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TAXONOMY OF THE PREDATORY MITE FAMILY CUNAXIDAE (ACARI) IN CENTRAL THAILAND

Mr. Marut Fuangarworn

A Thesis Submitted in Partial Fulfillment of the Requirements
for the Degree of Master of Science in Zoology
Department of Biology
Faculty of Science
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นายมารุต เฟื่องอาวรณ์

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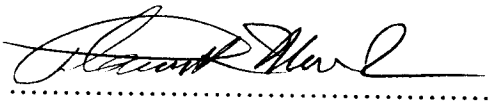

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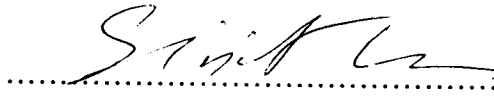

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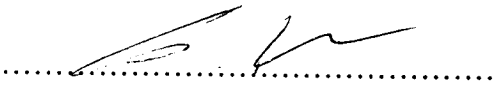

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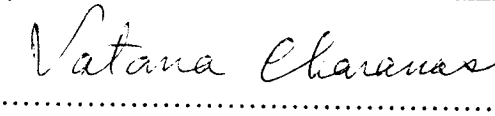

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มารุต เฟื่องอาวรณ์ : อนุกรมวิธานของไรตัวห้ำวงศ์ Cunaxidae (Acari) ในภาคกลางของประเทศไทย. (TAXONOMY OF THE PREDATORY MITE FAMILY CUNAXIDAE (ACARI) IN CENTRAL THAILAND) อ. ที่ปรึกษา : รองศาสตราจารย์จริยา เล็กประยูร, 210 หน้า. ISBN 974-17-5540-6.

การศึกษาอนุกรมวิธานของไรตัวห้ำวงศ์ Cunaxidae จากตัวอย่างที่เก็บได้ในภาคกลางของประเทศไทยระหว่างเดือนตุลาคม พ.ศ. 2545 ถึงเดือนกันยายน พ.ศ. 2546 พบไรวงศ์นี้ 4 วงศ์ย่อย 9 สกุล 33 ชนิด โดยวงศ์ย่อย Bonziinae มีเพียงหนึ่งสกุลคือ *Neoscirula* ซึ่งมี 2 ชนิด วงศ์ย่อย Coleoscirinae มี 3 สกุล คือ *Coleoscirus* *Pseudobonzia* และ *Scutascirus* สกุลละ 5, 3 และ 1 ชนิดตามลำดับ วงศ์ย่อย Cunaxiinae มี 3 สกุล คือ *Armascirus* *Cunaxa* และ *Dactyloscirus* สกุลละ 2, 9 และ 2 ชนิดตามลำดับ และวงศ์ย่อย Cunaxoidinae มี 2 สกุล คือ *Neocunaxoides* และ *Pulaeus* สกุลละ 4 และ 5 ชนิดตามลำดับ โดยทั้ง 33 ชนิด ใน 9 สกุลดังกล่าวนั้น พบว่า 16 ชนิดเป็นการรายงานครั้งแรก (first record) สำหรับประเทศไทย และมี 15 รูปแบบสัณฐานที่ไม่สามารถวินิจฉัยได้ การศึกษาครั้งนี้ได้จัดทำแนวทางสำหรับการจำแนก (key) วงศ์ย่อย สกุล และชนิด พร้อมคำบรรยายลักษณะและภาพประกอบของทุกชนิด โดยใช้ลักษณะต่างๆ ของไรเพศเมียในการวินิจฉัยสกุลและชนิด เช่นลักษณะของเส้นขน (setae) บริเวณด้านล่าง (ventral) ของไฮโปสโตม (hypostome) จำนวนปล้องและการเรียงตัวของเส้นขนบนพาลไพ (palpi) รูปร่างของทาร์ไซ (tarsi) จำนวนและลักษณะของแผ่นแข็งบนส่วนอิดิโอโซมา (idiosoma) จำนวนและความยาวของเส้นขนบริเวณด้านหลัง และการเรียงตัวของเส้นขนบนปล้องขา เป็นต้น และพบไรตัวห้ำวงศ์ Cunaxidae มากที่สุดในดินและซากพืชทับถมบนพื้นดิน

ภาควิชา.....ชีววิทยา..... ลายมือชื่อนิสิต.....

สาขาวิชา.....สัตววิทยา..... ลายมือชื่ออาจารย์ที่ปรึกษา.....

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KEY WORD: TAXONOMY / PREDATORY MITES / CUNAXIDAE / ACARI / THAILAND
MARUT FUANGARWORN : TAXONOMY OF THE PREDATORY MITE FAMILY CUNAXIDAE (ACARI) IN CENTRAL THAILAND. THESIS ADVISOR : ASSOCIATE PROFESSOR CHARIYA LEKPRAYOON, 210 pp. ISBN 974-17-5540-6.

The study of the predatory mite family Cunaxidae in central Thailand was conducted during October 2002 – September 2003. Four subfamilies, 9 genera and 33 species were found. The subfamily Bonziinae was represented by the genus *Neoscirula* with 2 species. Coleoscirinae was represented by 3 genera: *Coleoscirus* with 5; *Pseudobonzia* with 3 and *Scutascirus* with 1 species. Cunaxiinae was represented by 3 genera: *Armascirus* with 2; *Cunaxa* with 9 and *Dactyloscirus* with 2 species. Cunaxoidinae was represented by 2 genera: *Neocunaxoides* with 4 and *Pulaeus* with 5 species. Of the 33 recorded species, in 9 genera, 16 species were first record for Thailand and 15 unidentified species were found. Keys to subfamilies, genera and species were provided. All species were described and illustrated. Genus and species limits were based on female characters such as types of setae on ventral side of hypostome, numbers of palp segments and their chaetotaxy, shape of tarsi, numbers of dorsal setae, numbers and details of idiosomal shields, types and length of various dorsal setae, and chaetotaxy of legs. Most cunaxids species were found in soil and litter habitats.

Department .....Biology.....
Field of study .....Zoology.....
Academic year .....2003.....

Student's signature Marut Fuangarworn
Advisor's signature Chariya Lekprayoon

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CHAPTER 1
INTRODUCTION

The Acari (mites and ticks) is the largest group within the class Arachnida, phylum Arthropoda. They are very small (adult body length ranging from 0.1-30 millimeters) and differ from other arachnids in that all traces of body segmentation have disappeared (Krantz, 1978; Evans, 1990; Halliday *et al.*, 2000). They occupy an extraordinarily diverse range of niches. Many of them have remained predatory as their ancestors, but other groups have adapted to plant feeding, scavenging on dead plant matter, and have developed into various kinds of association with other organisms such as commensalisms, phoresy, and parasitism. (Halliday *et al.*, 2000).

The Acari are important to humans in various aspects. Many species are serious pests of agricultural crops. Other species are parasitic on domestic animals and cause losses in meat, egg, and fiber production. Humans can be attacked by scabies mites, and by pathogens transmitted by chigger mites, and ticks. Many species of Suborder Astigmata cause damage of stored food products; some species living in human habitations are known as "house dust mites" are primary source for human allergy. On the other hand, some mites are beneficial to humans in their role as biological control agents against agricultural pests. Mites, through their natural role, also provide "ecosystem services" in the form of nutrient cycling.

It is estimated that about 48,200 species of mites were described worldwide (Halliday *et al.*, 2000). This number is considered only 5-10% of all mite species in the world. Mites in Thailand, however, had been received little or no attention in many groups. The acarofauna of the country, therefore, are poorly known. The available information is restricted to the group of economic and medical importance. The family Cunaxidae (Suborder Prostigmata) has not been studied at all.

The cunaxid mites are pale yellow to orange in color. They are distinguished from other prostigmatans in that the chelicerae are separated and hinged at base; 2 pairs of sensillae are on prodorsum; palpus has 3-5 segments with strong spines, spurs, or apophyses, usually terminating with strong claw. Cunaxids are free-living

terrestrial mites occur on the surface of humus soil, in litter layers and on trees trunks. They are predaceous on nematodes and other microarthropods including the phytophagous mite pests of many economic plants. This family of mites, therefore, is one of the most interesting acarine groups that can be used as a biological control agent (Gerson and Smiley, 1990).

As mentioned above, the cunaxids and many groups of mites, in Thailand had never been studied faunistically and taxonomically. This could hamper any further researches that need the faunistic and taxonomic information. Therefore this study was conducted in the country for the first time, with special attention to the central region of Thailand where is the important agricultural area and is subject to urbanizations.

Objectives

To collect and study taxonomy of the predatory mite family Cunaxidae in central Thailand.

Anticipated benefits

The results of this study will facilitate further research in agricultural acarology, biogeography and evolutionary biology.

CHAPTER 2

LITERATURE REVIEW

2.1 Taxonomic History

The mites that are now called Cunaxidae were previously placed under the family Bdellidae. Until 1902, Thor (1902) proposed Cunaxidae to accommodate three genera, transferred from Bdellidae, namely *Cunaxa* Von Heyden, 1826, *Eupalus* Koch, 1838, and *Scirula* Berlese, 1887. He also conditionally placed the genus *Pseudocheylus* in this family (Den Heyer, 1981c).

Fourteen years later, Berlese (1916) proposed subgenus *Dactyloscirus* in the genus *Scirus* to accommodate his new species, *Scirus* (*Dactyloscirus*) *eupaloides*. He (Berlese, 1916) also erected the new genus *Coleoscirus* with *C. halacaroides* Berlese, 1961 as a type species.

Oudemans (1922) proposed the genus *Rosenhofia* [subsequently synonymized with the genus *Dactyloscirus* Berlese by Smiley (1975)] to accommodate *R. machairodus* Oudemans, 1922 [=*D. machairodus* (Oudemans) sensu Smiley (1975; 1992)]. Five years later, he (Oudemans, 1927) also erected the genus *Bonzia* for *B. halacaroides* Oudemans, 1927.

Since the family Cunaxidae was proposed, the work of Thor and Willmann (1941) was the first comprehensive study of the family recognizing seven genera and thirty species and varieties. They evaluated the subgenus *Dactyloscirus* to the generic status.

However, Baker and Hoffmann (1948) recognized only six genera, namely *Coleoscirus* Berlese, *Rosenhofia* Oudemans, *Bonzia* Oudemans, *Cunaxa* Von Heyden, *Scirula* Berlese, and *Cunaxoides* Baker and Hoffmann. They considered *Dactyloscirus* a junior synonym of the genus *Cunaxa* Von Heyden, 1826 and proposed the genus *Cunaxoides* to replace the genus *Eupalus* Koch, 1838, a junior homonym of *Eupalus* Gistl, 1834 (in the Coleoptera). This classification system was followed by Baker and Wharton (1952).

In his generic revision of the family Cunaxidae, Smiley (1975) retained the genus *Dactyloscirus* and considered *Rosenhofia* a junior synonym of *Dactyloscirus.* He also proposed four new genera, viz. *Parabonzia, Pseudobonzia, Neocunaxoides* and *Pseudocunaxa* (= *Coleoscirus*).

Although working mainly on the afrotropical fauna, Den Heyer (1975 and later papers), made most contribution to the taxonomy of the family Cunaxidae. He did not only describe/redescribe a number of cunaxid taxa but also made higher classification of the family (Den Heyer, 1980c). He erected four subfamilies, Bonziinae (Den Heyer, 1978a), Coleoscirinae (Den Heyer, 1978c), Cunaxoidinae (Den Heyer, 1979d), and Scirulinae (1980c). He provided numerous illustrations, both line drawing and SEM photographs, of both sexes and many nymphal stages. As Sepasgosarian (1984), in the compilation of cunaxid works, stated that "This work (a classification system for the family Cunaxidae) is so important that no taxonomist should described a new genus or a new species without consulting Den Heyer's work".

