

## THE GENUS *TETRAPOLIPUS* (ACARI: PODAPOLIPIDAE), PARASITES OF TROPICAL AND SEMITROPICAL CERAMBYCIDAE (COLEOPTERA), NEW DISTRIBUTION RECORDS AND DESCRIPTIONS OF FOUR NEW SPECIES

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**ABSTRACT** - The genus *Tetrapolipus* Berlese 1911 (Acari: Podapolipidae) known from three species collected from *Batocera* species (Coleoptera: Cerambycidae) in Indonesia and New Guinea is reviewed and new distribution records from Africa, Australia, India, Malaysia and the Philippines are presented. *Tetrapolipus diastocerae* n. sp., *Tetrapolipus afrobatocerae* n. sp., *Tetrapolipus ramarajui* n. sp. and *Tetrapolipus seemani* n. sp. are described. *Tetrapolipus diastocerae* from *Diastocera wallichii* Hope and *Tetrapolipus* species from *Anoplophora lucipor* Newman, 1842 are the first records of *Tetrapolipus* from cerambycid beetles other than *Batocera*. *Tetrapolipus afrobatocerae* is the first record of the genus *Tetrapolipus* in Africa, *Tetrapolipus hunteri* Husband, 1973 is the first record of *Tetrapolipus* in Australia and the first record of *Tetrapolipus* sp. from the Philippines is presented. *Kurosapolipus* species from *Macropophora* species (Cerambycidae) in the Western Hemisphere are compared with *Tetrapolipus* in the Eastern Hemisphere.

**Key words** - Acari, Podapolipidae, parasites, Coleoptera, Cerambycidae, *Batocera*, *Diastocera*, *Anoplophora*, *Tetrapolipus*, *Kurosapolipus*, new species, Malaysia, Sri Lanka, Zaire.

### INTRODUCTION

The genus *Tetrapolipus* Berlese, 1911 was described for *Tetrapolipus* (*Podapolipus*) *batocerae* (Berlese, 1910) collected from *Batocera tigris* (= *B. hectoris*, = *B. maculata*) Voet in Batavia, Java, Indonesia. Husband (1973) reviewed *Tetrapolipus* and described *Tetrapolipus hunteri* Husband, 1973 collected from *Batocera wallacei* Thomson at Kiunga, Fly River, Papua, New Guinea. Many genera and species of podapolipid mites have adult females with four legs. A key to males, adult females and larval females of nine genera with this character are given in Kurosa and Husband (1994). A key to larval females of 14 genera with this character, illustrations of males and a discussion of the group were presented by Husband and Kurosa (2000). Two species of the genus *Tenebrapolipus* and two species with adult females with four legs, *T. ceropriae* Kurosa and Husband, 2001 and *T. imasakai* Kurosa and Husband, 2001, were described and compared with the group of podapolipid mites with adult females with four legs (Kurosa and Husband, 2001). *Tetrapolipus sulawesiensis* Zhang and Li, 2002 was described from *Batocera hercules* Boisduval in Sulawesi, Indonesia.

A study of *Macropophora* species (Coleoptera: Cerambycidae) from tropical South America provided the only other genus of Podapolipidae collected from cerambycid beetles, *Kurosapolipus* Husband and Li, 1993. *Kurosapolipus* and *Tetrapolipus* were compared by Husband and Li (1993). *Tetrapolipus diastocerae* n. sp. from Malaysia, *Tetrapolipus afrobatocerae* n. sp. from the Republic of the Congo, *Tetrapolipus ramarajui* n. sp. from India and Sri Lanka and *Tetrapolipus seemani* n. sp. from Papua, New Guinea are described. Distribution and host records from *Batocera*, *Anoplophora* and *Diastocera* species from Africa, Asia, Australia and the Philippines are presented and the genus *Tetrapolipus* is discussed. A key to larval females of seven species of *Tetrapolipus* is offered.

### MATERIALS AND METHODS

More than 500 specimens representing more than 20 species of Cerambycidae genera *Anoplophora*, *Apriona*, *Batocera* and *Diastocera* were examined for subelytral parasitic mites in the family Podapolipidae (Acari: Tarsonemina). The beetles were collected in Japan, China, Taiwan, Philippines, New Guinea, Indonesia,

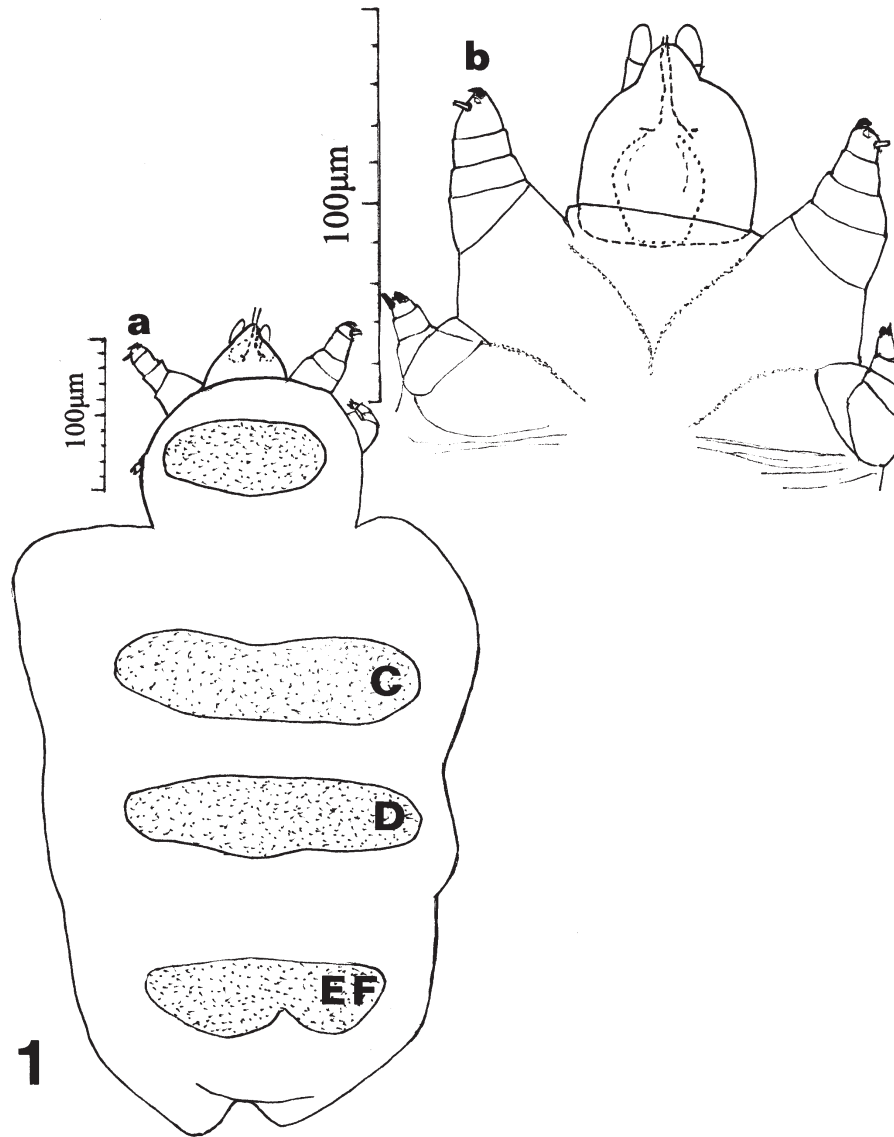


Fig. 1. *Tetrapolipus diastocerae* n. sp. - Adult female (a) dorsal aspect, (b) ventral propodosoma.

