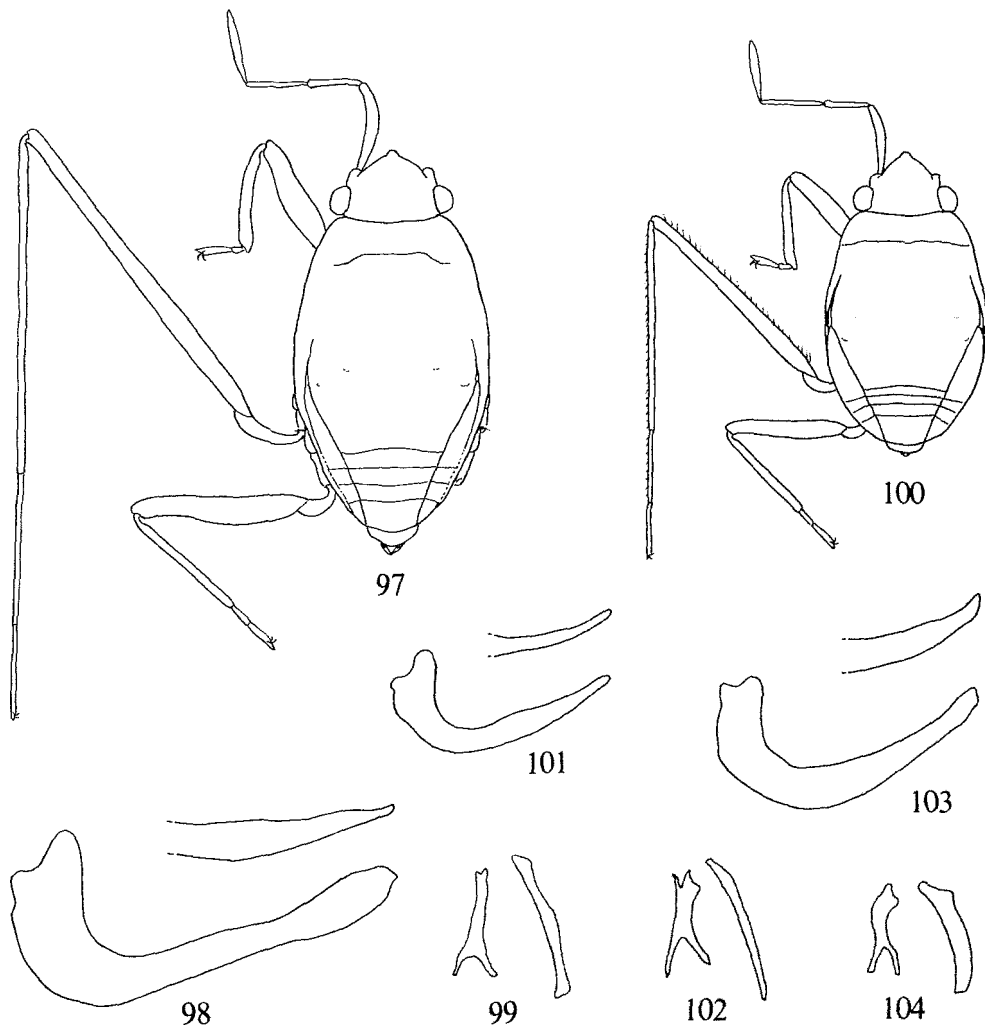
tum and towards abdominal end (♀). Female connexiva terminated by long, whitish hairs. A large obscure brownish spot at base of head. Antennae and legs dark brownish or black; femora and tibiae more or less shiny.

Structural characters. *Male* (Fig. 97) subovate, length about 1.9x greatest width across thorax (151:79). Head length almost 0.8x head width across eyes (36:46); eye width about 0.25x head width between eyes (8:31). Relative lengths of antennal segments (1-4): 35:19:24:32; segment 2 thus distinctly shorter than segment 3; segment 1 subequal in length to head, only slightly thicker than segment 4 (5:4). Relative lengths of leg segments (femur:tibia:tarsus): fore leg: 53:43:18; middle leg: 136:123:97; hind leg: 63:54:21; grasping comb long, about 2/5 length of tibia (17:43); middle femur 0.9x total length; relative length of middle tarsal segments (1-2): 60:37; hind femur distinctly thicker than middle femur (11:8); Abdominal venter deeply depressed in middle. Claspers long and stout, distinctly visible behind genital segments (as in Fig. 114); blade of each clasper (Fig. 98) almost straight, laterally flattened, with spatulated apical part. Vesical sclerites (Fig. 99).