During the period of 1970-1990, a numbers of cunaxid species were added to the family from various parts of the world. The most remarkable paper was of Bu and Li (1987b) who proposed new genus and new subfamily, Orangescirulinae, to accommodate their new species, *Orangescirula youngchuanensis* from China.

In 1992, the world cunaxid fauna (166 species) was reviewed by Smiley (1992). Based on the number of palpal segments, the kinds of palpal setae, and the kinds of setae hg_1, he recognized 17 genera and proposed a new family classification that divides the Cunaxidae into nine subfamilies. Key to subfamilies, genera and species were provided. However, Smiley (1992) missed the paper of Inayatullah and Sahid (1989) describing two new species of the genus *Neocunaxoides* Smiley, 1975, from Pakistan.

However, some papers published in a year before 1992 were not included in Smiley' s (1992) work. These are of Gupta (1991), describing one and two new species of *Neocunaxoides* and *Cunaxa* respectively, from Northeast India; Bu and Li

(1991), describing one new species of *Pulaeus*, from China, and Barilo (1991), describing one new species of *Pulaeus* and *Neoscirula* each, from Uzbekistan.

After Smiley' s (1992) publication, The Cunaxidae received considerable attention from many acarologists and were reported from many parts of the world such as India (Gupta, 1992; Chinniah and Mohanasundaram, 2001), Pakistan (Muhammad and Chaudhri, 1992; Inayatullah and Sahid, 1993, 1996), Hawaii (Swift, 1996), Crimea (Khaustov and Kuznetsov, 1998), the Philippines (Corpuz-Raros and Garcia, 1995; Corpuz-Raros, 1995; Corpuz-Raros, 1996a; Corpuz-Raros and Garcia, 1996; Corpuz-Raros, 1996b; Corpuz-Raros, 1996c; Corpuz-Raros, 1996d), China (Lin, 1997; Lin and Zhang, 1998; Lin, 2001; Lin, *et al.*, 2001; Lin and Zhang, 2002; and Lin, *et al.*, 2003), and Greece (Sionti and Papadoulis, 2003a; 2003b).

2.2 Morphology

Den Heyer (1981c) and Smiley (1992) provided excellent descriptions of and discussions on the morphology of Cunaxidae. In general, the body is divided into three regions, the gnathosoma, propodosoma, and hysterosoma (Fig. 1). The gnathosoma consists of two chelate chelicerae, a hypostome, and two palpi. The chelicerae and hypostome form a conelike structure projecting in between the palpal bases as in Bdellidae. The propodosoma, delimited dorsoposteriorly by a conspicuous constriction, bears two pairs of legs and two pairs of sensillum. The hysterosoma bears the two posterior pairs of legs, anus, and genitalia.

Gnathosoma consists of chelicerae, hypostome, and palpi. The number of palp segments vary from three, in Cunaxoidinae (Figs. 2B, 71C, 74E, 79E, 84C), to five segments, in Cunaxiinae and Coleoscirinae (Figs 2A, 4D, 9E, 34E, 39E). The five-segmented palp (Fig. 2A) is considered to be a primitive form, consisting of trochanter, basifemur, telofemur, genu, tibiotarsus (Smiley, 1992). The three-segmented palp (Fig. 2B) is considered that the femur (basifemur and telofemur) have fused with the genu segment, producing a segment called "femurogenu". The configuration of setae, spinelike setae and/or apophyses, on palp segments is usually constant within a species, providing useful taxonomic characters for separating subfamilies, genera and species. Hypostome possesses two pairs of adoral setae and four pairs of setae, hg_1, hg_2, hg_3, and hg_4 on the ventral side (Fig. 2A). These setae

are usually simple and slender, except hg_1, found only in the subfamily Bonziinae, are geniculate (Fig. 3B). The chelicerae (Figs. 1 and 2C) of Cunaxidae lack of immovable digit; a distal membranous projection of segment II may over the movable digit dorsally (Den Heyer, 1981c).

Propodosoma is the anterior portion of the mite behind the gnathosoma. Dorsal propodosoma usually possesses a single shield or plate. The shield may be smooth or reticulated, bearing four pairs of setae, *vi*, *ve*, *sci*, and *sce* (Fig. 1). Setae *vi* and *sci* are sensillus while *ve* and *sce* are usually simple. Ventral propodosoma consists of coxae I and II, they usually fuse to form coxae I+II on each side. In some species, coxae I+II coalesce to form a sternal shield (Figs. 4B, 9B, 71B)

The remainder of the body is the hysterosoma (Fig. 1). There may be one to three main shields or without any shields on dorsal hysterosoma (Smiley, 1992). These shields may be reticulate or non-reticulated, and sometimes lack setae. The integument that is outside shield is usually striation. Hysterosoma may be processes six to eight pairs of dorsal setae (see Table 2-1 for setae designation) but they are constant in numbers within the genus (Smiley, 1992). The numbers of these setae, therefore, are used for separating the genera while the types of these setae are used in separating cunaxid species within the genus. However, different authors used different setae designations. Kethley (1990), based on the topology of these setae, first homologized setae designations within the acarine suborder Prostigmata, which the Cunaxidae belong to. Although Smiley (1992) did not use this system, many acarologists (Swift, 1996; Lin and Zhang, 2002; Lin *et al.*, 2003; Sionti and Papadoulis, 2003a; 2003b) applied Kethley' s (1990) system to their works on the Cunaxidae. Swift (1996) equated the setal notation of Atyeo (1960) for Bdellidae and Den Heyer (1979c) and Smiley (1992) for Cunaxidae as in Table 2-1.

Table 2-1. Dorsal setal designation used by various authors for Bdellidae and Cunaxidae.

Atyeo, 1960	Smiley, 1992	Den Heyer, 1979	Swift, 1996
Anterior sensillum	Anterior sensillum	PS1	*vi*
Lateral propodosomal	P1	dl1	*ve*
Posterior sensillum	Posterior sensillum	PS2	*sci*
median propodosomal	P2	dc1	*sce*
Internal humeral	D1	dc2	c_1
External humeral	L1	dl2	c_2
Internal dorsal	D2	dc3	*d*
Internal lumbral	D3	dc4	*e*
Internal sacral	D4	dc5	*f*
External clunal	D5	dc6	h_1
External sacral	*	dl6	h_2
Posterio anal	*	*	ps_1
Anal seta	*	*	ps_2

*No designation

The ventral region of the hysterosoma includes the coxal plates, coxae, genital plates, accessory plate(s) (Figs. 31B, 82B), and anal region (Smiley, 1992). The genital plate has a constant number of setae (4 pairs) in all genera except *Parabonzia* which has 9 pairs (Smiley, 1992). The integument that is outside the ventral shields is usually striate, bearing varied numbers of setae. The anus is on terminal end of hysterosoma with one to three pairs of anal setae.

The leg of cunaxid mites has six segments in larval stage, and seven segments in nymphal and adult stage (Smiley, 1992). Each leg (Fig. 1) consists of, proximal to distal end, coxa, trochanter, basifemur, telofemur, genu, tibia, and tarsus. The chaetotaxy on these segments is usually unique and can be used for identification to species level. Each leg terminates with two claws and an empodium with four raylets (Fig. 2D).

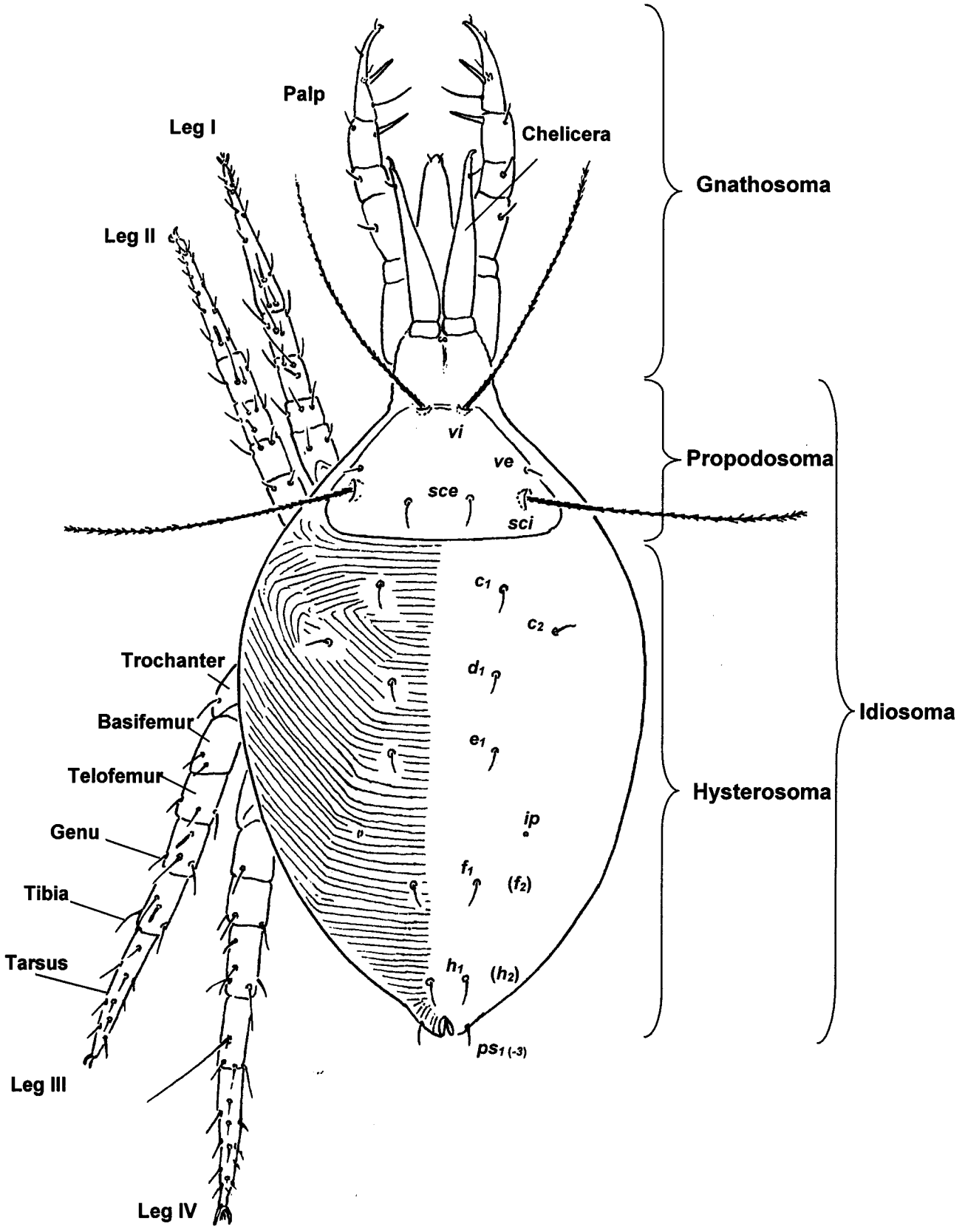

Figure 1. Dorsum of female Cunaxidae, *Cunaxa setirostris* (Hermann). (modified from Shiba, 1976)

