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External Features of Cheyletid Predatory Mite, *Hemicheyletia bakeri* (Ehara) Found in Citrus Orchards of Japan

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Abstract: The cheyletid predatory mite, Hemicheyletia bakeri (Ehara) habitat on the citrus plants in Ehime prefecture of Japan. Mite had an elongated body with the length of 230 *f*Ým and the width of 92 *f*Ým. Gnathosoma, propodosoma and hysterosoma were well differentiated. The propodosomal shield had four pairs of fanlike setae on the lateral side and two pairs on the middle portion. Opisthosomal shield possessed four pairs of fanlike setae on the corners. Anus of this mite consisted of elongated excretory pore as flap-shaped organ projected outwardly. There were three long and sharp tip setae on both sides. Legs comprised of six segments, coxa, trochanter, femur, genu, tibia and tarsus. Tarsus of leg one was longer and smoothly surfaced while, of leg two had sub segments. Tibia of the leg three and leg four had a pair of setae as other legs while tarsus of leg four was longer compared to three. Tarsus of the leg one had thick base, which was divided into two segments. Smaller segment had a pair of hook-shaped claws and several thin tenent hair. The tarsus of leg two, three and four possessed a pair of smoothly surfaced and hook-like claws. The empodial claws were elongated having pad-shaped tips. Eyes were granular-shaped projected outwardly with five regular circles and disconnected lines surrounded the eyeball. A pair of setae covers both sides of upper portion of eye.

Key words: Anus, hysterosoma, propodosoma, shields, tarsus

Introduction

Mites injury to citrus fruits, leaves and buds results from the penetration of stylets into plant tissues (Jeppson, 1989). Spider mites are among the most common plant pests, mainly feeding on leaves, causing damage to the plant parts, cotyledons, fruits, flowers and tips of shoots (Tomczyk and Kropczynska, 1985).

The Cheyletoidae consists of parasitic as well as free-living predator species. The parasitic forms are also found in the family (on birds and mammals), Cloacaridae (on reptiles) and Syringophillidae (in quills of the body and flight feathers of birds). The majorities are skin parasites, feeding on tissue fluids and are often associated with mange (scaling hair loss and pruritis). Cheyletiella parasitiworox can cause mange in domesticated and wild rabbits while Cheyletiella yasguri some times develop itching dermatitis (Smiley, 1969).

Harrlov and Morch (1975) have described a putative mutual relationship between Ornitocheyletia hallae and ascomycete, Micromonospora characeae on pigeons. The oedemata and hyperkeratinosis of the epidermal cells of skin of the host resulting from the bite of cheyletid mite.

All the cheyletiellidae are parasites of vertebrates while the cheyletidae contains mostly free living predators and only a small number of species living in association with vertebrates (Cheyletus sp. and Eucheyletia sp.).

The existence of a cheyletid mite, *Paracheyletia mori* (Ehara) was observed in Japan by Ehara (1962) and on other plants was described by Ehara and Ibrahim (1988) in Malaysia.

The ecological data of some cheyletid mites was available but the presence of *H. bakeri* as a predator of Panonychus citri (McGregor) was not ascribed in reviewed literature. The project was conducted to elucidate the external features of this mite for the identification of functional organs.

Materials and Methods

The experiment was conducted between January 1999 to December 1999 in the Citriculture Laboratory, Faculty of Agriculture, Ehime University. The leaves revealed symptoms of *H. bakeri* were collected from the citrus plants of the campus vicinity.

Identification of cheyletid mites was confirmed under stereomicroscope. Samples were pre-fixed in 4¢H glutaraldehyde in 0.1M phosphate buffer (pH 7.2) followed by rinsing in the same buffer and were post-fixed in 1¢H osmium tetroxide. Dehydration was carried out with a graded ethanol series and were dried in a Vacuum Device. Dried samples were mounted on the specimen stubs, coated with gold using 1B-2 ion sputter and finally were viewed under Hitachi S-2250N Scanning Electron Microscope at 20kV and photographed.