Australia, Malaysia, Thailand, Sri Lanka, India, Pakistan, Iran, Madagascar, Republic of the Congo, Africa and Virgin Islands. Mites removed from wing bases and meso-metathoracic tergites were mounted in modified Hoyer's medium.

Specimens of *Batocera tigris*, type host for *Tetrapolipus batocerae*, were provided by Sampurno Kadar-san, Bogor, Indonesia. Cerambycidae were purchased from Insects International, Fort Davis, Texas, U.S.A. and borrowed from the Bishop Museum, Honolulu, Hawaii, U.S.A.; Musee Royal de L'Afrique Centrale, Tervuren, Belgium; California Academy of Science, San Francisco, California, U.S.A.; Cornell University, Ithaca, New York, U.S.A.; Michigan State University, East Lansing, Michigan, USA; University of Michigan Museum of Zoology,

Ann Arbor, Michigan, U.S.A.; and the Natural History Museum, London, United Kingdom.

Measurements were taken with a Zeiss phase contrast microscope with an ocular micrometer. The length of the gnathosoma was taken along the sagittal line from the tip of the anteromedian protrusion to the level of the most basal point of the gnathosoma. All measurements refer to length in  $\mu\text{m}$ . Setae no longer than the diameter of their setal acetabulae are listed as microsetae (m). Setal acetabulae without setal remnants are listed as vestigial (v). Setae are frequently obscured, broken, bent, vertical or with extremely fine tips which makes measurement difficult. Setae are at least as long as indicated. The terminology follows Lindquist (1986).

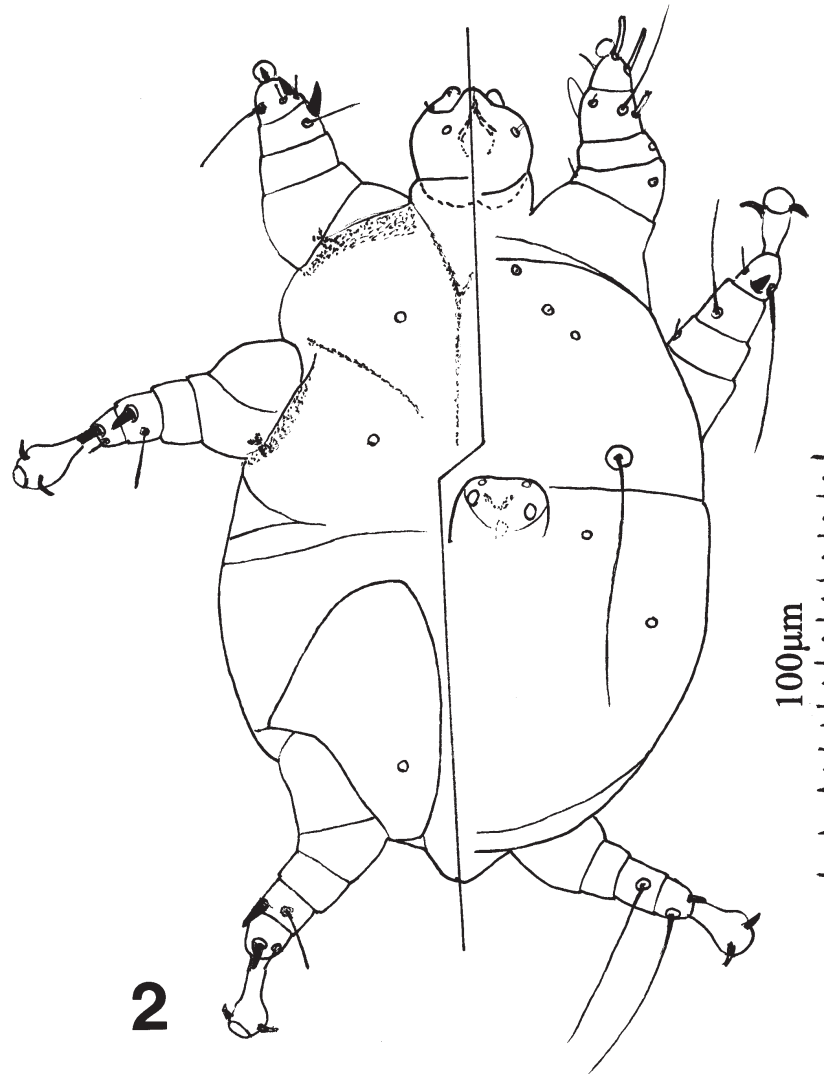


Fig. 2. *Tetrapolipus diastocerae* n. sp. - Male, dorsal aspect right, ventral aspect left.

Adult female *Tetrapolipus* have no idiosomal setae and two pairs of legs with at most five pairs of tarsal setae. Setae  $v_2$ ,  $sc_1$ ,  $c_1$ ,  $c_2$ ,  $d$ ,  $e$ ,  $f$ ,  $h_1$ ,  $h_2$ ,  $ps_1$  and  $ps_3$  of males are not present, are microsetae or are vestigial. Larval females were chosen as holotypes in this study.

Abbreviations for deposit of holotypes and paratypes are: Queensland Museum, Brisbane, Australia (QM); Musee Royal de L'Afrique Centrale, Tervuren, Belgium (MB); the Museum of Natural History, London, United Kingdom (MNH); Zoological Museum, University of Hamburg, Germany (ZMH); Tamil Nadu Agricultural University, Coimbatore, India (TNAU); Museum Zoologicum Bogariense, Bogor, Indonesia (MZB); Bishop Museum, Honolulu, Hawaii, U.S.A. (BMH); California Academy of Sciences, San Francisco, California, U.S.A. (CAS); Cornell University, Ithaca, New York, U.S.A. (CUM); A. J. Cook Entomological Museum, Michigan State University, East Lansing, Michigan,

U.S.A. (MSU); University of Michigan Museum of Zoology, Ann Arbor, Michigan, U.S.A. (UMMZ); Museum of Biological Diversity, The Ohio State University, Columbus, Ohio (OSU); and the United States National Museum of Natural History, Washington, D.C., U.S.A. (NMNH).