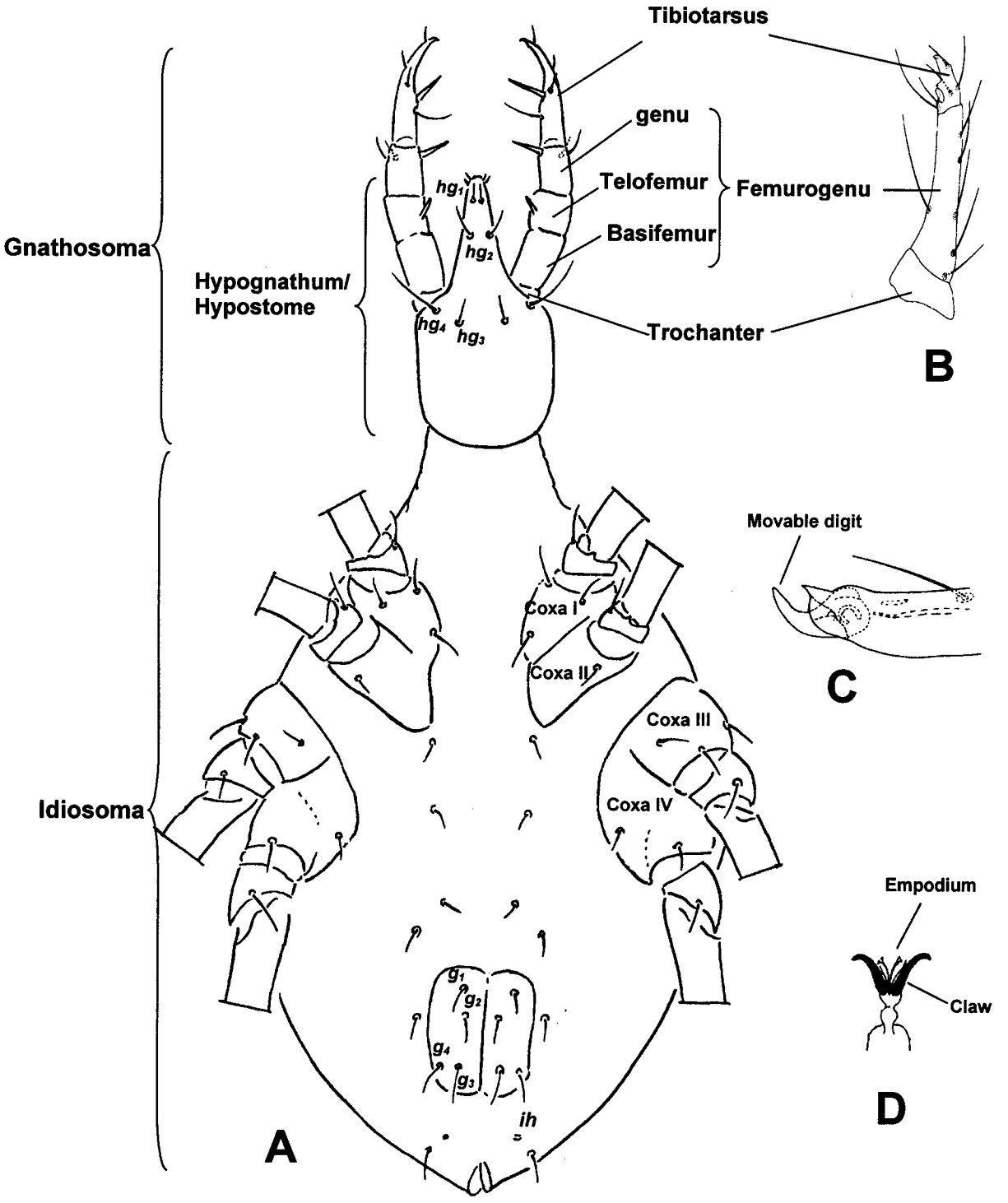

Figure 2. Female Cunaxidae – A, venter of five-segmented palp Cunaxidae, *Cunaxa setirostris* (Hermann); B, three segmented palp; C, tip of chelicera; D, tip of tarsus. (A, modified from Shiba ,1976; B, C, and D, modified from Den Heyer, 1981).

2.3 Biology

Because of their small size, biology and behavior of mites can only be observed in laboratory. Zaher *et al.* (1975) reared *Cunaxa capreolus* (Berlese) at 30 °C on three types of diet, plant materials, booklice, and spider mites, *Eutetranychus orientalis* (Klein). They found that the mite completed a generation in about 4 weeks and each female deposited about 45 eggs. Average prey consumption during development was 230 booklices or 472 spider mites/cunaxid. The mites fed neither on prey eggs nor on several plant diets.

Walter and Kaplan (1991) reported the feeding behavior and live history of a cunaxid mite, *Coleoscirus simplex* (Ewing), that colonized rootknot nematode culture in Florida and reviewed feeding behavior in cunaxid mites. They found, at 28 °C , that females took 10 – 16 days to develop from eggs to adults while males took 10 – 12 days. Mean generation time was 14.3 days. About 4 eggs were laid per day when excess nematode prey. The mite can build a silken web over the entrance to a crevice to protect itself during molting. Egg devolopment to female and male averaged 4.2 $\pm$ 0.2 and 3.6 $\pm$ 0.3 days, repectively, from oviposition to hatch.

In feeding behavioral study, Walter and Kaplan (1991) found that *Coleoscirus simplex* fed on nematodes, lightly sclerotized arthropods, such as juvenile and tenneral adult Oribatida, juvenile Mesostigmata, Eupodidae, and collembola (*Proisotoma* sp. and *Tullbergia* sp.). *Coleoscirus simplex* did not feed on the eggs of either rootknot nematodes or arthropods. *Neoscirula* sp. (Coleoscirinae) and *Pulaeus* sp. (Cunaxoidinae) also fed on both nematodes and arthropods, but three species in the Cunaxinae, *Dactyloscirus inermis* (Tragardh), *Dactyloscirus* sp., and *Cunaxa* sp., fed only on arthropods.

2.4 Cunaxidae in Thailand

The Cunaxidae of Thailand has never been treated taxonomically at all. The previous researchers, on acarine in general, reported only generic and/or family level of these mites. Dr. Edwards W. Baker, during his visiting to Thailand in 1974-1975, examined mite specimens in the collection at the Post-Entry Quarantine Building in Bang Khen. He (Baker, 1975) then reported three species of this family: *Neocunaxoides* sp., *Pseudocunaxa* sp., and *Dactyloscirus* sp.

Vaivanijkul *et al.* (1978) found *Neocunaxoides* sp. on *Anthocephalus cadamba* Miq., in Lumpini Park, Bangkok.

Charanasri (1990) found the Cunaxidae commonly together with mite pests of pomelo from Pichit, Chainat, Nakorn Pathom and Samut Songkhram.

Charanasri *et al.*, (2001) found one species of cunaxid mites on passion fruits (*Passiflora edulis* Sims), and was only 1.47 % of total predatory mites. They also reported that one individual of this cunaxid mites fed on 3.6 tritonymphs of *Tetranychus fijiensis*, a spider mite pest of passion fruit, per day.

As far as I am aware, five species of the family Cunaxidae were formally reported from Thailand. Boonkong *et al.* (1986) recorded two species of this family, *Cunaxa capreolus* (Berlese), and *Cunaxa setirostris* (Herman), among other mites and insects found on stored garlic in Thailand. Smiley (1992) reported *Armascirus taurus* (Kramer) and described two new species, *Cunaxa rackae* and *Cunaxa thailandicus* from Thailand. The two latters were intercepted from plant products exported from Thailand.

CHAPTER 3

MATERIALS AND METHODS

3.1 Materials

1. Field equipments:
    - 1.1 Hand shovel
    - 1.2 Plastic bags
    - 1.3 Beating tray
    - 1.4 Hand lens
    - 1.5 Vials filled with 70% ethanol
    - 1.6 GPS
2. Laboratory equipments:
    - 2.1 Berlese funnels
    - 2.2 Phase contrast microscope mounted with drawing tube.
    - 2.3 Stereo microscopes
    - 2.4 Fiber optic light
    - 2.5 Petri dish
    - 2.6 Painting brush # 0
    - 2.7 0.3 mm sieve
    - 2.8 Saturated NaCl solution
    - 2.9 70% ethanol
    - 2.10 Slide warming plate,
    - 2.11 Oven
    - 2.12 Slides and cover glasses
    - 2.13 Hoyer's solution
    - 2.14 Glyptal and ringing table

3.2 Methods

The Cunaxid mites were collected from various localities in central Thailand (Fig. 3) as defined by Smitinand (1969) on the basis of plant distribution, during October 2002-September 2003. The primary collecting sites include *Citrus* orchards, groves, and the natural forests.

For each collecting sites, plant mites were collected by direct searching on leaves or sampling 30-50 leaves and placed them in the plastic bags with labels. In dry condition, beating technique was also used to collect mites from vegetations.

To collect mites living in soil-litter, at least 5 soil-litter samples (20X20 cm^2 in area, and 5 cm. depth) were collected into plastic bags with labels. The plastic bags were left their mouth open to avoid water condensation inside the bags.

All samples were brought back to the laboratory. The leave samples were examined under stereomicroscope. The mites were transferred to the small vial filled with 70% ethanol by using a moist brush. Berlese funnels (Krantz, 1978) were used to extract mites from soil-litter into 70% ethanol for 7 days. Floating technique with saturated NaCl solution was used to separate microarthropods from soil and debris particles falling into the preserved samples. Separated microarthropods were examined under stereomicroscope to separate cunaxid mites from other animals.

Additional specimens were available from Chulalongkorn University Museum of Natural History and mite collections of the Entomology and Zoology Division, Department of Agriculture, Bang Khen.

Specimen Preparation and Examination.

The cunaxid mites were directly transferred from alcohol to be mounted in Hoyer's medium on a slide. Hoyer's medium was prepared as the following formula:

Distilled water	80 ml.
Gum Arabic	60 g
Chloral Hydrate	400 g.
Glycerine	20 g.

The newly prepared slides were kept in an oven which set a temperature at 48 °C for a week and then ringed the cover glass with the glyptal. The mite specimens were examined with a phase contrast microscope.

Drawings were made from slide-mounted material with the aid of drawing tube mounted with the microscope. Measurements in micrometers (μm) were made

using stage-calibrated ocular micrometer and are presented as ranges, minimum to maximum, and mean in parentheses. The symbol "μm" is omitted. Structure measurements are idiosomal length and width, hypognathum length and width, palpal length, cheliceral length, length of legs (Figs. 1 and 2).

Classification and Identification are based on Smiley (1992) in careful comparison with the original descriptions. General terminology follows Smiley (1992) except the idiosomal chaetotaxy following that of Kethley (1990). Taxonomic characters are described and keys to subfamilies, genera, and species are presented with some discussion on morphology, biology, ecology of the cunaxid mites in central Thailand.