Results

More than two mites were found on the leaves which showed symptoms of mite colony from February to May and August to November 1999. The population was decreased to minimum from June to August and then from November to January (Fig. 1). This mite had an elongated body with the length of 230 *f*Ým and the width of 92 *f*Ým (Fig. 2). Gnathosoma (Gn) extended anteriorely from propodosoma (Pr) and the posterior shield comprised of hysterosoma (Hy) (Fig. 2). Gnathosoma (Gn) elongated anteriorely in a thumb-like organ fixed in the propodosoma (Pr) (Fig. 3). The hysterosoma (Hy) attached at the posterior end of the propodosoma, which was existed between the leg four of the mite (Fig. 3). The propodosomal shield (PS) was narrow towards gnathosoma and wider to opisthosoma (Fig. 4). It had four pairs of fanlike setae (Se) on the lateral side and two pairs on the middle portion of the setae. The cuticle comprised of lobed surface arranged in an irregular pattern (Fig. 4). Opisthosomal shield (OS) was wide at the anterior end and contracted towards posterior side (Fig. 5). This shield possessed four pairs of setae (Se) on the corners in sequence. The cuticle was lobed in an irregular pattern (Fig. 5).

The opisthosomal posterior (OP) comprised of a pair of small setae (Se) which were originated from the rear end of the

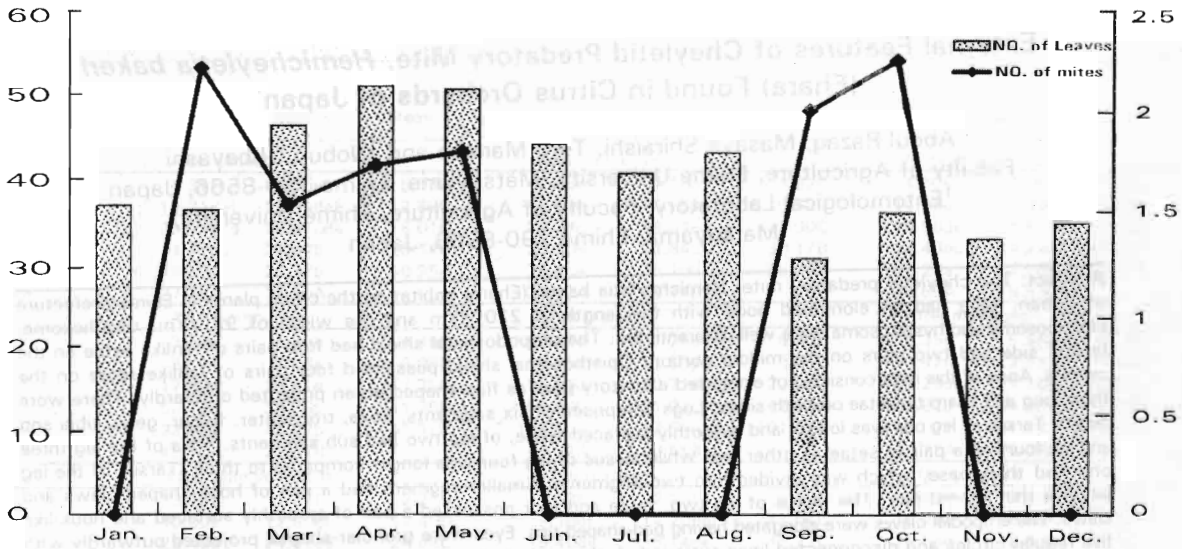
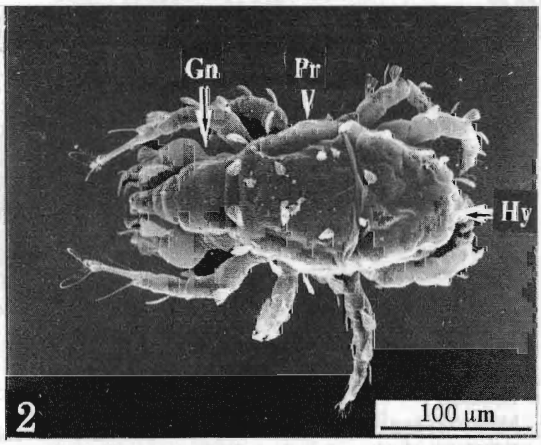
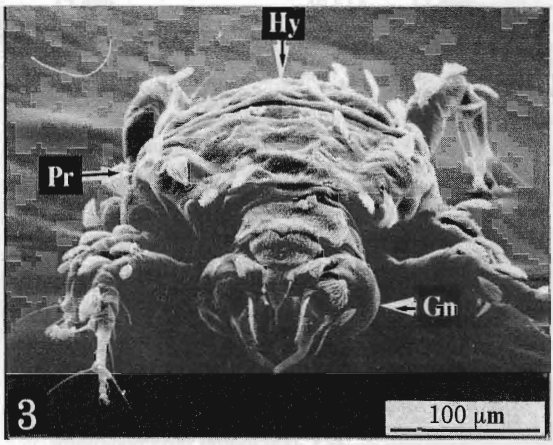
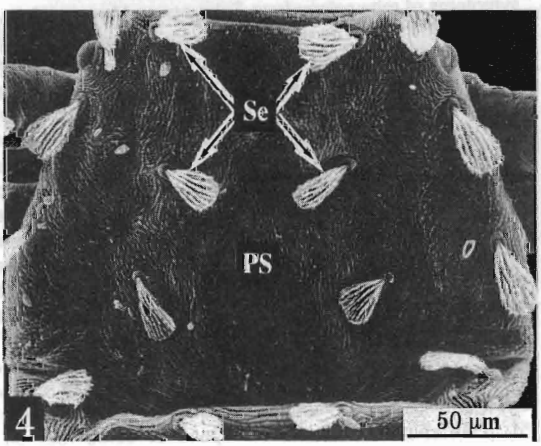