#### SYSTEMATICS

##### Family PODAPOLIPIDAE Ewing, 1922

##### Genus *Tetrapolipus* Berlese, 1911

##### *Tetrapolipus diastocerae* n. sp.

(Figs. 1-3)

**Diagnosis** - Male and larval female *Tetrapolipus diastocerae* lack tibiae II, III setae  $l'$  and  $l''$ , setae  $h_2$  are shorter (3) and setae  $e$  are longer (77-86) in larval female *T. diastocerae* than in larval females of *Tetrapolipus* spe-

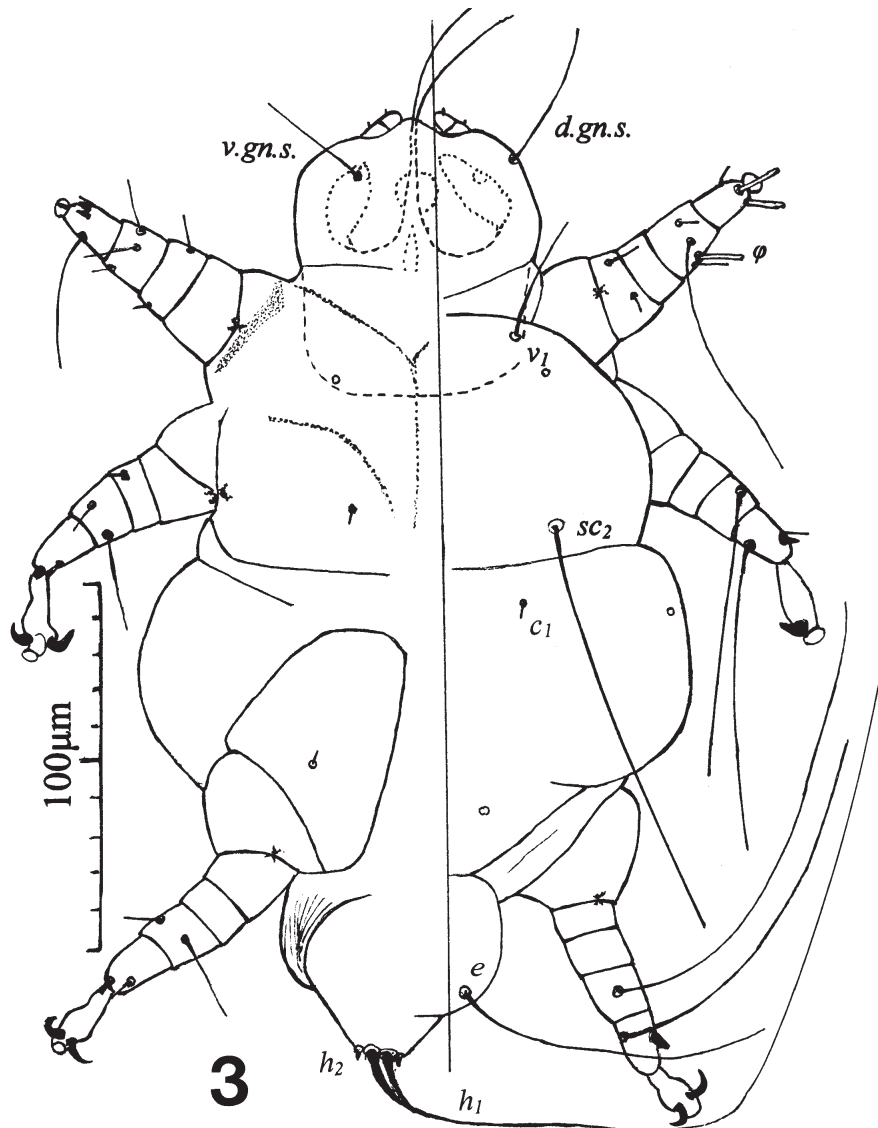


Fig. 3. *Tetrapolipus diastocerae* n. sp. - Larval female, dorsal aspect right, ventral aspect left.

cies except *T. seemani* ( $h_2 = 20-27$ ,  $e = 410-450$ ). Adult females lack conspicuous ambulacra I, have distinct, entire plates C, D and EF and prodorsal plates and the width of the propodosoma is near  $\frac{1}{2}$  the width of the hysterosoma.

**ADULT FEMALE** (Fig. 1) - Gnathosoma length 53-58, width 45-50 ( $n = 3$ ). Stigmata not evident. Cheliceral stylets length 25-27, pharynx width 25-28, no gnathosomal setae (Table 1). Dorsum - Idiosoma length 470-566, width 289-360, propodosoma  $\frac{1}{2}$  width of hysterosoma, plates without setae. Prodorsal plate length 37-40, width 75-102, plate C length 40-53, width 165-194, plate D length 31-45, width 175-180, plate EF length 10-25, width 156-166. Venter - Coxae I, II without setae. Legs - Legs I, II without femoral, genual or tibial

setae. No legs III, IV. Tarsi I without ambulacra, subunguinal setae clawlike with opposing stout setae  $pv''$ , setae  $tc''$  thick, blunt, 5. Tarsi II setae  $tc'$  and  $s$  spine-like.

**MALE** (Fig. 2) - Gnathosoma length 30, width 29-30 ( $n = 3$ ). Cheliceral stylets length 12, pharynx width 7-8, dorsal setae thick 2-3, ventral setae microsetae (Table 1). Dorsum - Idiosoma length 145-150, width 115-120. Prodorsal plate setae  $v_1$ ,  $v_2$ ,  $sc_1$  microsetae,  $sc_2$  45-60. Fused plates C and D, setae vestigial. Genital capsule at anterior margin of fused plates C/D, length 15-21, width 20-22. Venter - Coxal setae  $1a$ ,  $2a$ ,  $3b$  v. Legs - Femora I setae  $l'$  4-6,  $d$  v, genu I setae  $v'$  4-5,  $l''$  m, tibia I setae  $v'$  spine-like 7, setae  $1l'$  and  $l''$  m, setae  $k$  distally split, tarsi I setae  $pl''$  13-22, solenidia  $\omega$  not evident. Femora II without setae, genua II setae  $l'$  5, tibiae setae  $v'$  spinelike 7,