Female (Fig. 95) fusiform, length about 2.15x greatest width across thorax (166:77). Head structure as in male; relative lengths of antennal segments (1-4): 33:19:24:32. Thoracic notum distinctly raised with greatest height in anterior part of mesonotum (Fig. 96), rather abruptly depressed posteriorly, furnished with short, erect pubescence which is longest on pronotum. Mesopleura distinctly impressed, upper parts with distinct tufts of erect hairs. Relative lengths of leg segments (femur:tibia:tarsus): fore leg: 51:42:20; middle leg: 119:108:85; hind leg: 63:49:22; middle femur slightly more than 0.7x total length. Abdomen tapering in width towards abdominal end; abdominal terga distinctly depressed behind metanotum; connexiva erect in basal parts, inflexed upon abdominal dorsum above tergum 7; tergum 8 large and more or less deflected, concealing proctiger.

Distribution and habitat

Southern Papua New Guinea (Central Province). Very common at Malupore Island marine research station, near Port Moresby, Papua New Guinea; among coral blocks at dead low tide, swimming in small pools away from wind and wave action (Polhemus, field notes).



Figs. 97-104. 97-99. *Halovelvia novoguineensis* sp.n. (97. Male, dorsal view. 98. Left clasper; dorsal aspect of blade above. 99. Vesical sclerites). 100-102. *Halovelvia fosteri* sp.n. (100. Male, dorsal view. 101. Left clasper; dorsal aspect of blade above. 102. Vesical sclerites). 103-104. *Halovelvia tongaensis* sp.n. (103. Left clasper; dorsal aspect of blade above. 104. Vesical sclerites).

16. *Halovelvia fosteri* sp.n.

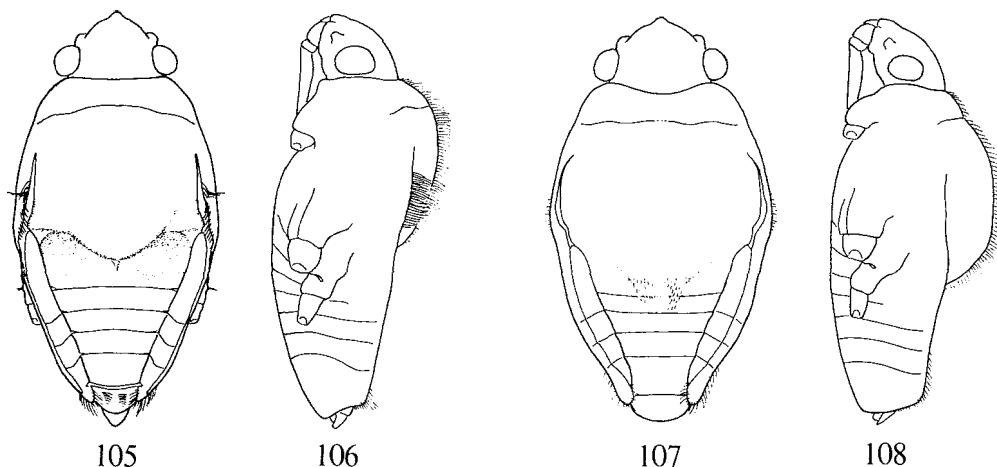
Figs. 100-102, 105-106.

Type area: Viti Levu, Fiji Islands.

Type material examined: Holotype ♀, FIJI ISLANDS: Viti Levu, Suva, Laucala Bay, channel in mangroves, 19.vi.1983, W.A. Foster, in the University Museum of Zoology, Cambridge. - *Paratypes*: 1♂, same locality and date as holotype (CUMZ); 1♂ 1♀, Viti Levu, Vuda, mangrove lagoon, 18.viii.1986, W.A. Foster (ZMUC).

Diagnosis: Recognized by the deviant colour-pattern, especially of the female, with pale pleural and ventral surfaces of body, pale fore femora, and by the modifications of the female thoracic and abdominal dorsum.

Etymology: Named after Dr W.A. Foster, Cambridge, who collected this and other species of *Halovelvia* in the South Pacific.



Figs. 105-108. 105-106. *Halovelia fosteri* sp.n. (105. Female body, dorsal view. 106. Female body, lateral view). 107-108. *Halovelia tongaensis* sp.n. (107. Female body, dorsal view. 108. Female body, lateral view).

Description

Size. ♂♂: length 1.46-1.58 mm, width 0.78-0.84 mm; ♀♀: length 1.90-1.95 mm, width 0.90-0.96 mm.

Colour. Dark brownish above with greyish pubescence on abdomen (♂); pleural and ventral surfaces light brownish or yellowish; female connexiva yellowish, basally with a dense row of erect, blackish hairs; each connexivum terminated by long, pale brownish hairs. Base of head with a large, obscure yellowish brown spot. Pronotum broadly yellowish brown (♂) or narrowly yellowish (♀) along posterior margin; mesonotum with pale median stripe. Antennae and legs brownish, base of first antennal segment and most of fore femora paler.