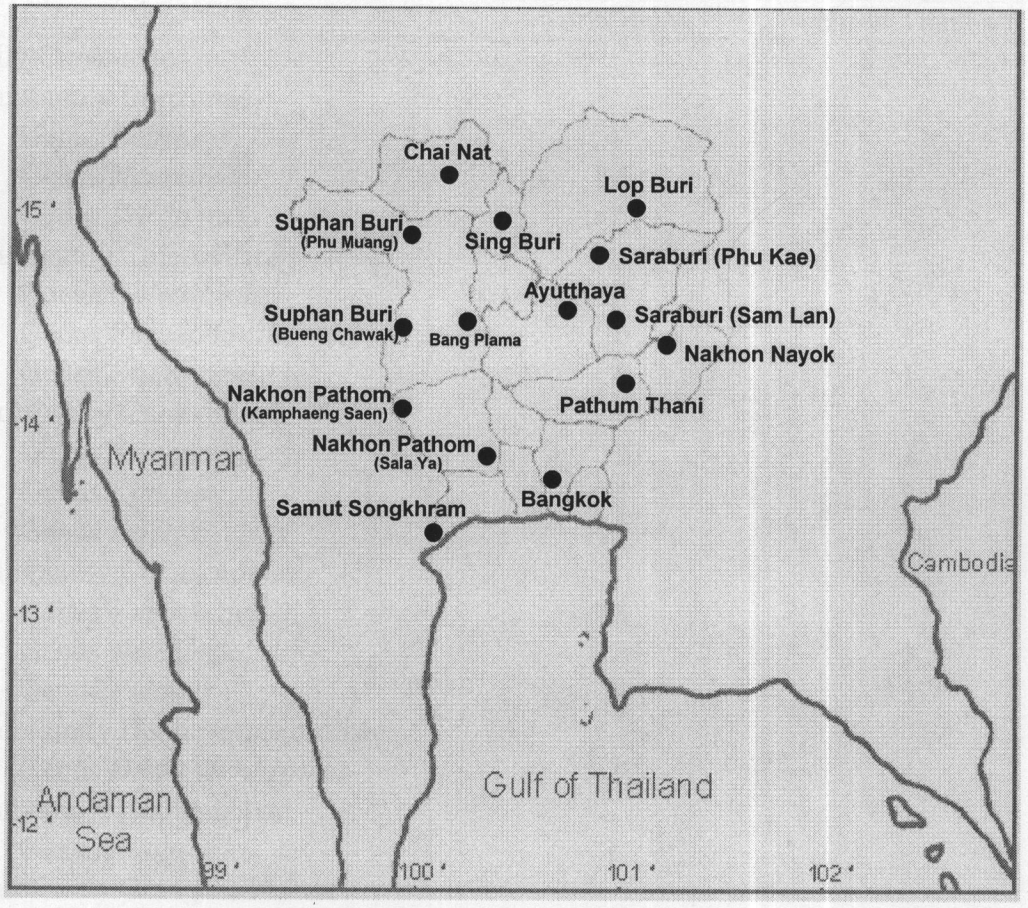

Figure 3. Collecting sites of Cunaxidae in central Thailand.

CHAPTER 4

RESULTS

4.1. Fauna of Cunaxidae in Central Thailand

The numbers of described species to date (March, 2004) are summarized in Table 4-1. Thirty-three species (13.30 % of the world cunaxid fauna) in 9 genera and 4 subfamilies of cunaxid mites were found in this study. Of these, 16 species are recorded for the first time for Thailand and 15 distinct morphotypes which are not fit for any described species are treated here as species 1, 2, 3, and so on.

Table 4-1. Numbers of species belonging to the family Cunaxidae described to date (March, 2004) and numbers of species found in central Thailand.

Taxa	numbers of species	
	world fauna	central Thailand
Family Cunaxidae		
Subfamily Bonziinae		
Genus *Bonzia*	4	-
Genus *Neoscirula*	16	2
Genus *Parabonzia*	7	-
Subfamily Coleoscirinae		
Genus *Coleoscirus*	23	5
Genus *Pseudobonzia*	20	3
Genus *Scutascirus*	7	1
Subfamily Cunaxiinae		
Genus *Armascirus*	12	2
Genus *Cunaxa*	54	9
Genus *Dactyloscirus*	27	2
Subfamily Cunaxoidinae		
Genus *Cunaxoides*	18	-
Genus *Neocunaxoides*	28	4
Genus *Pulaeus*	24	5
Subfamily Denheyernaxoidinae		
Genus *Denheyernaxoides*	2	-
Subfamily Neobonzinae		
Genus *Neobonzia*	1	-
Subfamily Orangescirulinae		
Genus *Orangescirula*	2	-
Subfamily Paracunaxoidinae		
Genus *Paracunaxoides*	1	-
Subfamily Scirulinae		
Genus *Scirula*	2	-
TOTAL	248	33

4.2. Classification of the Predatory Mite Family Cunaxidae in Central Thailand

The predatory mites family Cunaxidae found in this study can be classified as following, based on Smiley (1992)

Phylum Arthropoda
Class Arachnida
Subclass Acari
Order Acariformes
Suborder Prostigmata
Superfamily Bdelloidea

Family Cunaxidae Thor, 1902
Subfamily Bonziinae Den Heyer, 1978
Genus *Neoscirula* Den Heyer, 1977
1. *Neoscirula ogawai* (Shiba, 1976)*
2. *Neoscirula* sp. 1

Subfamily Coleoscirinae Den Heyer, 1978
Genus *Coleoscirus* Berlese, 1916
3. *Coleoscirus bakeri* Corpuz-Raros, 1996*
4. *Coleoscirus simplex* (Ewing, 1917)*
5. *Coleoscirus tuberculatus* Den Heryer, 1978*
6. *Coleoscirus* sp. 1
7. *Coleoscirus* sp. 2

Genus *Pseudobonzia* Smiley, 1975
8. *Pseudobonzia clathratus* (Shiba, 1976)*
9. *Pseudobonzia gruezoi* Corpuz-Raros, 1996*
10. *Pseudobonzia* sp. 1

Genus *Scutascirus* Den Heyer, 1976
11. *Scutascirus pentascutellus* Corpuz-Raros, 1996*

Subfamily Cunaxiinae Oudemans, 1902
Genus *Armascirus* Den Heyer
12. *Armascirus tuarus* (Kramer, 1881)
13. *Armascirus* sp. 1

Genus *Cunaxa* Von Heyden, 1826
14. *Cunaxa grobleri* Den Heyer, 1979 *
15. *Cunaxa lukoschusi* Smiley, 1992 *
16. *Cunaxa romblonensis* Corpuz-Raros and Garcia, 1995 *
17. *Cunaxa setirostris* (Hermann, 1804)
18. *Cunaxa venusae* Corpuz-Raros and Garcia, 1995*
19. *Cunaxa vizcayana* Corpuz-Raros and Garcia, 1995*
20. *Cunaxa* sp. 1
21. *Cunaxa* sp. 2
22. *Cunaxa* sp. 3

Genus *Dactyloscirus* Berlese, 1916
23. *Dactyloscirus* sp. 1
24. *Dactyloscirus* sp. 2

Subfamily Cunaxoidinae Den Heyer, 1979
Genus *Neocunaxoides* Smiley, 1975
25. *Neocunaxoides neopectinatus* (Shiba, 1976)*
26. *Neocunaxoides philippinensis* Corpuz-Raros, 1996*
27. *Neocunaxoides* sp. 1
28. *Neocunaxoides* sp. 2
Genus *Pulaeus* Den Heyer, 1980
29. *Pulaeus lenis* Corpuz-Raros, 1996*
30. *Pulaeus villacarlosae* Corpuz-Raros, 1996*
31. *Pulaeus* sp. 1
32. *Pulaeus* sp. 2
33. *Pulaeus* sp. 3

*First Records for Thailand

Family CUNAXIDAE Thor, 1902

Diagnosis: Chelicerae separated and hinged at base, moving laterally over cone-like gnathosoma. Ventral hypostome with 4-6 pairs of setae. Female genital (except *Parabonzia*) without internal setae or spines. Genital aperture with 2-3 pairs of acetabular. Palpal segment terminating (except *Parabonzia*, not found in this study) with a claw. Palp with strong spines and/or apophysis. Tarsal empodium claw like.

Key to the Subfamilies of Cunaxidae in Central Thailand

1. Palpi five segments.....2
   Palpi three segments.....Cunaxoidinae
2. Tarsi short and stout, without lateral, bilobed flanges terminally.....3
   Tarsi long with lateral, bilobed flanges terminally.....Cunaxiinae
3. Setae hg_1 geniculate; setae f_2 absent.....Bonziinae
   Setae hg_1 simple; setae f_2 present .....Coleoscirinae

Subfamily Bonziinae Den Heyer, 1978

Bonziinae Den Heyer, 1978a: 601; Smiley, 1992: 41.

Diagnosis: Palpi five segmented, Palp telofemur with either a simple seta, a spinelike seta, or a multi-branched seta; apex of tibiotarsus terminating with two stout setae and a claw, usually with tubercles or spinelike processes, or an elongate solenidion. Setae hg_1 usually geniculate, if not they are stronger than other ventral gnathosomal setae. Tarsi I-IV robust and not acutely tapering.

Only one genus was discovered in this study

Genus *Neoscirula* Den Heyer, 1977

Neoscirula Den Heyer, 1977a: 73; Smiley, 1992: 51; Barilo, 1991: 135; Corpuz-Raros, 1996b: 16; Lin and Zhang, 1998: 27; 2002: 146. Type-species: *Neoscirula theroni* Den Heyer, by original designation.

Diagnosis: Palpi five segmented. Distal segment terminating with a long simple seta and a small claw. Claw may sometimes be dentate. Palp telofemur without multi-branched seta but with a slender simple, spinelike or stout simple seta. Setae hg_1 on ventral gnathosoma usally stout, contiguous and geniculate. Dorsal propodosoma with a weakly sclerotized shield, and sometimes with subcuticular reticulations. Dorsal hysterosomal shields absent.

Two species, *Neoscirula ogawai* and 1 unidentified species, of this genus were recognized in this study. A comparison of main characters between them is present in Table 4-2.

1. *Neoscirula ogawai* (Shiba, 1976)

(Figs. 4 and 5)

Coleoscirus ogawai Shiba, 1976: 126.

Neoscirula ogawai: Smiley, 1992: 59; Corpuz-Raros, 1996b: 26.

Diagnosis - This species is recognized from its congeners by the presence of the spinelike seta that is subequal in size to the claw on palp tibiotarsus.

Female – Dimension - Length of idiosoma 215-275 (236.67), width 175-225 (188.67); length of hypognathum 83-88 (86.33), width 65-78 (71.5.5); length of palp

58-63 (59.5); length of chelicera 80-93 (84.67); length of legs: I 165-190 (175); II 150-175 (160); III 160-180 (175); IV 180-215 (199).

Gnathosoma - Hypostome (Fig. 4B) subrectangular, coneshaped distally; ventral surface of hypostome granulated with subcuticular cells and four pairs of *hg* setae, hg_1 longest and geniculate. Palp with five segments (Fig. 4D) and palpal chaetotaxy as follows: Trochanter with no setae; basifemur with one dorsal spinelike seta; telofemur with one dorsal spinelike seta; genu with four simple setae; tibiotarsus with one ventrobasal simple seta, two long simple setae dorsoapically, inner surface with one simple setae and two spinelike setae subequal in size to the calw above. Chelicera with two segments (Fig. 4D), segment I and dorsobasal half of segment II granulated; subterminal seta behind chela not discernable.

Dorsum (Fig. 4A) – Propodosoma with a finely granulated shield bearing two pairs of sensillar setae, setae *ve* and *sce*, *ve* about two times *sce*; Dorsal hysterosoma without any shields. Hysterosomal surface striate, complemented with hysterosomal setae c_1, c_2, d_1, e_1, f_1, h_1, and h_2, and a pair of cupule *ip*. Setae f_1 and h_1 subequal in length.