Fig. 1: Seasonal availability of cheyletid predatory mite, Hemicheyletia bakeri (Ehara) in citrus orchards.







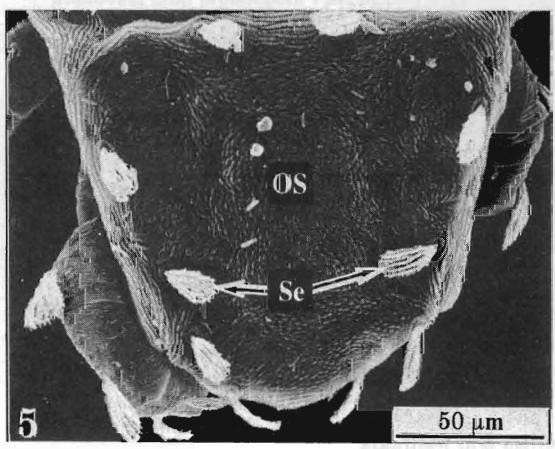


Fig. 2-5: Scanning electron micrographs showing external features of cheyletid predatory mite, Hemicheyletia bakeri (Ehara) on satsuma mandarin. 2: The body having gnathosoma (Gn) propadosoma (Pr) and hysterosoma (Hy). 3: Anterior view of the body exposing gnathosoma (Gn), propodosoma (Pr) and hysterosoma (Hy). 4: Propodosomal shield (PS) with setae (Se). 5: Opisthosomal shield (OS) arranged with setae (Se).