Structural characters. *Male* (Fig. 100) ovate, total length almost 1.9x greatest width across thorax (117:62). Head length about 0.8x head width across (32:40); eye width slightly more than ¼ width of head between eyes (7:25). Relative lengths of antennal segments (1-4): 24:17:24:25; segment 1 shorter than head, not thicker than segment 4 (4:4); segment 3 distinctly longer than segment 2. Hind margin of pronotum distinct throughout, almost reaching lateral margins. Relative lengths of leg segments (femur:tibia:tarsus): fore leg: 44:38:15; middle leg: 85:77:48; and hind leg: 48:41:19. Grasping comb very short, about 1/6 tibial length (6:38); middle femur almost 0.75x total length; relative lengths of

middle tarsal segments (1:2): 27:21; middle femur and tibia with a row of suberect hairs on outer surface, each hair as long as width of tibia; hind femur not thicker than middle femur (7:7). Abdominal venter with a broad, basal tumescence furnished with long pubescence, reaching sternum 3; venter depressed beyond sternum 4. Claspers relatively short; blade of each clasper (Fig. 101) slender, curved mesad, apex blunt; vesical sclerites (Fig. 102).

Female (Fig. 105) subovate, length 2.0x greatest width across thorax (156:77). Head structure as in male; length of antennal segments (1-4): 28:17:24:26. Thoracic dorsum distinctly raised with greatest height in anterior part of mesonotum (Fig. 106), furnished with long, erect pubescence; metanotum very steeply depressed upon abdominal dorsum, broadly projecting in middle; mesopleura distinctly impressed, upper margins furnished with a prominent row of long, erect hairs. Relative lengths of leg segments (femur:tibia:tarsus): fore leg: 47:41:18; middle leg: 99:87:57; and hind leg: 54:48:22. Middle femur almost 0.65x total length; middle leg structure otherwise as in male. Abdomen tapering posteriorly; basal abdominal tergites laterally impressed, forming a median ridge on first three tergites; connexiva vertically raised from their start at the level of posterior mesonotum; tergum 8 quite narrow and short, exposing proctiger behind, furnished with lateral tufts of dark hairs.

Distribution and habitat

Probably endemic to the Fiji Islands (Viti Levu). The type specimens were collected in a channel in mangroves at Laucala Bay and in a mangrove lagoon at Vuda, Viti Levu. The localities were described by Foster & Treherne (1986).

17. *Halovelina tongaensis* sp.n.

Figs. 103-104, 107-108.

Type area: Tongatabu, Tonga Islands.

Type material examined: Holotype ♂, TONGA ISLANDS: Tongatapu, Nuku'alofa, 11.VIII.1986, W.A. Foster, in the University Museum of Zoology, Cambridge. - *Paratypes:* 1 ♂ 2 ♀, same locality and date as holotype (CUMZ, ZMUC).

Diagnosis: Recognized by the relatively long antennal segment 3, the shape of the male claspers, the strongly convex and pilose female thoracic dorsum, and the distinct, median patch of greyish hairs on basal abdominal terga of the female.

Etymology: Named for the type area, the Tonga Islands.

Description

Size. ♂♂: length 1.50-1.52 mm, width 0.88-0.91 mm; ♀♀: length 1.95-2.01 mm, width 1.04-1.08 mm.

Colour. Black, with abdominal terga and entire connexiva covered by thick greyish pubescence (♂), or an elongate, median patch of greyish hairs on first three abdominal terga (♀). Female connexiva terminated by long, pale hairs. A large yellowish brown spot at base of head. Antennae and legs blackish brown.

Structural characters. Male ovate, length 1.75x greatest width across thorax (122:70). Head length almost 0.8x head width across eyes (37:47); eye width ¼ of head between eyes (8:32). Relative lengths of antennal segments (1-4): 30:18:22:27; segment 1 slightly shorter than head, distinctly thicker than segment 4 (6:4); segment 3 clearly longer than segment 2. Hind margin of pronotum indistinct in lateral parts. Relative lengths of leg segments (femur:tibia:tarsus): fore leg: 44:37:15; middle leg: 82:72:51; and hind leg: 47:38:20; grasping comb about 3/7 length of fore tibia (16:37); middle femur almost 0.7x total length; relative lengths of middle tarsal segments (1-2): 29:22; hind femur as thick as middle femur (7:7). Abdominal venter not modified. Claspers relatively short, barely crossing each

other dorsal to the genital segment; blade of clasper (Fig. 103) vertically flattened, slightly curved dorsad and mesad, apex in lateral view blunt; vesical sclerites (Fig. 104).