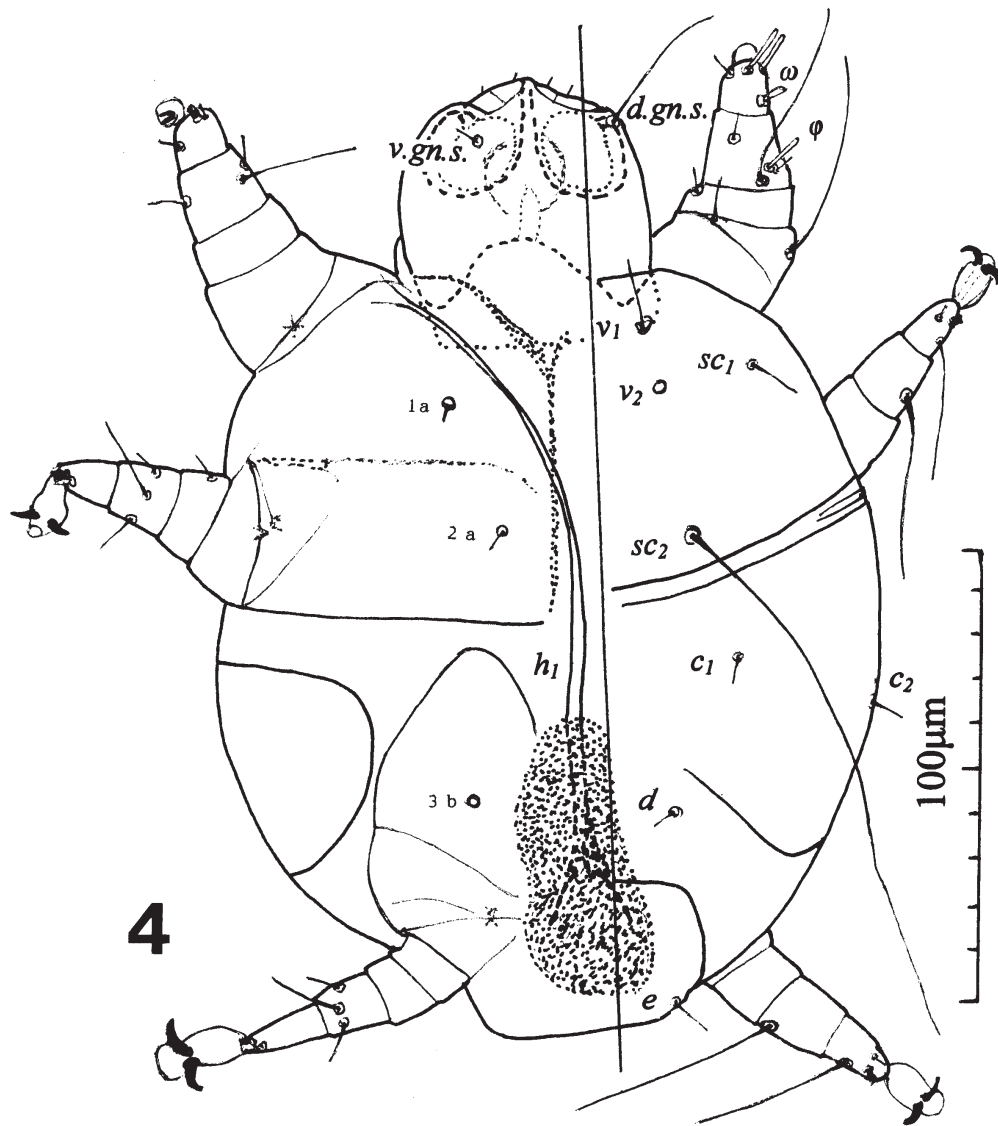


Fig. 4. *Tetrapolipus afrobatocerae* n. sp. - Larval female, dorsal aspect right, ventral aspect left.

setae  $v''$  10-15, tarsi II setae  $pl''$  37-43. Femora and genua III without setae, tibiae III setae  $v'$  spinelike 5-7,  $v''$  10-15, tarsi III setae  $pl''$  40-48. Legs I-III setation for femur, genu, tibia, tarsus: 2-2-6-7, 0-1-3-5, 0-0-3-5, respectively.

**LARVAL FEMALE** (Fig. 3) - Gnathosoma length 50-60, width 66-70 ( $n = 3$ ). Cheliceral stylets length 95-103, pharynx width 10-13, dorsal setae 40-47, ventral setae 31-33. Dorsum - Idiosoma length 192-200, width 138-250. Prodorsal plate setae  $v_1$  40-41,  $v_2$   $v$ ,  $sc_2$  106-119. Plate C, setae  $c_1$  3-5, plate D setae  $d$   $v$ , plate E fused anteromedially with plate C. Plate EF length 40-45, width 53-62, setae  $e$  77-86. Plate H, setae  $h_1$  208-253,  $h_2$  thick 3. Venter - Coxae I, II, III setae  $1a$   $v$ ,  $2a$  thin 5,  $3b$  5-6. Legs - Femur I setae  $d$  5, genu I setae  $v'$  7-10,  $v''$  3-5, tibiae I solenidion  $\phi$  10-15, setae  $k$  8-10, tarsi I setae  $l''$  30-37. Genu II setae  $v'$  6-7, tibiae II setae  $v'$  5-9,  $v''$  21-

25, tarsi II setae  $pl''$  60-86. Tibiae III setae  $v'$  9-10,  $v''$  22-27, tarsi III setae  $pl''$  83-100. Legs I-III setation for femur, genu, tibia, tarsus 2-2-7-7, 0-1-3-5, 0-0-3-5, respectively.

**EGG** - Length 242, width 143 ( $n=1$ ).

**Type material** - Holotype larval female (RWH 270903-4-6), Tapah, Malaysia, from metathoracic tergite of *Diastocera (Thysis) wallichi* Hope (Coleoptera: Cerambycidae), coll. April 1989, purchased from Insects International, Fort Davis, Texas, U.S.A., deposited in University of Michigan Museum of Zoology, Ann Arbor, Michigan (UMMZ). Paratypes - Five males, seven adult females, eight larval females and five vials with many mites, with same data as the holotype. One male, one adult female and one larval female deposited in the following collections: ZMH, OSU, NMNH. Balance of specimens and type host deposited with the holotype.

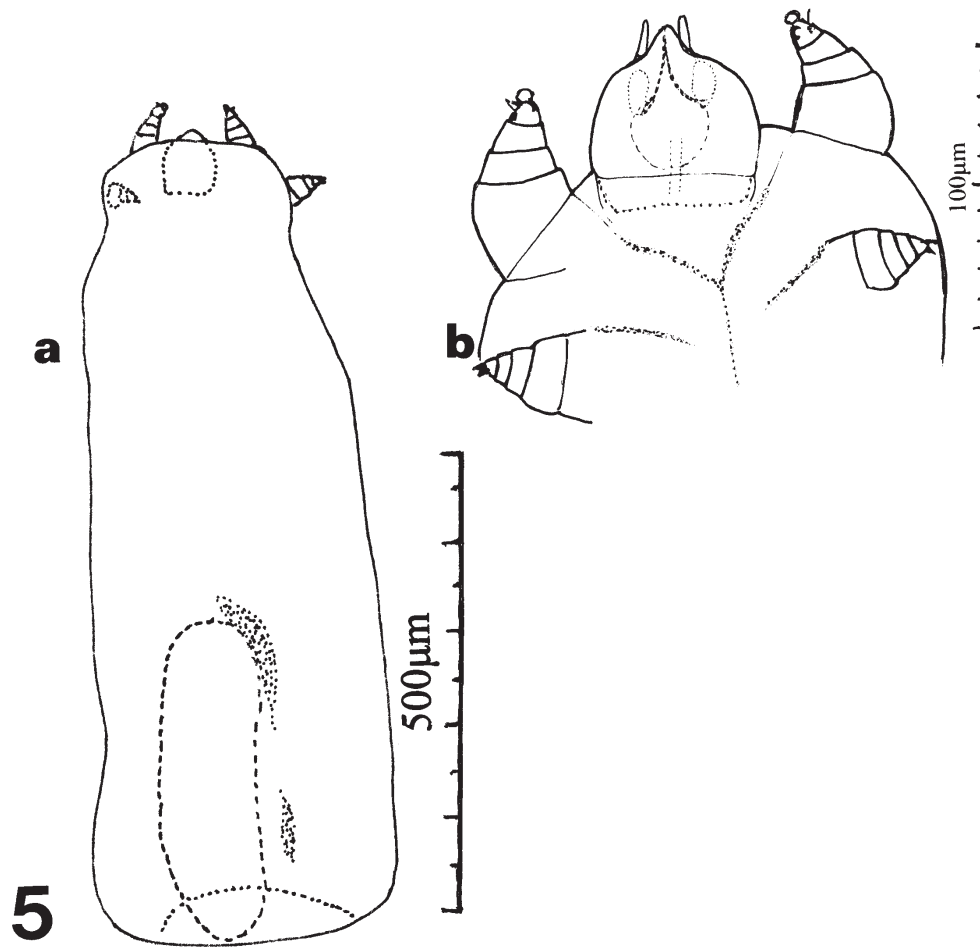


Fig. 5. *Tetrapolipus ramarajui* n. sp. - Adult female (a) dorsal aspect, (b) ventral propodosoma.