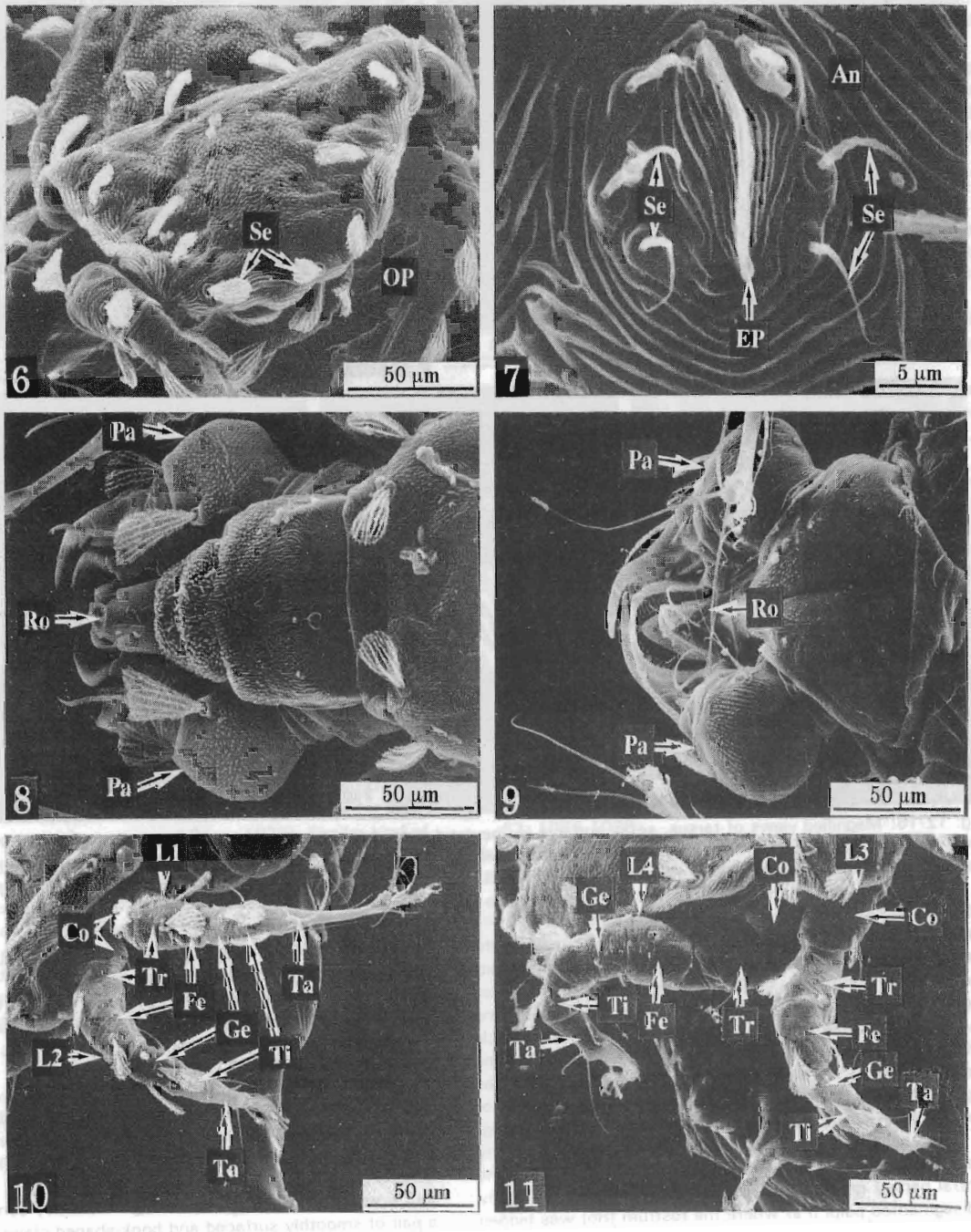


Fig. 6-11: Characteristics of functional organs in cheyletid predatory mite, Hemicheyletia bakeri (Ehara). 6: Opisthosomal posterior (OP) possessed a pair of setae (Se). 7: Anus (An) has elongated excretory pore (EP) and three setae (Se) on each side. 8: Dorsal view of mouthparts having palpi (Pa) and rostrum (Ro). 9: Ventral view of mouthparts revealed palpi (Pa) and rostrum (Ro). 10: Dorsal view of leg one (L1) and leg two (L2) comprised of coxa (Co), trochanter (Tr), femur (Fe), genu (Ge), tibia (Ti) and tarsus (Ta). 11: Leg three (L3) and leg four (L4) composed of coxa (Co), trochanter (Tr), femur (Fe), genu (Ge), tibia (Ti) and tarsus (Ta).