Female (Fig. 107) subovate, length almost 1.9x greatest width across thorax (161:86). Head structure as in male except that antennal segment 1 is more slender; relative lengths of antennal segments (1-4): 26:18:22:27. Thoracic dorsum distinctly raised, regularly convex dorsally (Fig. 108), furnished with long, erect pubescence on mesonotum, metanotum, and basal abdominal terga. Relative lengths of leg segments (femur:tibia:tarsus): fore leg: 47:40:18; middle leg: 89:85:57; hind leg: 53:43:23; middle femur 0.55x total length. Abdomen in dorsal view (Fig. 107) tapering in width posteriorly; metanotum and basal three abdominal terga with a broad median raised area; connexiva obliquely raised, converging towards abdominal end; tergum 8 produced and deflected posteriorly to conceal proctiger.

Distribution

Probably endemic to the Tonga Islands (Tongatapu).

18. *Halovelina annemariae* sp.n.

Figs. 109-111, 118-119.

Halovelina amphibia Bergroth; Esaki 1926: 162 (records Dregerhafen, New Guinea).

Type area: New Georgia, Solomon Is.

Type material examined: Holotype ♀, SOLOMON ISLANDS: New Georgia, Munda, 9.iv.1983, Lanna Cheng, in the Zoological Museum, University of Copenhagen. - *Paratypes:* 5 ♂ 10 ♀, same locality and date as holotype (ZMUC); 1 ♀, New Georgia, Kundukundu, 6.iv.1983, Lanna Cheng (ZMUC); 4 ♂ 2 ♀, New Georgia, Munda, 1900 shore, 24.iii.1983, Lanna Cheng (ZMUC); 1 ♀, New Georgia, Munda, lagoon, 7.iv.1983, Lanna Cheng (ZMUC); 2 ♂ 2 ♀, New Georgia, 3 km off Munda, in lagoon, 3.iv.1983, Lanna Cheng (ZMUC). PAPUA NEW GUINEA: 4 ♂ 1 ♀, N. Guinea, Dregerhafen, Biro 1898, also labelled "*Halovelina amphibia* Bergroth, det. T. Esaki" (HNM, JTPC).

Diagnosis: Recognized by the relatively long antennal segment 3, the very slender male claspers, lateral tufts of hairs on female mesonotum, and the almost parallel-sided female abdomen with suberect connexiva; the dorsal convexity and pubescence of the female thorax and especially the shape of male claspers separate the new species from *lannae* sp.n. and *wallacei* sp.n.

Etymology: Named after my wife, Annemarie.

Description

Size. ♂♂: length 1.68-1.74 mm, width 0.92-0.95 mm; ♀♀: length 2.10-2.25 mm, width 0.95-0.99 mm.

Colour. Blackish brown; intersegmental limits of abdominal tergites and entire connexiva covered by thick greyish pubescence (♂), or an elongate, median patch of greyish hairs on posterior mesonotum, metanotum, and first three abdominal terga (♀). Female connexiva terminated by long, whitish hairs. A large yellowish brown spot at base of head. Antennae and legs blackish brown.

Structural characters. Male (Fig. 109) subovate, length slightly less than 1.9x greatest width across thorax (139:74). Head length about 0.6x head width across eyes (29:45); eye width slightly more than ¼ of head between eyes (8:29). Relative lengths of antennal segments (1-4): 27:17:21:26; segment 2 thus clearly shorter than segment 3; segment 1 subequal in length to head, distinctly thicker than segment 4 (6:4). Hind margin of pronotum indistinct in lateral parts. Relative lengths of leg segments (femur:tibia:tarsus): fore leg: 49:39:16; middle leg: 115:106:80; and hind leg: 55:46:19; grasping comb about 2/5 length of fore tibia (15:39); middle femur about 0.8x total length; relative lengths of middle tarsal segments (1-2): 47:33; hind femur distinctly thicker than middle femur (11:8). Abdominal venter not modified. Claspers relatively long, distinctly crossing each other dorsal to the genital segment; blade of clasper (Fig. 110) very slender and regularly curved both dorsad and mesad, apex simply pointed; vesical sclerites (Fig. 111).

Female (Fig. 118) fusiform, length 2.3x greatest width across thorax (180:79). Head structure as in male except that antennal segment 1 is more slender. Thoracic dorsum distinctly raised in middle of mesonotum (Fig. 119), furnished with a suberect pubescence which is distinctly longer on posterior mesonotum, metanotum, and basal abdominal terga. Meso- and metapleura slightly impressed, furnished with suberect pubescence which is longest towards the base of connexiva. Relative lengths of leg segments (femur:tibia:tarsus): fore leg: 46:38:18; middle leg: 114:107:85; hind leg: 53:47:22; middle femur 0.6x total length. Abdomen in dorsal view (Fig. 118) with subparallel sides to the level of segment 5, tapering in width posteriorly; metanotum and basal three abdominal terga laterally impressed, forming a broad median raised area; connexiva suberect, converging towards abdominal

end but not inflexed upon abdominal dorsum; tergum 8 produced and deflected posteriorly, concealing proctiger.