**Etymology** - *Tetrapolipus diastocerae* is named for the genus of the host species, *Diastocera wallichi*.

***Tetrapolipus afrobatocerae* n. sp.**  
(Fig. 4)

**Diagnosis** - Larval female *Tetrapolipus afrobatocerae* have conspicuous prodorsal setae  $sc_1$  (12), short cheliceral stylets (64) located in the anterior  $\frac{1}{2}$  of the gnathosoma, short ventral gnathosomal setae (7), conspicuous tarsi I solenidia  $\omega$  (7) and short plate EF setae  $e$  (8).

**LARVAL FEMALE** (Fig. 4) - Gnathosoma - Length 53, width 55 ( $n = 1$ ). Cheliceral stylets length 64, pharynx width 18, dorsal setae 34, ventral setae 7. Idiosoma length 170, width 148. Prodorsal plate setae  $v_1$  16,  $v_2$  v,  $sc_1$  12,  $sc_2$  133. Plate C, setae  $c_1$ ,  $c_2$ , 6-7, plate D, setae  $d$  7, plate EF setae  $e$  8. Plate H setae  $h_1$  150, setae  $h_2$  obscured by crystals. Venter - Coxae I, II, III setae 1a 5, 2a 5, 3b v. Legs - Femur I setae  $l'$  10,  $d$  47, genu I setae  $v''$  not present, tibiae I solenidia  $\phi$  8, tarsi I solenidia

$\omega$  7, setae  $pl''$  5. Tibiae II setae  $v''$  19,  $d$  40, tarsi II setae  $pl''$  33. Tibiae III setae  $v''$  17,  $d$  45, tarsi III setae  $pl''$  35. Leg I, II, III setation for femur, genu, tibia, tarsus 2-1-7-8, 0-1-4-5, 0-0-4-5.

**Type material** - Holotype larval female (RWH 200301-2), Democratic Republic of the Congo, Uele: Penge (Ehulu), from metathoracic tergite of *Batocera wyliei* (*Batocera albertium*) Thomas, coll. 1932, Putnam, deposited in Musée Royal de L'Afrique Centrale, Tervuren, Belgium (MB).

**Etymology** - *Tetrapolipus afrobatocerae* is named for the locality, Africa, and the host genus, *Batocera*.

***Tetrapolipus ramarajui* n. sp.**  
(Figs. 5-7)

**Diagnosis** - Setae  $h_2$  of larval female *Tetrapolipus ramarajui* are longer (35-42) and further apart (23-25) than other species of *Tetrapolipus* (3-28 and 10-19, respectively). Setae  $e$  on plate EF are longer (18-28) than setae  $e$  of *T. afrobatocerae* (8) and *T. seemani* (11-14) but

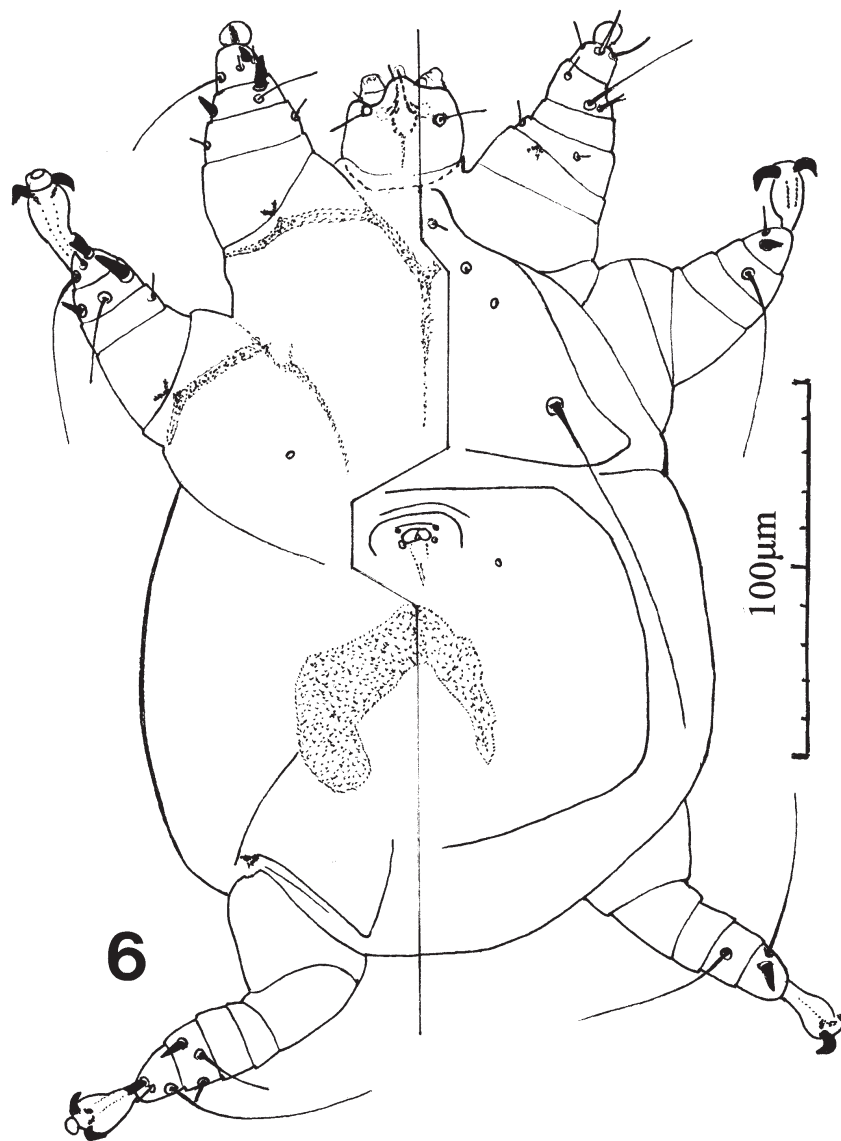


Fig. 6. *Tetrapolipus ramarajui* n. sp. - Male, dorsal aspect right, ventral aspect left.

shorter than setae *e* of other *Tetrapolipus* (24-454). Tarsi III setae *pl''* are longer (77-90) than in all species except *T. batocerae* (63-79). The propodosoma of adult female *T. ramarajui* is nearly as wide as the hysterosoma and plates C, D and EF are not present. Dorsal gnathosomal setae in male *T. ramarajui* are longer (9-11) than in males of other genera of *Tetrapolipus* (3-6).

**ADULT FEMALE** (Fig. 5) - Gnathosoma length 52-68, width 50-63 (n = 4). Stigmata not evident. Cheliceral stylet length 28-33, pharynx width 30 (Table 1). Dorsum - Idiosoma length 575-910, width 206-380. No idiosomal plates. Venter - Without coxae I, II setae. Legs - No setae on femora, genua or tibiae I, II. Tarsi I ambu-lacra with sucker, length 5. Tarsi I subunguinal setae claw-like with opposing setae *pv''*, tarsi II setae *tc'* and *s* spine-like.