Venter (Fig. 4B) – Coxae I-II and Coxae III-IV contiguous and surface finely broken striate and granulate; coxae I-II forming pentagonal-shaped sternal shield bearing seven pairs of setae (including coxal setae) and subcuticular cells; coxae III-IV forming lateral plates with three pairs of setae each; genital plates finely granulate with four pairs of simple setae, g_4 longest, arranged as shown in figure 4B; four pairs of simple setae on membrane between ventral shields; anal region with three pairs of anal setae ps_1, ps_2, and ps_3, and one pair of cupule *ih*.

Legs (Fig. 5) – All legs shorter than idiosoma; tarsi I-IV stout and without terminal lateral lobes. Number of setae on leg segments I-IV as follows: Coxae 3-3-3-3; trochanters 1-1-2-1; basifemora 4-5-3-1; telofemora 5-5-4-3; genu I, 3 attenuate solenidia, 1 micrcroseta + 4; genu II, 2 attenuate solenidia + 5; genu III, 1 attenuate solenidion + 5; genu IV, 2 attenuate solenidion 5; tibia I, 2 attenuate solenidia + 5; tibia II, 1 blunt solenidion + 5; tibia III, 1 attenuate solenidion + 5; tibia IV, 1 trichobothrium + 4; tarsi I, 2 attenuate solenidia, 2 blunt solenidia, 1 peglike seta, + 24 [including "dt" and "tsl" of Den Heyer (1979a)]; tarsi II, 1 blunt solenidion + 24; tarsi III, 21; tarsi IV, 18.

Male – Similar to female in having the strongly developed Coxae III and IV and short palpi with some stout setae.

Type – Female Holotype, Port Dickson, Negeri Sembilan, Malaysia, in litter from intertidal zone, 26. II. 1971, by M. Shiba. Type deposited in the biological laboratory, Matsuyama Shinonome Junior College, Matsuyama, Japan.

Material examined - 6FF, Pho Chon Kai, Bang Rachan, Sing Buri, on banana litter, 20. X. 2002; 4FF, as previous data but on bamboo litter; 10FF, as previous data but on unknown litter; 1F, as previous data but in a termite nest; 10FF, Pho Chon Kai, Bang Rachan, Sing Buri, on litter *Streblus asper* Lour., 17. X. 2002; 1F, Phu Kae Botanical Garden 14°40′30′′N 100°53′10′′E, on litter, 7. IV. 2003; 1F, Sala Loy, Tha Ruae, Ayutthaya 14°31′75′′N 100°42′26′′E, alt. 27 m., on litter under *Tamarindus indicus*, 23. III. 2003, by; 1F, Kaeng Sam Chan, Sarika, Nakhon Nayok 14° 18′05′′N 101°18′17′′E, on litter under *Citrus grandis*, 7. VI. 2003; 3FF, as previous data but on 6. IX. 2003; 1F, near Sam Lan waterfall, Saraburi 14°25′56′′N 100°57′51′′E, on forest litter, 7. IV. 2003; 18FF, near Sarika waterfall, Nakhon Nayok 14°18′17′′N101°15′33′′E, on forest litter, 7. IV. 2003; 1F, Bang Khan Taek, Samut Songkhram, on coconut litter, 23. VI. 2002; 10FF, Bang Khan Taek, Samut Songkhram, on litter under *Citrus grandis*, 6. IX. 2002; 2FF, as previous data but on litter of *Leucaena leucocephala*; 4FF, Chulalongkorn University Campus, on litter under *Delonix* sp., 9. VII. 2002; 1F, Khlong Sip Song, Pathum Thani, 14°06′42′′N 100°52′37′′E, on *Acacia* sp. litter, 16. IX. 2003.

Distribution: Malaysia; The Philipines; Thailand, additional localities from this study (Fig. 8): Ayutthaya, Bangkok, Nakhon Nayok, Samut Songkhram, Saraburi, Sing Buri.

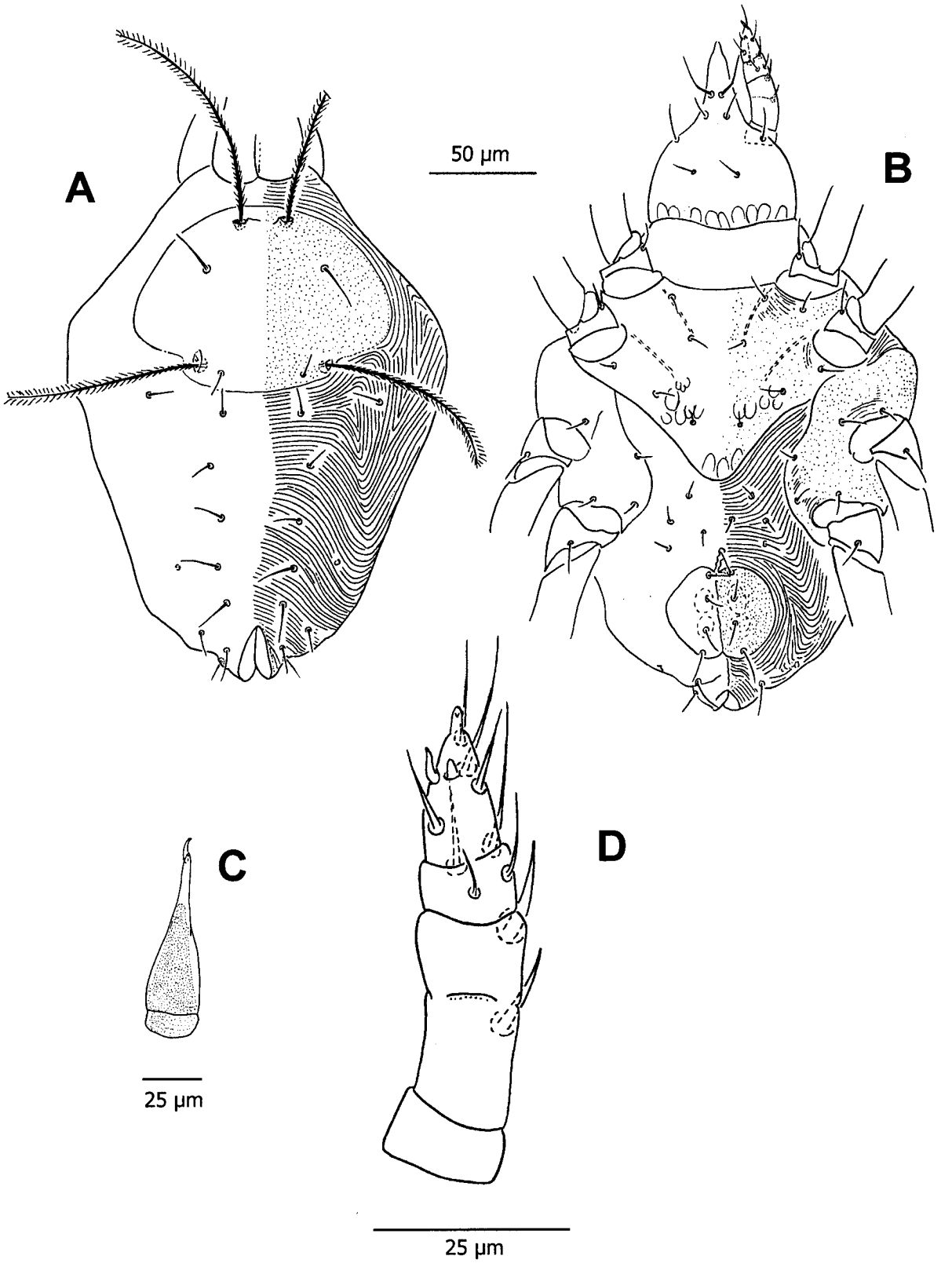

Figure 4. *Neoscirula ogawai*, female – A, dorsum; B, venter; C, chericera; D, palp.

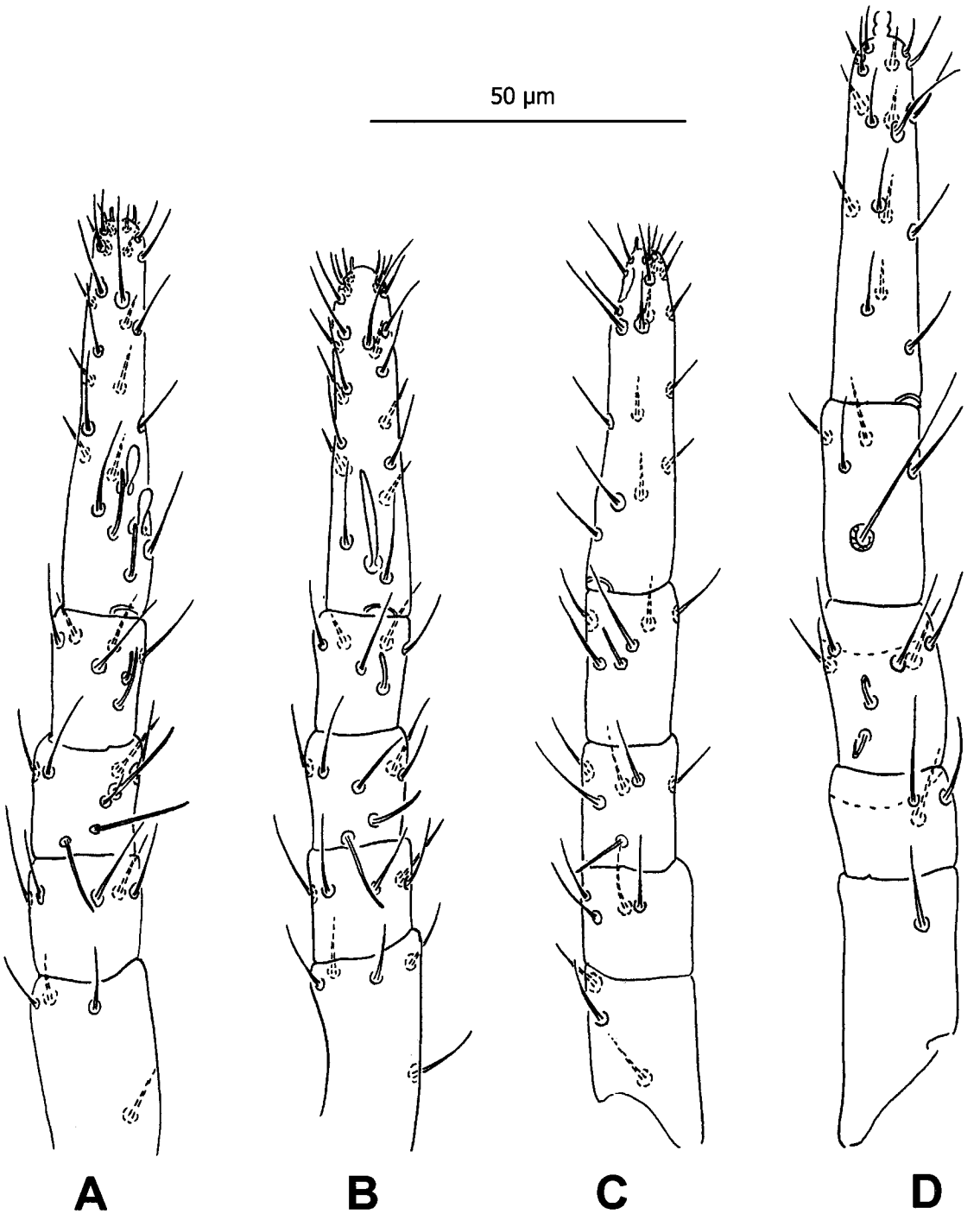

Figure 5. *Neoscirula ogawai,* female – A, leg I; B, leg II; C, leg III; D, leg IV.