Distribution and habitat

Papuanian. Recorded from the Solomon Islands (New Georgia) and northern Papua New Guinea (Province unknown). Collected from lagoon at Munda, New Georgia, Solomon Islands (Cheng *in litt.*).

Discussion

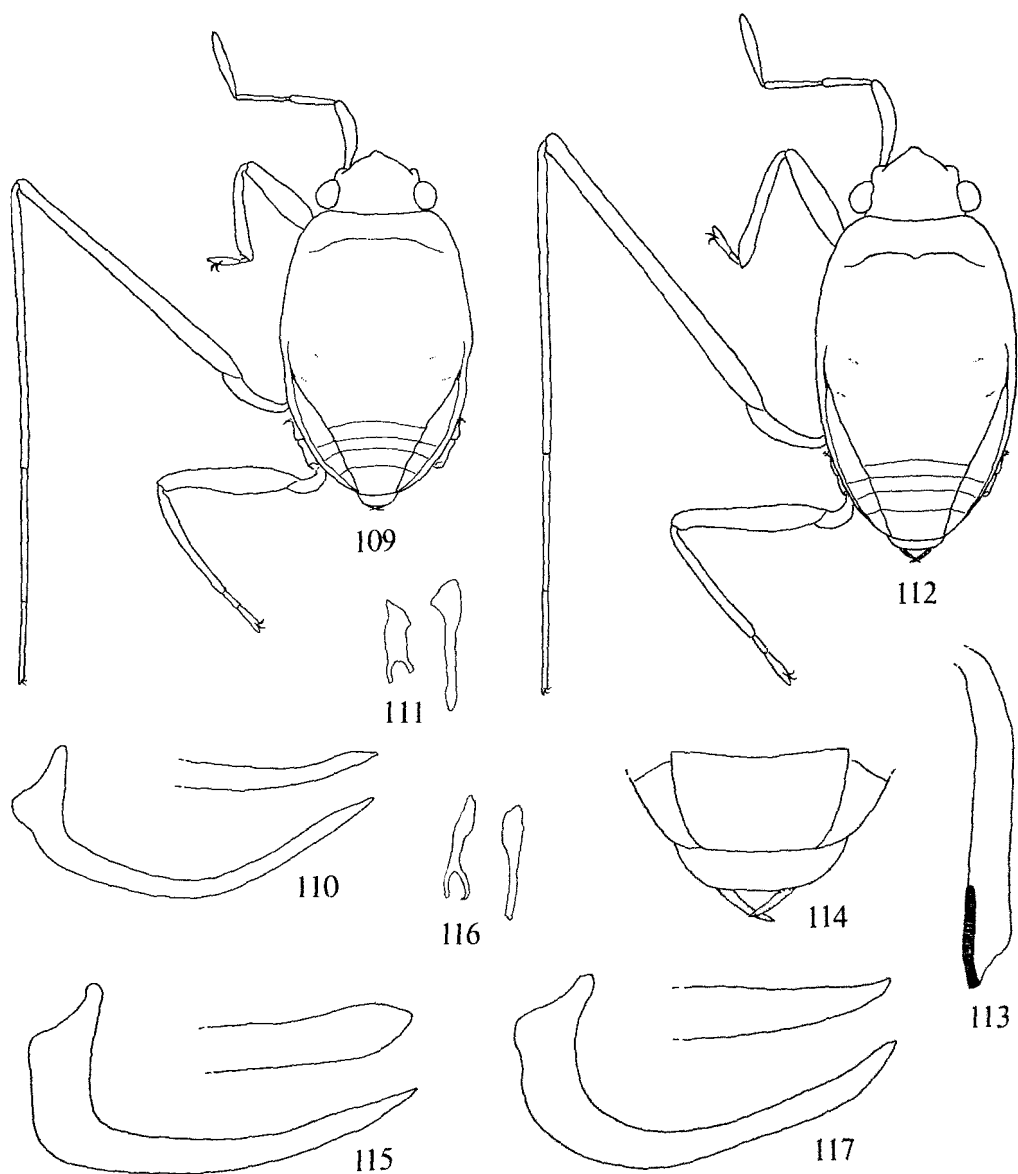
Specimens from Dregerhafen, New Guinea identified by Esaki (1926: 162) as *Halovelina amphibia* Bergroth have been examined by me; the females are clearly distinct from the female type of this species (e.g., in the relative lengths of middle legs, see p. 88) and it is difficult to understand why Esaki failed to recognize their separate identity. The specimens in question belong to *annemariae* sp.n. and have been designated as paratypes.

19. *Halovelina lannae* sp.n.

Figs. 112-116, 120-121.

Type area: Onrust Island off Djakarta, Java.