**MALE** (Fig. 6) - Gnathosoma length 30-32, width 30-35 (n = 3). Cheliceral stylets 10-15, pharynx width 5-9, dorsal setae 9-11, ventral setae 8-12 (Table 1). Dorsum - Idiosoma length 186-275, width 142-192. Prodorsal plate setae *v*<sub>1</sub> 5, setae *v*<sub>2</sub> and *sc*<sub>1</sub> v-m, setae *sc*<sub>2</sub> 62-100, genital capsule at anterior margin of fused plates C/D length 12-17, width 27-30. Venter - coxal setae *1a* m, *2a* m-3, *3b* v-m. Legs - Femora I setae *l'* 8-9, *d* 4-5, genua I setae *v'* 6, *v''* 2, tibiae I setae *k* 6-7. Tibiae II setae *v'* spinelike, 5, tibiae III setae *v'* spinelike, 5-7, tarsi III setae *pl''* 34-60. Leg I-III setation for femur, genu, tibia, tarsus: 2-2-6-7, 0-1-4-5, 0-0-4-5, respectively.

**LARVAL FEMALE** (Fig. 7) - Gnathosoma length 78-93, width 92-97 (n = 3). Cheliceral stylets length 152-177, pharynx width 10-13, dorsal setae 69-80, ventral setae 41-45. Dorsum - Idiosoma length 285-300,

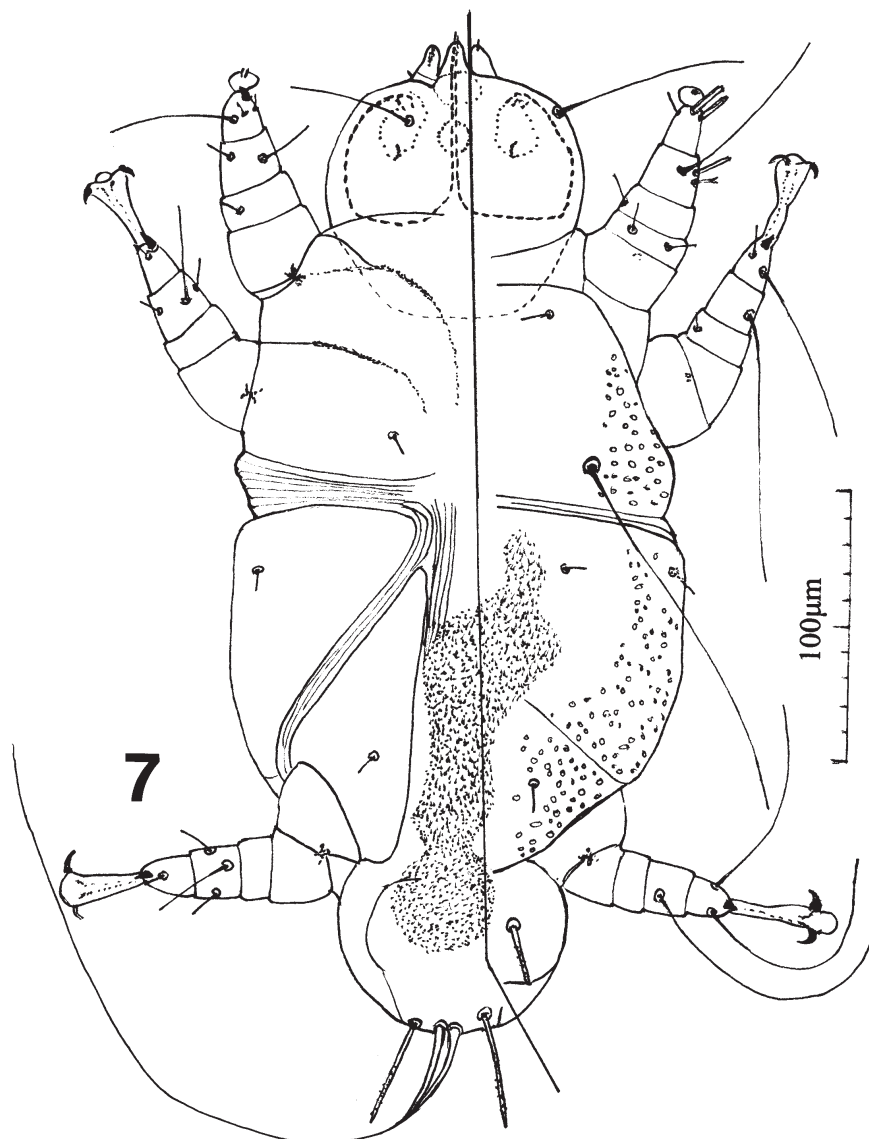


Fig. 7. *Tetrapolipus ramarajui* n. sp. - Larval female, dorsal aspect right, ventral aspect left.

width 160-172. Prodorsal plate setae  $v_1$  10-11,  $sc_2$  130-150. Plate C setae  $c_1$  7-8,  $c_2$  9-11, plate D setae  $d$  9, plate EF length 15-38, width 58-72, setae  $e$  with microspines 18-28. Plate H setae  $h_1$  278-286,  $h_2$  with microspines 35-40,  $h_2$ - $h_2$  distance 23-25. Venter - Coxae I, II, III setae  $1a$  0,  $2a$  7-9,  $3b$  7-10. Legs - Femur I setae  $l'$  10-12,  $d$  10, tibiae I solenidia  $\phi$  13-17, setae  $k$  5-7,  $l''$  10. Tarsus III setae  $pl''$  75-90. Legs I-III setation as in the male.

**EGG** - Length 288-420, width 129-178 ( $n = 8$ ).

**Type material** - Holotype: Larval female (RWH 110502A-10), Ceylon (Sri Lanka) from metathoracic tergites of *Batocera rufomaculata* (DeGeer) (Coleoptera: Cerambycidae), no date of collection, no specific locality, coll. Koebele, deposited in the California Academy of

Sciences (CAS). Paratypes: Three males, same data as holotype; two males, India, Gujarat, Rampur, host *Batocera rufomaculata*, June 1991; one male, India, Gujarat, Rampur, host *Batocera numitor* Newman, June 1991; seven adult females, same data as holotype; two adult females, Ceylon (Sri Lanka), host *Batocera rufomaculata*, coll. Prof. S. G. Williams; one adult female, Ceylon (Sri Lanka), host *Batocera rufomaculata*, September 1914, coll. Whittle; two adult females, India, Gujarat, Rampur, host *Batocera rufomaculata*, June 1991, two adult females, India, Bombay, host *Batocera rufomaculata*, coll. G. Bryant; eight larval females, same data as holotype; two larval females, India, Gujarat, Rampur, host *Batocera rufomaculata*, June 1991; one larval female, Ceylon (Sri Lanka), host *Batocera rufo-*