2. *Neoscirula* sp. 1

(Figs. 6 and 7)

Diagnosis - This species is most similar to *N. theroni* Den Heyer, 1977a, in having an indistinctly demarcated propodosomal shield. It may be separated from the latter by the bidentate claw on palp tibiotarsus and the globular solenidia on tarsi I.

Female – Dimension (n=1) - Length of idiosoma 210, width 150; length of hypognathum 78, width 60; length of palp 53; length of chelicera 75; length of legs: I 150; II 135; III 145; IV 165.

Gnathosoma - Hypostome (Fig. 6B) subrectangular, coneshaped distally; ventral surface of hypostome granulated with subcuticular oval cells and four pairs of *hg* setae, hg_1 longest and slightly geniculate. Palp with five segments (Fig. 6C) and palpal chaetotaxy as follows: Trochanter with no setae; basifemur with one dorsal simple seta; telofemur with one dorsal simple seta; genu with four simple setae; tibiotarsus dorsoapically with two long simple setae, ventrolaterally with one simple setae, inner surface with one basal simple setae and two short simple setae below the bidentated claw. Chelicera with two segments (Fig. 6E), segment I and II granulated, one subterminal seta behind chela.

Dorsum (Fig. 6A) – Propodosoma with a propodosomal shield, the posterior edge clearly demarcated but anteriorlateral edges merging into integument and indistinctly demarcated; the remain portion of the shield finely granulated; the shield bearing two simple propodosomal setae, *ve* and *sce*, and two pairs of sensillar setae. Setae *ve* and *sce* subequal. Hysterosoma without any shields, surface striate and densely granulated, complemented with hysterosomal setae c_1, c_2, d_1, e_1, f_1, h_1, and h_2, and a pair of cupule *ip*. Setae f_1 and h_1 subequal.

Venter (Fig. 6B) – Coxae I-II and Coxae III-IV contiguous and surface finely broken striate and granulated; coxae plate I+II of each side separated by a narrow striae and fused anteriorly, with subcuticular cells; coxae III-IV forming lateral plates with three pairs of setae each; genital plates finely granulate with four pairs of simple setae, arranged as shown in figure 6; seven pairs of simple setae on membrane between ventral shields; anal region with two pairs of anal setae ps_1 and ps_2, and one pair of cupule *ih*.

Legs (Fig. 7) – All legs shorter than idiosoma; tarsi I-IV stout and without terminal lateral lobes. Number of setae on leg segments I-IV as follows: Coxae 3-3-3-3; trochanters 1-1-2-1; basifemora 4-5-3-1; telofemora 5-5-4-3; genu I, 4 attenuate

solenidia, 1 microseta + 4; genu II, 3 attenuate solenidia + 5; genu III, 1 attenuate solenidion + 5; genu IV, 2 attenuate solenidion 5; tibia I, 2 blunt solenidia + 5; tibia II, 1 blunt solenidion + 5; tibia III, 1 blunt solenidion + 5; tibia IV, 1 trichobothrium + 4; tarsi I, 2 attenuate solenidia, 2 globular head solenidia, 1 peglike seta, + 23 [including "dt" and "tsl" of Den Heyer (1979a)]; tarsi II, 1 blunt solenidion + 23; tarsi III, 17; tarsi IV, 18.

Male – Unknown.

Material examined - 1F, Pho Chon Kai, Bang Rachan, Sing Buri, on banana litter, 20. X. 2002.

Distribution – Thailand, additional localities from this study (Fig. 8): Sing Buri.

Table 4-2. Comparison of main characters between species belonging to the genus *Neoscirula*

Characters	*N. ogawai*	*N.* sp. 1
apical seta on inner surface of palp tibiotarsus	clawlike	simple
terminal claw of tibiotarsus	normal	bidentate
lateral edge of propodosomal shield	distinctly defined	indistinctly define
ratio *ve/sce*	2	1
sternal shield	undivided	divided
numbers of ventral setae on membrane	4 pairs	7 pairs
genital shield	granulate	granulate
chaetotaxy of basifemora I-II-III-IV	4-5-3-1	4-5-3-1
chaetotaxy of telofemora I-II-III-IV	5-5-4-3	5-5-4-3
number of solenidia on genu I-II-III-IV	3-2-1-2	4-3-1-2
number of solenidia on tibia I-II-III-IV	2-1-1-0	2-1-1-0

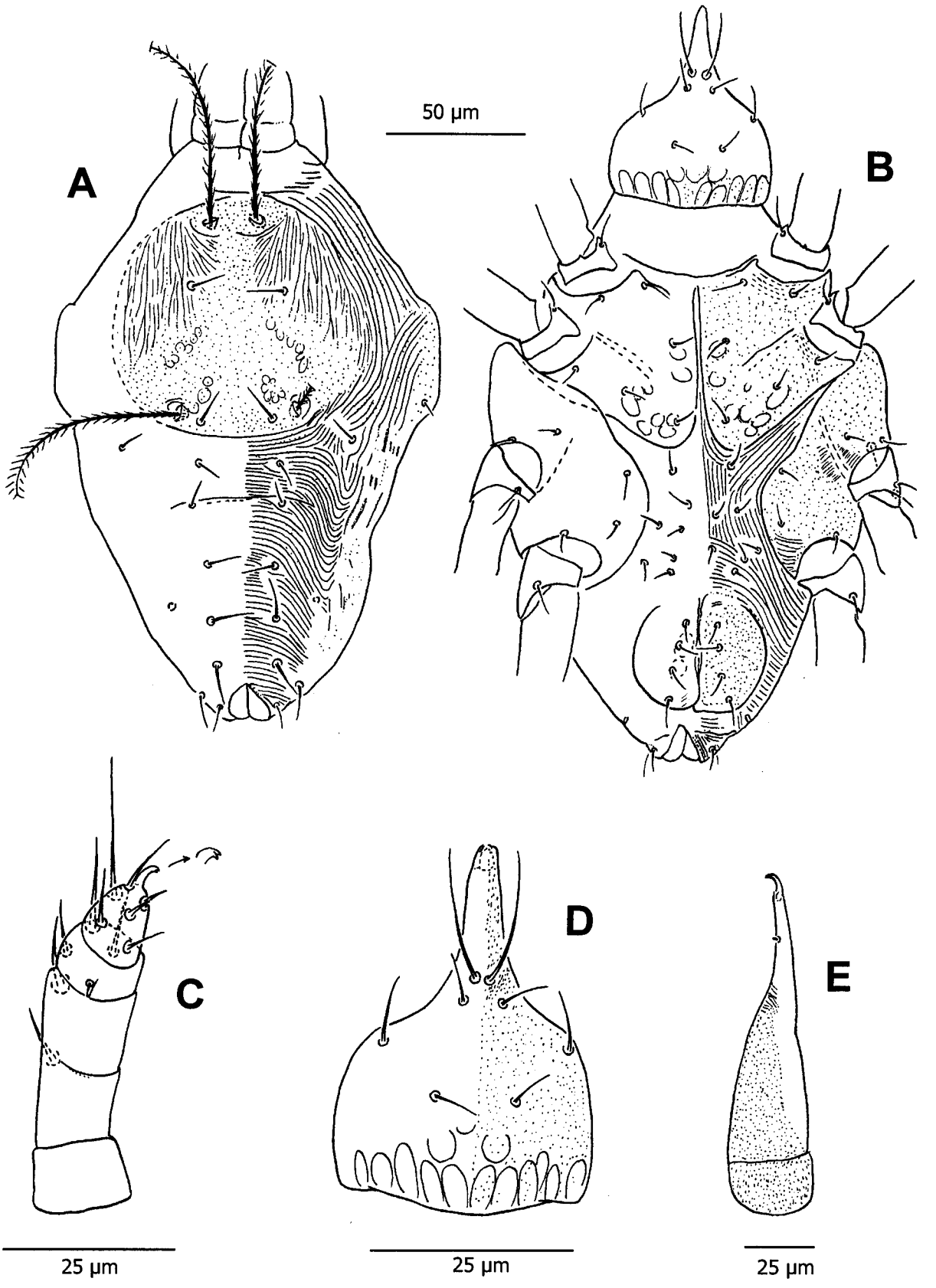

Figure 6. *Neoscirula* sp.1, female – A, dorsum; B, venter; C, palp; D, ventral hypostome; E, chelicera.

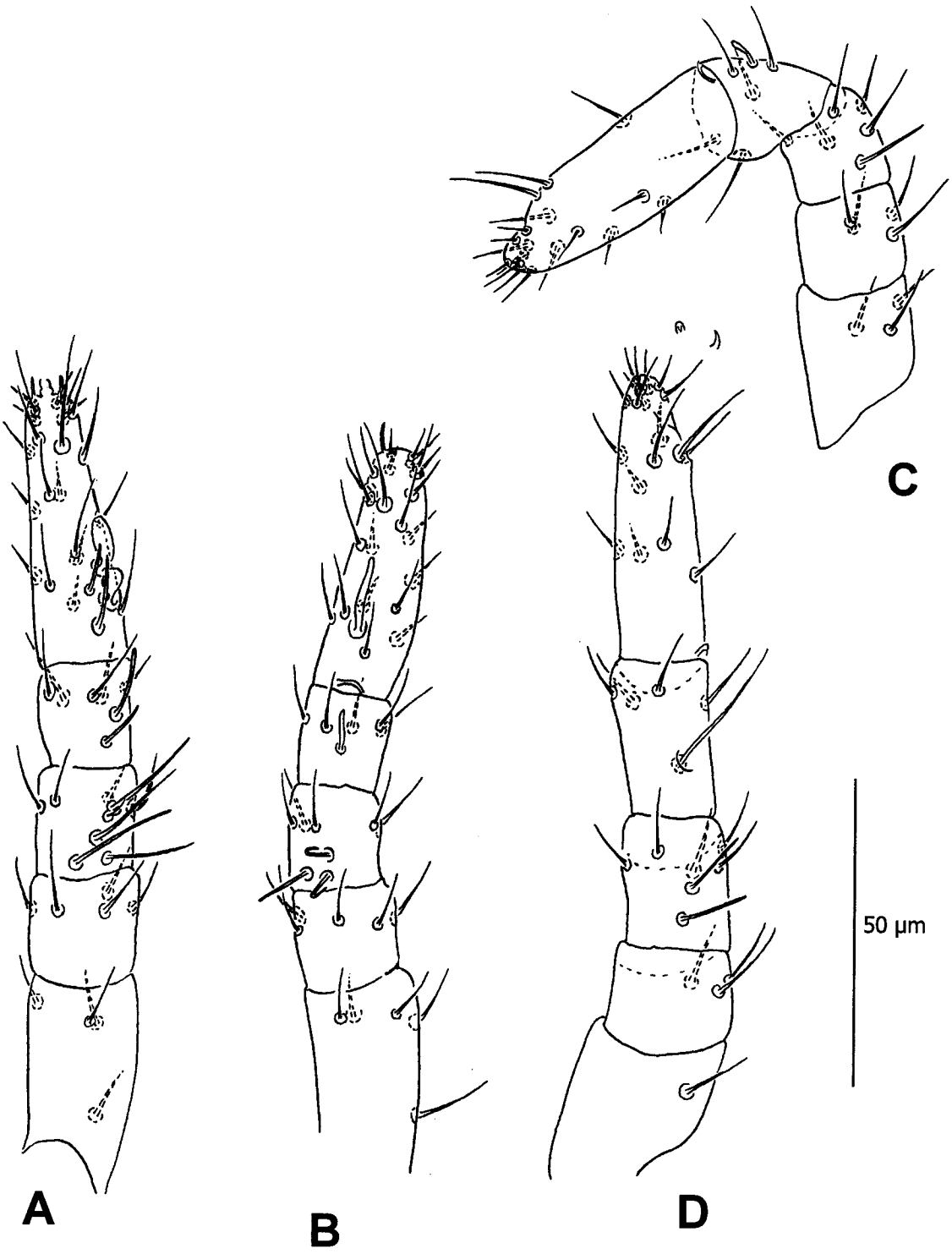

Figure 7. *Neoscirula* sp. 1, female – A, leg I; B, leg II; C, leg III; D, leg IV.