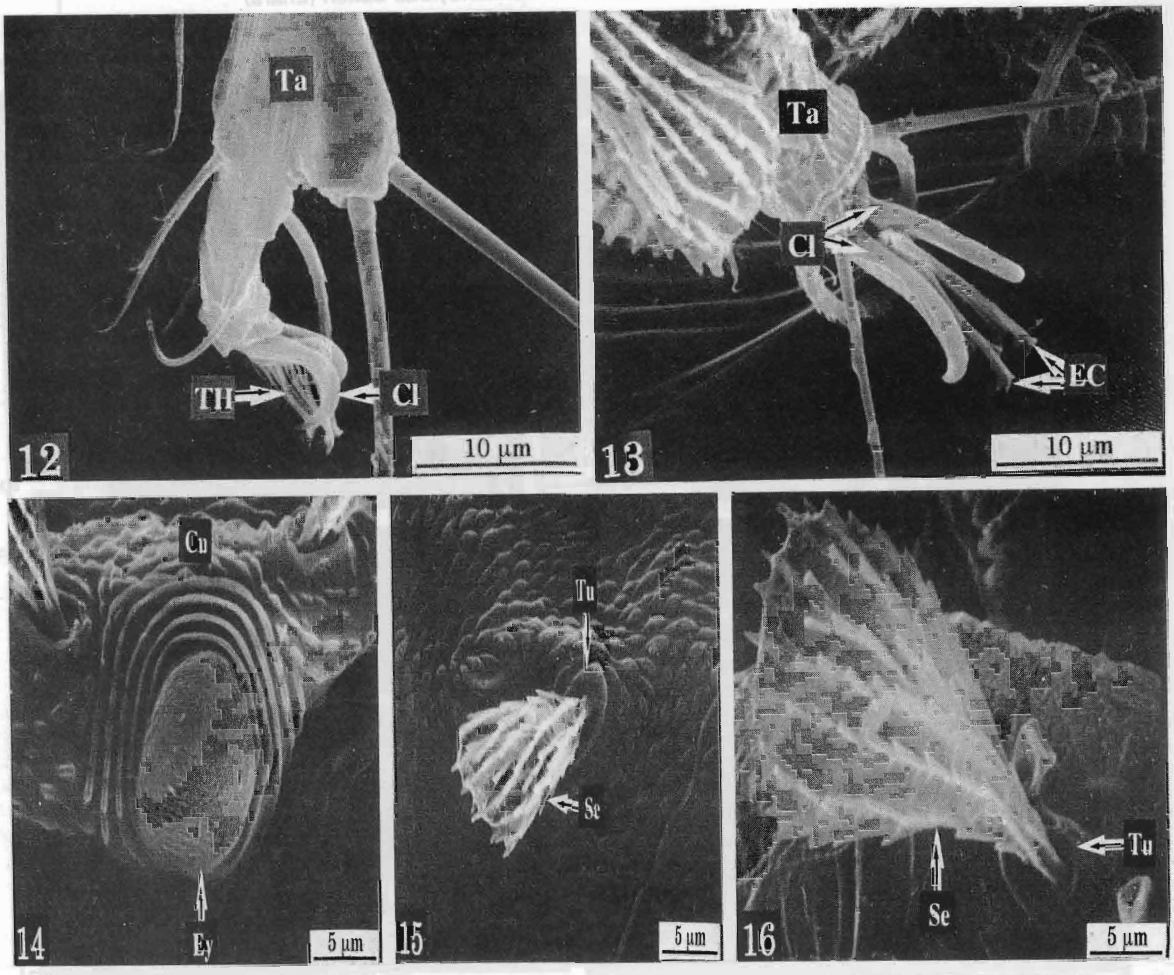


Fig. 12-16: Magnified views of tarsus, setae and eye in cheyletid predatory mite, Hemicheyletia bakeri (Ehara). 12: Tarsus (Ta) occupied by a pair of claws (Cl) and tenant hairs (TH). 13: Tarsus (Ta) having claws (Cl) and empodial claws (EC). 14: Five lined cuticle (Cu) around the eye (Ey) ball. 15: Small seta (Se) originated from the rounded tubercle (Tu). 16: Wing-like seta (Se) projected from the tubercle (Tu).

shield (Fig. 6). This portion had horizontal striation on the cuticle and between the setae (Fig. 6). Anus (An) of this mite composed of elongated excretory pore (EP) like a flap-shaped organ extended outwardly (Fig. 7). The anus had three long and sharp-tip setae (Se) on both sides of flaps. The cuticle striation was vertical to the excretory pore and circular around the setae. Setae were originated from the pad-like tubercles (Fig. 7). The dorsal portion of gnathosoma (Gn) comprised of a pair of fleshy palpi (Pa) and an elongated rostrum (Ro) (Fig. 8). Gnathosoma attached with the propodosoma by overlapping with a smoothly surfaced cuticle strip (Fig. 8). The ventral part of gnathosoma also consisted of a pair of fleshy and segmented palpi (Pa) where the rostrum (Ro) was hidden under other organs (Fig. 9). The gnathosoma connected with the propodosoma as thumb-shaped organ whereas the posterior portion was reduced to a triangular-shape (Fig. 9). Leg one (L1) and two (L2) were composed of six segments, coxa (Co), trochanter (Tr), femur (Fe), genu (Ge), tibia (Ti) and tarsus (Ta) (Fig. 10). Tibia of the leg one and two had a pair of setae while the other segments possessed one. Tarsus of leg one was longer and smoothly surfaced while the tarsus of leg two had sub-segments (Fig. 10). The leg three (L3) and leg four (L4) were also consisted of six segments, coxa (Co) trochanter (Tr), femur (Fe), genu (Ge), tibia (Ti) and tarsus (Ta) (Fig. 11). Tibia of the leg three and leg four had a pair of setae similar to other legs while tarsus of leg four was longer as compare to three (Fig. 11).