Type material examined: *Holotype* ♂, JAVA: Onrust (island off Djakarta), Java Sea, 4.v.1929, collecting from boat on surface, at artificial light, Th. Mortensen, in the Zoological Museum, University of Copenhagen. - *Paratypes*: 313♂♂ 34♀♀, same locality and date as holotype (ZMUC). BORNEO: 19♂♂ 6♀♀ ♀, Sabah, beaches 2 km NW of Kuala Penyu, 10 August 1983, G.F. Hevel & W.E. Steiner (USNM). PHILIPPINES: 1♂, Mindanao, Zamboanga del Sur Prov., Santa Cruz Is. off Zamboanga, coral reef, CL 1997, VII-21-85, J.T. & D.A. Polhemus (JTPC); 1♀, Palawan, Pacduan Beach, 40 km S. of Puerto Princessa, CL 2004, VII-25-85, J.T. & D.A. Polhemus (JTPC); 1♀, Palawan, Penascosa, July 15,16 1977, M. Sato (JTPC). SINGAPORE: 14♂♂ 9♀♀ ♀, Pulau Ham-tu, Lagoon, 10.3.85, D.H. Murphy (JTPC); 1♀, P. Pawaii off S'pore, viii.1965, RMQ (JTPC); 1♀, Belakang Mati Reef, I.vii.1965, Zoology Dept., Univ. Singapore (JTPC); 14♂♂ 4♀♀ ♀, Pulau Salu, 10.viii.1976, Lanna Cheng (JTPC); 3♂♂ 1♀, Pulau Salu, 11.viii.1976, Lanna Cheng (JTPC); 6♂♂ 1♀, Pulau Salu, 31.vii.1976, intertidal rocks, Lanna Cheng (ZMUC); 7♂♂ 10♀♀ ♀, Pulau Salu, iv.1977, Lanna Cheng (ZMUC); 8♂♂ 10♀♀ ♀, Pulau Salu, 4.iv.1977, Lanna Cheng (ZMUC); 10♂♂ 10♀♀ ♀, Pulau Salu, 14.iv.1977, Lanna Cheng (ZMUC); 1♀, Pulau Salu, 19.v.1980, R.A. Lewin (ZMUC). WEST MALAY-SIA: 1♂ 1♀, Johor, rocky coast at Mersing, CL 2057, VIII-13-85, J.T. & D.A. Polhemus (JTPC).

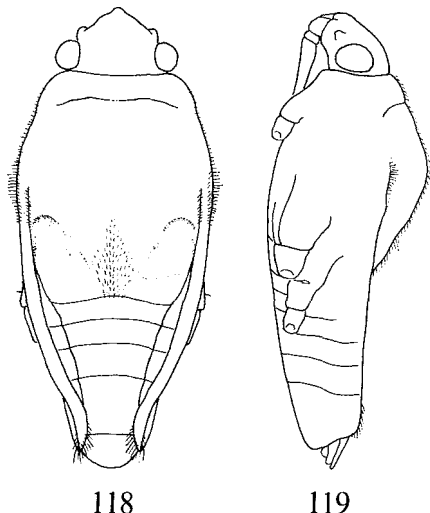


Figs. 109-117. 109-111. *Halovelia annemariae* sp.n. (109. Male, dorsal view. 110. Left clasper; dorsal aspect of blade above. 111. Vesical sclerites). 112-116. *Halovelia lannae* sp.n. (112. Male, dorsal view. 113. Left fore tibia of male. 114. Male abdominal end, dorsal view. 115. Left clasper; dorsal aspect of blade above. 116. Vesical sclerites). 117. *Halovelia wallacei* sp.n. Left clasper; dorsal aspect of blade above.

Diagnosis: Recognized by the short male grasping comb (less than $\frac{1}{3}$ of tibial length), the long and stout male claspers, the female abdominal tergum which is basally raised in middle, and the almost parallel-sided female abdomen with suberect connexiva. The dorsal convexity and

pubescence of the female thorax and the shape of male claspers separate the new species from *annemariae* sp.n.

Etymology: Named after my colleague and friend, Dr Lanna Cheng, who collected this and numerous other *Halovelia*-species.



Figs. 118-119. *Halovelia annemariae* sp.n. (118. Female body, dorsal view. 119. Female body lateral view).

Description

Size. ♂♂: length 1.78-1.93 mm, width 0.95-1.02 mm; ♀♀: length 2.18-2.40 mm, width 0.98-1.02 mm.

Colour. Black or dark brown with greyish pubescence which is longer and denser on abdominal dorsum (♂) or towards abdominal end (♀). Female connexiva terminated by whitish hairs. A large obscure brownish spot at base of head. Antennae and legs dark brownish or black; femora and tibiae shiny.