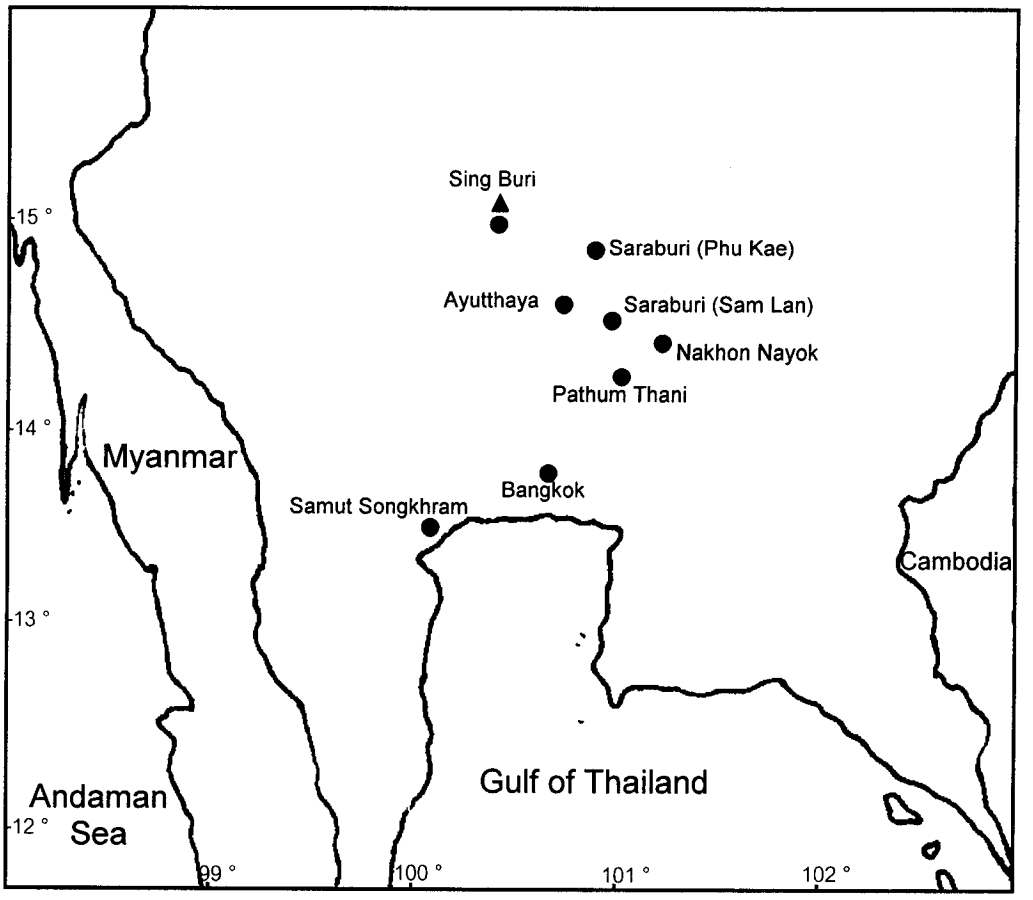

Figure 8. Collecting sites of *Neoscirula ogawai* (circle), and *Neoscirula* sp.1 (triangle) in central Thailand.

Subfamily Coleoscirinae Den Heyer, 1978

Coleoscirinae Den Heyer, 1978c: 522.

Diagnosis – Palpi five segments; distal apex of tibiotarsus terminating with a long seta and small claw. Setae hg_1- hg_4 simple, setae f_2 present; Tarsi I-IV stout and without terminal lateral lobes.

Key to the Genera of the Coleoscirinae

1. Ventral idiosoma with subtriangular plates adjacent to ventrolateral coxal and genital plates.....*Scutascirus* Den Heyer
   Ventral idiosoma without subtriangular plates adjacent to ventrolateral coxal and genital plates.....2
2. Dorsum with a single shield extending from propodosoma into hysterosomal region.....*Coleoscirus* Berlese
   Dorsum with a single shield confined to propodosomal region .....
   .....*Pseudobonzia* Smiley

Genus *Coleoscirus* Berlese, 1916

Scirus Hermann, 1804: 60; Berlese, 1888a: 188; 1905: 231; 1910: 199; Ewing, 1917: 150. Type species: *Scirus longirostris* Hermann by original designation.

Coleoscirus Berlese, 1916: 131; Thor and Willmann, 1941: 175; Baker and Hoffmann, 1948: 252; Beker and Wharton, 1952: 193; Smiley, 1975: 225; Den Heyer, 1978c: 522; 1980c: 4; Shiba, 1976: 126; Sepasgosarian, 1984: 136; Muhammad and Chaudhri, 1992: 309; Smiley, 1992: 75; Corpuz-Raros, 1996a: 1; Type species: *Coleoscirus halacaroides* Berlese.

Pseudocunaxa Smiley, 1975: 241; Den Heyer, 1980c: 5; Sepasgosarian, 1984: 138; Inayatullah and Shahid, 1993: 315. Type species: *Scirus simplex* Ewing, by original designation.

Lapicunaxa Tseng, 1980: 262. Type species: *Lapicunaxa horidula* Tseng by original designation.

Diagnosis: Palpi five segments and without apophysis, the body is strongly sclerotized and is coverd by one dorsal shield extending from propodosoma into hysterosomal regions. Ventral hysterosoma without subtriangular plates adjacent to ventrolateral coxal and genital plates. Setae ps_3 absent.

Five species, 3 described species and 2 unidentified species, are recognized in this study. Key to described species found in central Thailand is present below and a comparison between these five species is given in Table 4-4.

Key to the Species of *Coleoscirus* in Central Thailand

1. Dorsal plate bearing 4 pairs of hysterosomal setae.....2
   Dorsal plate bearing more than 4 pairs of hysterosomal setae.....*C. simplex*
2. Palpal basifemur with a simple seta; Palpal tibiotarsus medially with a large tubercle.....*C. tuberculatus*
   Palpal basifemur with a spinelike seta; Palpal tibiotarsus medially with a small tubercle.....*C. bakeri*

3. *Coleoscirus bakeri* Corpuz-Raros, 1996

(Figs. 9 and 10)

Coleoscirus bakeri Corpuz-Raros, 1996a: 5.

Diagnosis – The species is distinguished from other species of the genus by having four pairs of dorsal hysterosomal setae (c_1, c_2, d_1 and e_1) on the dorsal shield, and dorsal spinelike seta on palp basifemur and simple seta on telofemur.

Female – Dimension - Length of idiosoma 390-460 (435.83), width 260-280 (274.17); length of hypognathum 183-190 (187), width 108-120 (115.67); length of palp 168-180 (174.67); length of chelicera 173-180 (176); length of legs: I 280-290 (282); II 270-280 (275); III 305-310 (308); IV 335-340 (338).

Gnathosoma – Hypostome (Fig. 9D) subregtangular and coneshape distally; ventral surface of hypostome granulated with four pairs of *hg* setae, hg_4 longest, and two pairs of adoral setae. Palp with five segments (Fig. 9E) and palpal chaetotaxy as follows: Trochanter with no setae; basifemur with one dorsal spinelike seta; telofemur with one dorsal slender simple seta; genu with four simple setae; tibiotarsus with four simple setae, and one medial tubercle on inner margin, terminating with one long seta and a tridentate claw. Chelicera with two segments (Fig. 9C), segment I and II granulated, one long simple subterminal seta behind chela.

Dorsum (Fig. 9A) – Propodosoma with single finely granulated dorsal shield extending into hysterosoma region, bearing two pairs of simple propodosomal setae *ve* and *sce*, two pairs of setose sensillae and four pairs of dorsal simple hysterosomal

setae c_1, c_2, d_1, and e_1; the posterior edge of the shield slightly concave; integument outside shield striate and granulated, bearing setae f_1, f_2, h_1, and h_2; setae f_1 subequal to f_2; the cupules *ip* posteriorlaterad of e_1.

Venter (Fig. 9B) – Coxae I-II forming a sternal shield, granulated and with seven pairs of setae (including coxal setae); coxal III-IV forming a separated lateral shield on each side with six pairs of setae (including coxal setae) each; genital shields granulated with four simple setae, g_4 longest, arranged as shown in figure 9B; six pairs of simple setae on integument between these shields; anal region with two pairs of anal setae, ps_1 and ps_2.

Legs (Fig. 10) – All leg shorter than idiosoma. Tarsi I-IV stout and without terminal lateral lobes. Number of setae on leg segments I-IV as follows: Coxae 3-3-3-3; trochanters 1-1-2-1; basifemora 5-6-5-2; telofemora 5-5-4-3; genu I, 4 attenuate solenidia, 1 micrcroseta + 4; genu II, 2 attenuate solenidia, 1 blunt solenidion + 5; genu III, 1 attenuate solenidion + 5; genu IV, 2 attenuate solenidia + 5; tibia I, 1 blunt solenidion, 1 attenuate solenidion + 5; tibia II, 1 short blunt solenidion + 5; tibia III, 1 short blunt solenidion + 5; tibia IV, 1 trichobothrium + 4; tarsi I, 2 blunt solenidia, 2 attenuate solenidia, 1 peg-like seta + 24 [including "dt" and "tsl" of Den Heyer (1979a)]; tarsi II, 1 blunt solenidion + 24; tarsi III, 20; tarsi IV, 21.

Male - Unknown

Type – Female Holotype, Mt. Makiling at Bagong Silang, Los Banos, Laguna, on decomposing log, 27. V. 1993, by R. C. Garcia. Type deposited in the Museum of Natural History of University of The Philippines.

Material examined - 4FF, Bang Khan Taek, Samut Songkhram 13°22′39′′ N 99°57′18′′E, on soil-litter under *Citrus grandis*, 6. IX. 2002; 1FF, Bang Khan Taek, Samut Song Khram, on coconut litter, 23. VI. 2002; 1FF, Pho Chon Kai, Bang Rachan, Sing Buri, on banana leaf litter, 20. X. 2002.

Distributions – The Philippines; Thailand, additional localities from this study (Fig. 11): Sing Buri and Samut Songkhram.