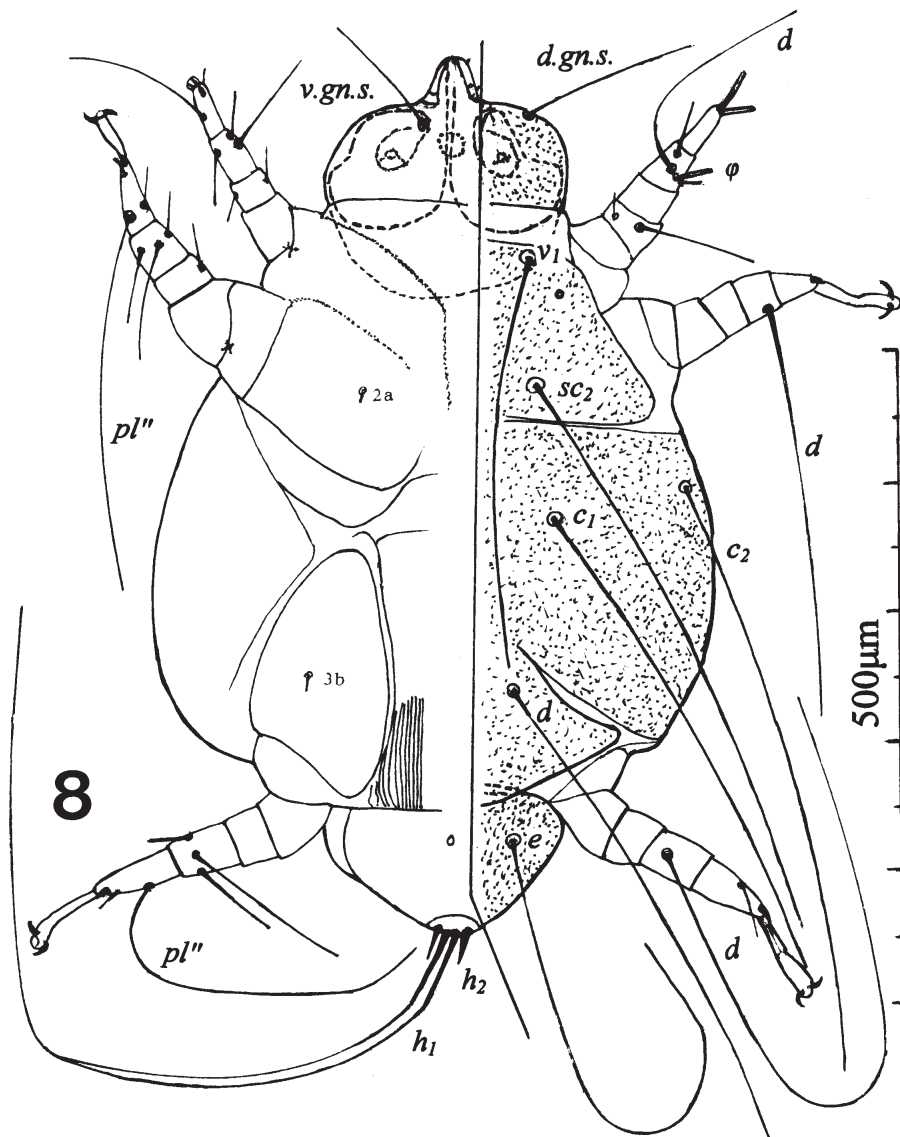


Fig. 8. *Tetrapolipus seemani* n. sp. - Larval female, dorsal aspect right, ventral aspect left.

*maculata*; one larval female, Ceylon (Sri Lanka), host *Batocera rubus*, September 1914; three larval females, India, Bombay, host *Batocera* species; eggs, Ceylon, (Sri Lanka), host *Batocera rufomaculata*; ten vials with *Tetrapolipus ramarajui*, all instars, in 70% ethanol. One male, adult female and larval female paratype to each of the following institutions: CAS, QM, MNH, TNAU, MSU, UMMZ, OSU and NMNH. One adult and one larval female paratype to MB, ZMH, BMH, balance of paratypes to UMMZ.

**Etymology** - *Tetrapolipus ramarajui* is named for Kunchi Ramaraju, professor of entomology at Tamil Nadu Agricultural University, Coimbatore, India, in recognition of his active research with the family Podapolipidae in India.

**Note** - Males, adult females and larval females of an undescribed species of *Tetrapolipus* from *Anoplophora lucipor* from Limay Province, Philippine Islands, also has larval females with long setae *e* and *h*<sub>2</sub>, 32 and 44 respectively. This species is currently under study.

***Tetrapolipus seemani* n. sp.**  
(Fig. 8)

**Diagnosis** - Idiosoma of larval female *Tetrapolipus seemani* n. sp. longer (more than 500) than idiosoma of other larval female *Tetrapolipus* (170-344) and setae *v*<sub>1</sub>, *c*<sub>1</sub>, *c*<sub>2</sub>, *d* and *e* longer (246-455) than the width of the gnathosoma (190-197). Surface of integument grainy.

**LARVAL FEMALE** (Fig. 8) - Gnathosoma length 168-190, width 190-197 (n = 4). Cheliceral stylets 330-

Table 1. Maximum measurements in micrometers ( $\mu\text{m}$ ) for *Tetrapolipus batocera* (Tb), *Tetrapolipus hunteri* (Th), *Tetrapolipus sulawesiensis* (Tsu), *Tetrapolipus diastocerae* n. sp. (Td), *Tetrapolipus afrobatocerae* n. sp. (Taf), *Tetrapolipus ramarajui* n. sp. (Tr), *Tetrapolipus seemani* n. sp. (Tse) and composite of species of *Kurosapolipus* from South America (Ksa).

	Tb	Th	Tsu	Td	Taf	Tr	Tse	Ksa
FEMALE								
Idiosoma length	810	1260	875	566	no	910	no	750
Idiosoma width	435	530	460	360	female	380	female	350
Gnathsoma width	61	80	53	50	-	63	-	65
Cheliceral stylets	38	42	49	27	-	33	-	50
Pharynx width	30	35	35	28	-	30	-	36
MALE								
Idiosoma length	172	341	249	150	no	275	no	185
Idiosoma width	133	191	177	120	male	192	male	130
Gnathsoma width	32	40	38	30	-	35	28	
Cheliceral stylets	15	20	17	12	-	15	-	14
Genital cap. width	14	23	30	22	-	27	-	20
Setae								
Ventral gnathosomal	10	7	8	m	-	12	-	m
Prodorsal plate $v_1$	7	5	12	m	-	12	-	m
Prodorsal plate $sc_2$	84	104	130	60	-	100	-	m
Genu II $l'$	6	8	10	5	-	5	-	5
Tibia II $l''$	6	25	7	0	-	5	-	33
Tibia III $l'''$	7	30	8	0	-	7	-	44
LARVAL FEMALE								
Idiosoma length	344	330	265	200	170	285	569	280
Idiosoma width	266	268	186	150	148	176	422	200
Gnathsoma width	93	132	108	70	55	94	197	68
Cheliceral stylets	148	267	175	103	64	155	393	102
Pharynx width	13	17	14	13	18	10	20	18
Setae								
Dorsal gnathosomal	62	95	80	47	34	80	138	58
Ventral gnathosomal	54	58	50	33	7	41	103	45
Prodorsal plate $v_1$	39	39	50	41	16	10	310	20
Plate C, $c_2$	10	10	4	v	6	11	455	40
Plate D, $d$	9	11	13	v	8	10	404	80
Plate EF, $e$	38	33	44	86	8	10	454	80
Tibia II $v'$	13	17	10	9	40	90	31	8
Tibia III $v'$	20	16	12	25	7	15	36	10
$h_1$	312	396	370	253	150	280	731	255
$h_2$	28	11	20	3	obsc.	42	27	22