Structural characters. **Male** (Fig. 112) subovate, length about 2.0x greatest width across thorax (149:76). Head length almost 0.6x head width across eyes (31:51); eye width about 0.3x head width between eyes (10:32). Relative lengths of antennal segments (1-4): 29:19:20:28; segment 1 subequal in length to head, only slightly thicker than segment 4 (5:4). Relative lengths of leg segments (femur:tibia:tarsus): fore leg: 50:45:20; middle leg: 127:109:93; hind leg: 62:51:25; grasping comb (Fig. 113) short, only 2/7 length of fore tibia (13:45); middle femur 0.85x total length; relative lengths of middle tarsal segments (1-2): 53:40; hind femur only slightly thicker than middle femur (10:9). Abdominal venter not modified. Claspers long and stout, distinctly visible behind genital segments (Fig. 114); blade of each clasper (Fig. 115) slightly curved dorsad, dorso-ventrally flattened, with more or less distinctly spatulated apical part. Vesical sclerites (Fig. 116).

Female (Figs. 120) rather elongate, with almost parallel body sides, length about 2.3x greatest width across thorax (192:83). Head structure as in male; relative lengths of antennal segments (1-4): 30:20:21:29. Thoracic dorsum distinctly raised, greatest height slightly behind middle of mesonotum (Fig. 121), furnished with erect pubescence which is longer in posterior parts of mesonotum and on metanotum and basal abdominal terga. Meso- and metapleura distinctly impressed. Relative lengths of leg segments (femur:tibia:tarsus): fore leg: 56:45:21; middle leg: 130:119:96; hind leg: 67:56:23; middle femur slightly less than 0.7x total length. Abdomen in dorsal view almost parallel-sided in anterior two-thirds, distinctly narrowing before apex; basal abdominal terga with a large depression on each side of a median tumescence; connexiva erect throughout their length; tergum 8 large and more or less deflected, concealing procitiger.

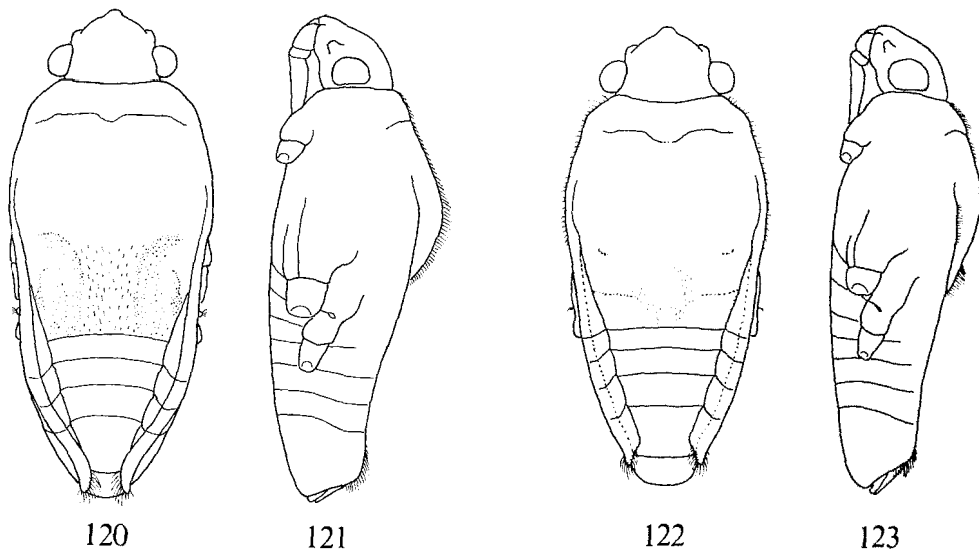
Distribution and habitat

Sundanian, extending into the Philippines. Recorded from Java (Onrust Island off Djakarta), West Malaysia (Johor), Singapore, Borneo (Sabah), and the Philippines (Mindanao, Palawan). Common at Pulau Salu, Singapore, on intertidal coral reefs (Cheng *in litt.*). At Mersing, Johor, also found on rocky coast (Polhemus, field notes).

Discussion

The convex female mesonotum has distinctly longer pubescence in females from Java, West Malaysia, and Singapore (Fig. 121), than in females from Sabah and the Philippines. The male claspers are less distinctly spatulate in specimens from Sabah than in specimens from other geographical areas. The single male from Mindanao has relatively longer claspers than other males examined, but more material (including females) is needed to decide upon the taxonomic significance of this variation.

The male claspers of the new species and that of *novoguineensis* sp.n. are quite similar. However, the blade of the claspers of these species is twisted and flattened in two different planes (compare Figs. 98 and 115), and other male characters clearly separate these two species. In the female sex, *lannae* sp.n. is more similar to *annemariae* sp.n. and the following new species.