Tarsus (Ta) of the leg one had thick base which was divided into two segments. Smaller one had two setae and longer had three setae (Fig. 12). Smaller segment had a pair of hook-shaped claws (Cl) and several thinner tenent hairs (TH) existed between them (Fig. 12). The tarsus (Ta) of leg two, three and four possessed similar structure (Fig. 13). They comprised of a pair of smoothly surfaced and hook-shaped claws (Cl). The empodial claws (EC) were elongated and had pad-shaped tips which were originated from the middle of the claws (Fig. 13). Eyes (Ey) of this mite revealed a granular-shaped, outwardly projected balls (Fig. 14). Five regularly circular and disconnected cuticle lines surrounded the eyeball. A pair of setae was on both sides of upper portion of eye (Fig. 14). The dorsal setae (Se) of the predator were projected from the rounded and elevated tubercles (Tu) (Fig. 15). Setae

possessed several shoots, which were connected with each other (Fig. 15). Setae (Se) of the legs membranous and had many smaller and irregular vein-shaped structures extended up to the tips (Fig. 16). The edges of the setae had needle-shaped projections. These setae were projected from the tubercle (Tu) as single stick and spread (Fig. 16).

Discussion

The cheyletid predatory mite, *H. bakeri* was not reported on citrus plants in Japan. Ehara (1962) found cheyletid predatory mite in Hokkaido. We found it predating on Panonychus citri (McGregor) in Ehime prefecture of Japan. Ecological data revealed the presence of this predator more than 2 mites per leaves from January to June and then August to November. The population of mite declined from mid June to mid August and in winter November to January.

The body of Paracheyletia bakari was oval-shaped having a length of 290 *f*Ým and the width of 230 *f*Ým. Rostrum reaching tarsus of the palpus, covered with the shield which was punctuate-striate behind the peritreme. It was tuberculate-punctate anterior to the peritreme (Ehara, 1962). Gnathosoma was attached anteriorely with propodosomal shield in a thumb-shaped portion.

The genus Bicheyletiela Fain in family Cheyletiellidae Volg had median hysteronotal shield wider then long and had small length setae (Fain, 1979). In contrast, *H. bakeri* had a pair of shields, where the propodosomal shield was narrow to wide towards hysterosoma and the hysterosomal shield was wide to narrow to the posterior side. These shields were occupied by well-arranged fanlike setae. The cuticle of these shields possessed irregular micro tubercles.

The predatory mite, H. bakari had one pairs of setae at posterior most genito-anal region. This mite have two pairs of setae on both sides of excretory pore (Ehara, 1962). H. *baraki* have a pair of setae on the lower end of posterior shield while the anus had three long and sharp tip setae on both sides of excretory pore. The setae were originated from the pad-like tubercles.

The *H. bakeri* legs were composed of coxa, trochanter, femur, genu, tibia and tarsus, which were occupied by several setae on each segment (Summers and Price, 1970). Similar kind of segments were found but the tibia of leg 1 and 2 had a pair of setae, whereas the other had one. The tarsus of leg one was smoothly surfaced which was composed of a pair of hook-shaped claws and several tenant hair. While the tarsus of other legs revealed a pair of claws and many empodial claws having pad-like tips.

Hemicheletia maki E. had a pair of eyes slightly anterior to and little outside of second pair of lateral propodosomal setae (Ehara and Ibrahim, 1988). While the eyes of *H. newyorkensis* were lens like, prominent and surrounded by striae (Delfinado and Khaing-Fields, 1976). Eyes of *H. bakeri* were granular shaped and projected outwardly similar to a ball. The sides of eye were covered with five disconnected cuticle lines. Eyes also possessed a pair of setae on lateral sides of eyeball.

In conclusion, this study provides new information regarding the seasonal fluctuation of the population of *H. bakeri* and the morphology of external organs. This experiment had elucidated the shape of the body, shields, structure of setae, segments of the legs and the structure of eyes.

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