393, pharynx width 20, dorsal setae 117-138, ventral setae 102-103. Dorsum - Idiosoma length 532-569, width 379-431. Prodorsal plate setae  $v_1$  246-310,  $v_2$  m (2 specimens with a seta on left side only, 20-35),  $sc_2$  450-495. Plate C, setae  $c_1$  365-390,  $c_2$  377-455, plate D, setae  $d$  374-404. Plate EF, setae  $e$  415-454. Plate H, setae  $h_1$  527-731,  $h_2$  20-27. Venter - Coxae I without setae, coxae II setae  $2a$  thin 13, coxae III setae  $3b$  15-16. Legs - Femora I setae  $v'$  7 (one), 18-22 (three),  $d$  78-85, genua I setae  $v'$  22-27,  $v''$  spinelike, 13-20, tibiae I solenidia  $\phi$  20-25, setae  $k$  8-13, tarsi I setae  $pl''$  90-120. Genu II setae

$v'$  28-34, tibiae II setae  $v''$  90-93,  $d$  basal, 225-310, tarsi II setae  $pl''$  128-290. Tibiae III setae  $d$  basal, 480-576, tarsi III setae  $pl''$  255-296. Legs I-III setation for femur, genu, tibia, tarsus 2-2-7-7, 0-1-4-5, 0-0-4-5, respectively.

**Type data** - Holotype: Larval female (RWH 7300505-19), N. E. Basu River, E. of Lae, 100 meters, Papua New Guinea, from under elytra of *Batocera wallacei* Thomson, 1858 (Coleoptera: Cerambycidae), coll. 14 September 1965, J. A. Gressitt, deposited in the Bishop Museum, Honolulu, Hawaii, U.S.A. (BMH). Paratypes: Four larval females, with same data as

holotype. One larval female deposited in each of the following collections: QM, UMMZ, OSU, host beetle and 1 vial with associated *Tetrapolipus hunteri* BMH.

**Etymology** - *Tetrapolipus seemani* is named for Owen Seeman, Queensland Museum, South Brisbane, Australia in recognition of his active research with the family Podapolipidae in Australia.

## DISCUSSION

The new species have characters that fit within the genus *Tetrapolipus* as discussed by Husband (1973), Husband and Li (1993), Husband and Kurosa (2000) and Kurosa and Husband (2001). *Tetrapolipus diastocerae* has the following apomorphic characters: male and larval instars with three tibiae II, III setae in contrast to tibiae II, III with four setae, larval females with idiosomal setae *c*<sub>2</sub> and *d* vestigial and adult females without conspicuous ambulacra I. Tibiae II, III setae *l*" are plesiomorphic (long) in male *T. hunteri*, apomorphic (absent) in male *T. diastocerae* and apomorphic (spinelike) in three species of *Tetrapolipus*. Tarsi I solenidia  $\omega$  are longer (7) in *T. afrobatocerae* and shorter (0-3) in the remaining species of *Tetrapolipus*. Many setae on legs of larval females are unusually short in *T. afrobatocerae* and unusually long in *T. seemani*, with the exception of femora I setae *d* which are long in both species but short in all other *Tetrapolipus*.

Parasitic mites in the genus *Tetrapolipus* are reported from *Anoplophora*, *Batocera*, and *Diastocera* (Cerambycidae) in the Eastern Hemisphere from 23° 25' N (Rampur, India) to 16° 55' S (Cairns, Australia) and from 25° E (Uele, Democratic Republic of the Congo) to 148° E (Buna, New Guinea). The host genus *Batocera* is widely distributed in tropical and subtropical Asia. *Batocera wyliei* is the only native African *Batocera* and *B. rufomaculata* has been introduced to eastern Africa and the Virgin Islands in the Western Hemisphere (Rigout, 1988).

Four legs are characteristic of adult female *Tetrapolipus* and *Kurosapolipus*. However, two or four legs occur in adult female *Coccipolipus* (Husband, 1972) and four or six legs occur in adult female *Rhynchopolipus* (Husband and OConnor, 1999). In the progression from eight legs in adult female *Chrysomelobia* to no legs in *Silphapolipus*, legs of adult females in genera of Podapolipidae are represented by vestiges of legs without setae or distinct segmentation. More discoveries of variations in leg numbers within genera of Podapolipidae are anticipated.

Regenfuss (1973) discusses preconjugate mating position for males and larval females in the family Podapolipidae. He suggests genuine copulation with the larval female may have developed from precopulation with a larval female as noted in a sister group of Podapolipidae, the Tarsonemidae. Larval females of gen-

era such as *Rhynchopolipus* and *Locustacarus* have defined circular areas below plate EF and above plate H that appear to be for attachment of male palpi. No such areas have been observed in larval *Tetrapolipus*. Opisthosomal structures and setal size and shape in larval females have potential for determining appropriate species for mating for males. The discovery of more than one species of *Tetrapolipus* on one host specimen suggests synhospitality as noted for podapolipid mites associated with carabid hosts by Regenfuss (1973). Studies of additional species from *Batocera* species from the Philippines are in progress.

## Key to larval female *Tetrapolipus*

1. Ventral gnathosomal setae 31-103, longer than width of base of tarsi I (10-20).....2  
Ventral gnathosomal setae 7, shorter than width of base of tarsi I (12).....*Tetrapolipus afrobatocerae* n. sp.
2. Setae *h*<sub>2</sub> short (3-11).....3  
Setae *h*<sub>2</sub> long (20-42).....4
3. Setae *h*<sub>2</sub> 3, tibiae II, III with 3 setae, setae *e* 77-86, longer than width of gnathosoma 66-70.....  
.....*Tetrapolipus diastocerae* n. sp.  
Setae *h*<sub>2</sub> 10-11, tibiae II, III with 4 setae, setae *e* 11-31, shorter than width of gnathosoma 99-126.....  
.....*Tetrapolipus hunteri* Husband
4. Prodorsal setae *v*<sub>1</sub> 5-50, shorter than width of gnathosoma 55-108, length of idiosoma short (170-344)..5  
Prodorsal setae *v*<sub>1</sub> 246-310, longer than width of gnathosoma 190-197, length of idiosoma long (532-569).....*Tetrapolipus seemani* n. sp.
5. Setae *h*<sub>2</sub> shorter, 20-28, and closer together, 10-16, prodorsal setae *v*<sub>1</sub> 25-50, longer than width of base of tarsi I, 13-18.....6  
Setae *h*<sub>2</sub> longer, 35-42, and further apart, 23-25, prodorsal setae *v*<sub>1</sub> 10-11, nearly equal to base of tarsi I, 12.....*Tetrapolipus ramarajui* n. sp.
6. Tibiae III setae *v*' 52-54, longer than setae *e* 24-31, Cheliceral stylets 128-137.....  
.....*Tetrapolipus batocerae* (Berlese)  
Tibiae III setae *v*' 29, equal to or shorter than setae *e* 28-44, cheliceral stylets 145-175.....  
.....*Tetrapolipus sulawesiensis* Zhang and Li

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