Figs. 120-123. 120-121. *Halovelvia lannae* sp.n. (120. Female body, dorsal view. 121. Female body lateral view). 122-123. *Halovelvia wallacei* sp.n. (122. Female body, dorsal view. 123. Female body lateral view).

20. *Halovelvia wallacei* sp.n.

Figs. 117, 122-123.

Type area: Cape Dadebo, Sulawesi Utara Province, Sulawesi.

Type material examined: *Holotype* ♀, SULAWESI: Sulawesi Utara Province, Cape Dadebo, 8 km W. of Malibago, CL 2112, mangroves behind reef, IX-8-85, J.T. & D.A. Polhemus, in the British Museum (Natural History), London, property of the Museum Zoologicum Bogoriense, Bogor, Indonesia. - *Paratypes*: 5♂♂ & 5♀♀, same locality and date as holotype (BMNH, JTPC, ZMUC); 4♂♂ & 3♀♀, same locality and date, intertidal reef (JTPC); 1♀, Sulawesi Utara Province, intertidal reef 19 km NE. of Inobonto, CL 2105, IX-6-85, J.T. & D.A. Polhemus (JTPC). LESSER SUNDA ISLANDS: 1♀, Sumbawa, Nusa Tenggara Barat Prov., coast 5 km E. of Nipa, 34 km NE. of Bima, CL 2176, X-21-85, J.T. & D.A. Polhemus (JTPC).

Diagnosis: Very similar to *lannae* sp.n. but separated from this species by the much less convex female thoracic dorsum, the two hair tufts on basal abdominal tergites of female, and the non-spatulate male claspers. The dorsal convexity and pubescence of the female thorax and the shape of male claspers separate the new species from *annemariae* sp.n.

Etymology: Named after the famous naturalist A.R. Wallace, whose name is forever tied to the biogeography of the Malay archipelago.

Description

Size. ♂♂: length 1.80-1.86 mm, width 0.91-0.98

mm; ♀♀: length 2.10-2.20 mm, width 0.91-0.98 mm.

Colour. Black with greyish pubescence which is longer and denser on abdominal dorsum (♂) or abdominal pleura; a median patch of greyish hairs on basal abdominal terga (♀). Female connexiva terminated by whitish hairs. A large obscure brownish spot at base of head. Antennae and legs black; femora and tibiae shiny.

Structural characters. *Male* subovate, length about 2.0x greatest width across thorax (148:73). Head length 0.65x head width across eyes (30:46); eye width about 0.25x head width between eyes (8:31). Relative lengths of antennal segments (1-4): 31:19:20:25; segment 1 subequal in length to head, thicker than segment 4 (6:4). Relative lengths of leg segments (femur:tibia:tarsus): fore leg: 49:42:18; middle leg: 127:113:88; hind leg: 63:49:23; grasping comb short, only 1/3 length of fore tibia (14:42); middle femur 0.85x total length; relative lengths of middle tarsal segments (1-2): 53:35; hind femur distinctly thicker than middle femur (11:8). Abdominal venter not modified. Claspers long and stout, crossing each other dorsal to genital segment; blade of each clasper (Fig. 117) slightly curved dorsad, dorso-ventrally flattened, with apical part evenly tapering to pointed apex. Vesical sclerites as in *lannae* sp.n.

Female (Fig. 122) elongate ovate, length about

2.2x greatest width across thorax (174:78). Head structure as in male; relative lengths of antennal segments (1-4): 29:18:21:25. Thoracic dorsum moderately raised in middle of mesonotum (Fig. 123), pronotum and anterior mesonotum furnished with erect pubescence. Meso- and metapleura not impressed. Relative lengths of leg segments (femur: tibia:tarsus): fore leg: 52:40:20; middle leg: 121:112:89; hind leg: 57:49:21; middle femur about 0.7x total length. Abdomen in dorsal view with almost parallel or only slightly converging sides anteriorly; base of abdominal dorsum slightly depressed on each side; median part furnished with one large tuft or two separate tufts of long erect hairs; connexiva slightly inclined throughout their lengths; tergum 8 large and more or less deflected, concealing proctiger.

Distribution and habitat

Recorded from Sulawesi (Sulawesi Utara Province) and the Lesser Sunda Islands (Sumbawa). At Cape Dadebo, Sulawesi Utara Province, this species was found along a *Rhizophora* mangrove on coral base and among exposed coral blocks on reef margin (Polhemus, field notes).

Discussion

The males of the new species and those of *lannae* sp.n. are very difficult to separate. However, the blade of the clasper is usually distinctly spatulate in *lannae* sp.n., never so in *wallacei* sp.n. (compare Figs. 115 and 117). The females of the two species are separated by the characters given in the diagnosis. The single female from Sumbawa lacks the long hairs on the basal abdominal tergites, but only the examination of more specimens from the Lesser Sunda Islands will show whether this is more than an individual variation.

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