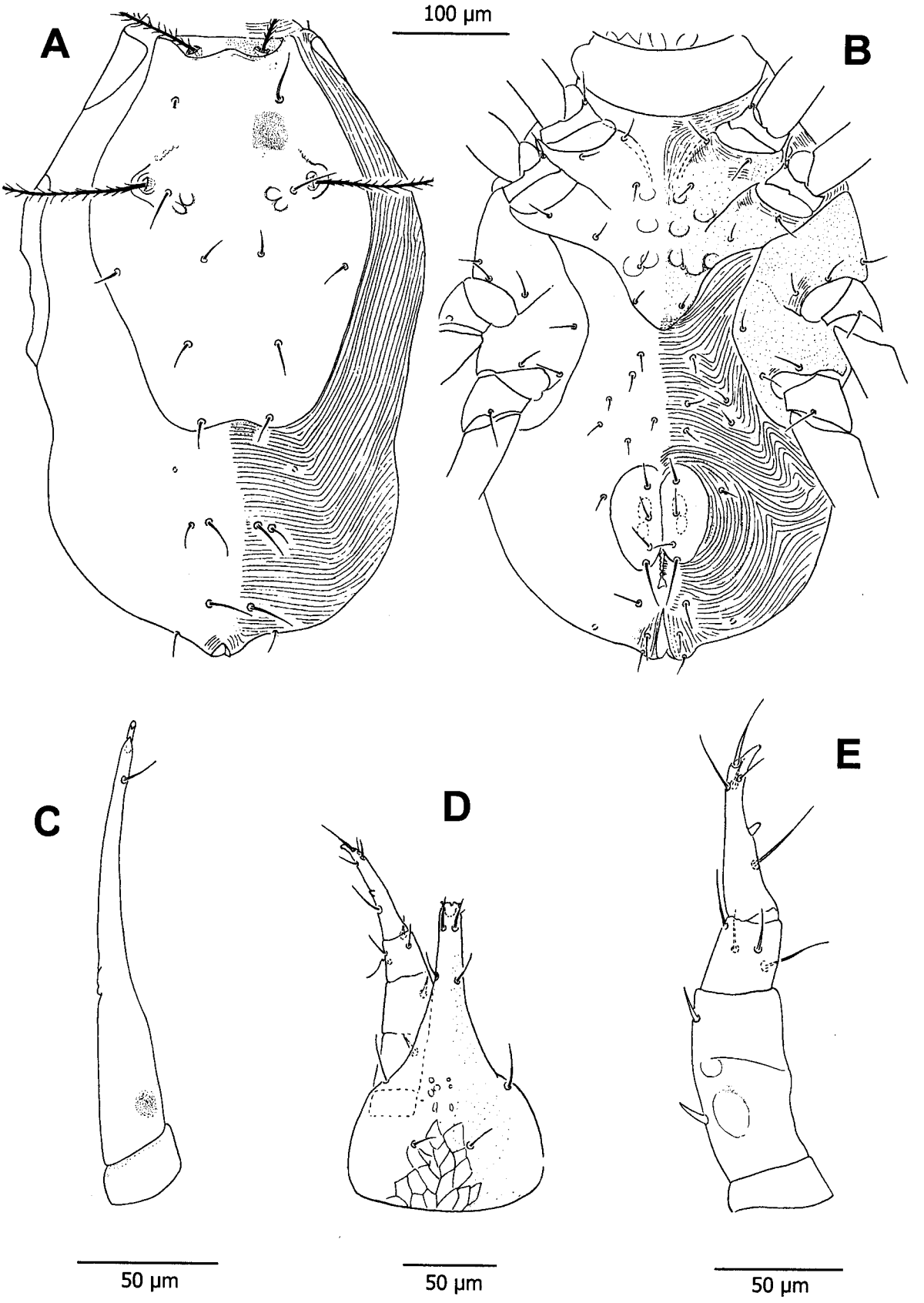

Figure 9. *Coleoscirus bakeri*, female – A, dorsum; B, venter; C, chelicera; D, ventral hypostome; E, palp.

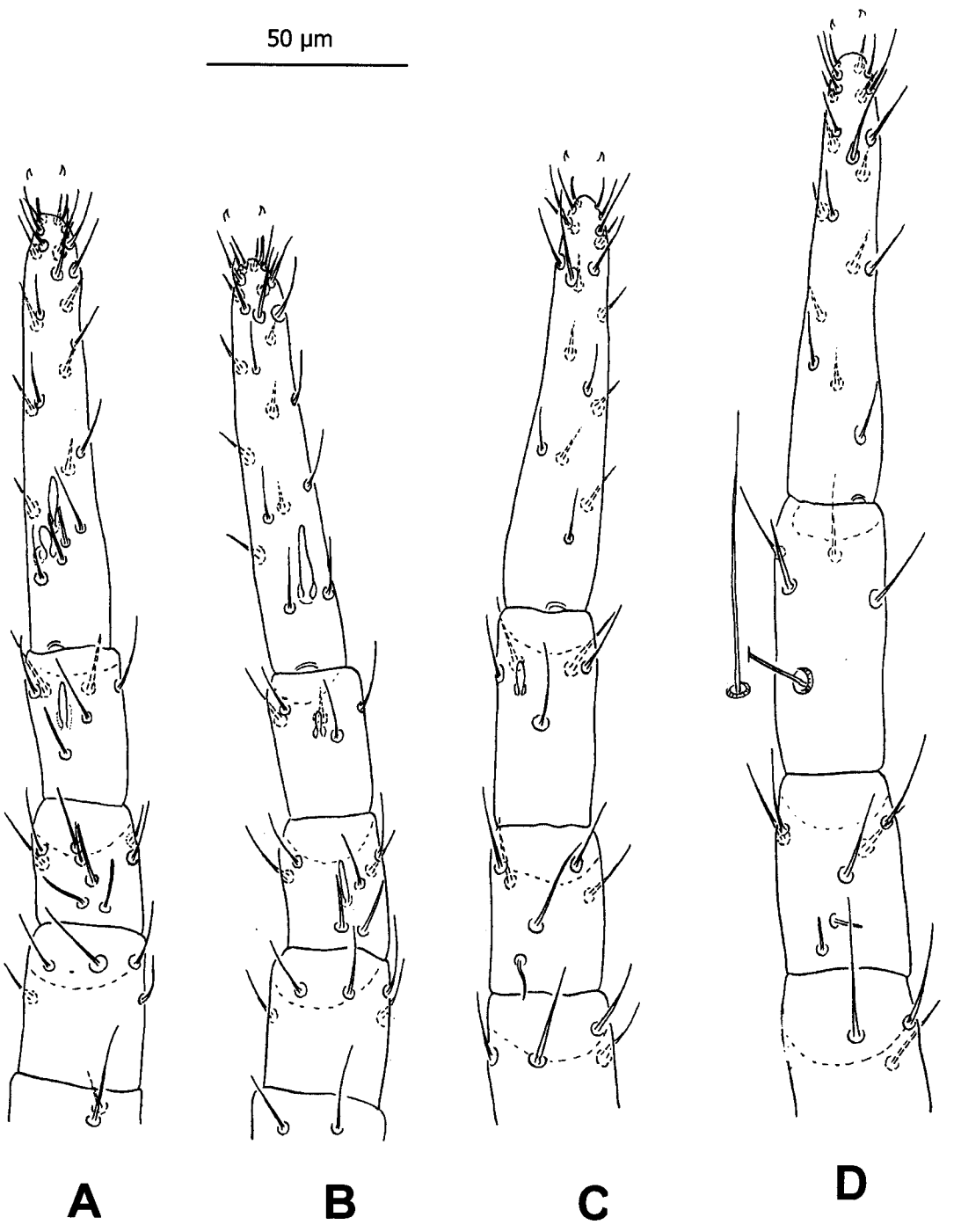

Figure 10. *Coleoscirus bakeri*, female – A, leg I; B, leg II; C, leg III; D, leg IV.

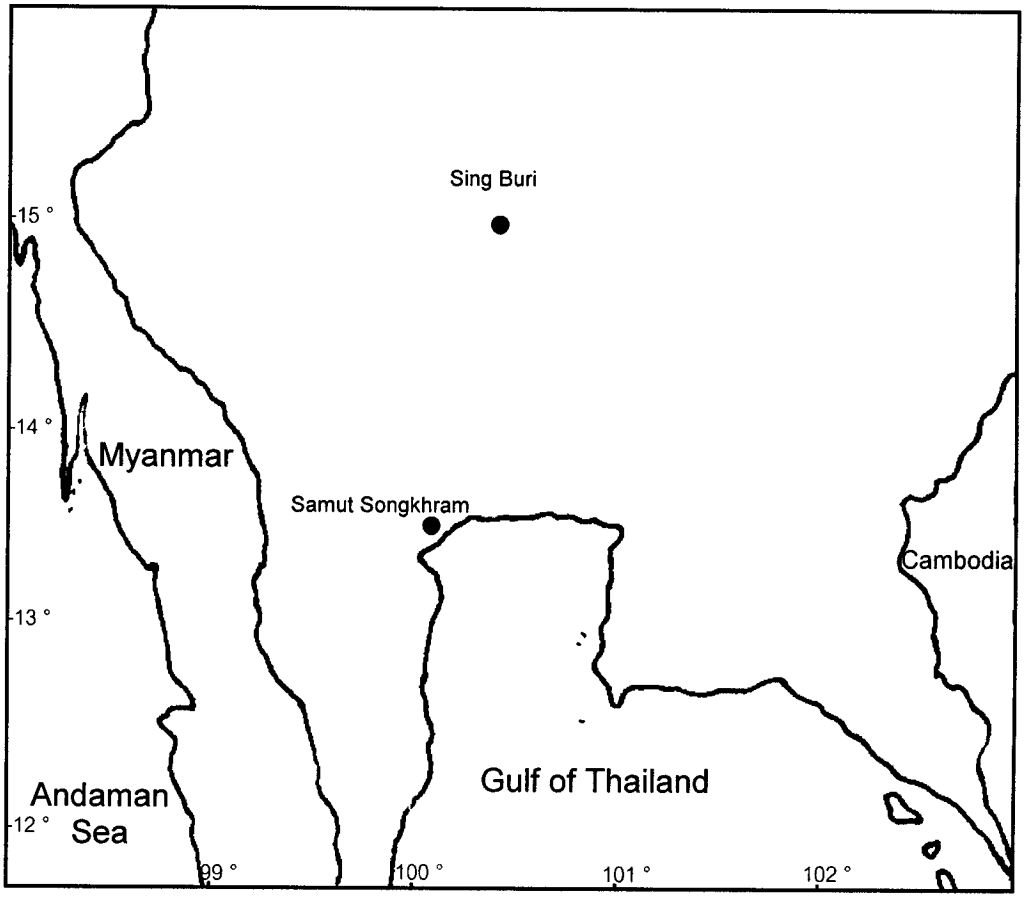

Figure 11. Collecting sites of *Coleoscirus bakeri* in central Thailand.

4. *Coleoscirus simplex* (Ewing, 1917)

(Figs. 12 and 13)

Scirus simplex Ewing, 1917: 150.

Cunaxa simplex, Thor and Willmann, 1941: 172; Baker and Hoffmann, 1948: 240; Muma, 1960: 324; Shiba, 1976: 114.

Pseudocunaxa simplex Smiley, 1975: 241; Sepasgosarian, 1984: 138.

Coleoscirus simplex Den Heyer, 1978a: 522; 1980e: 105; Sepasgosarian, 1984: 143; Smiley, 1992: 92; Corpuz-Raros, 1996a: 20.

Coleoscirus magadalenae Den Heyer, 1978a: 524; 1980e: 106.

Diagnosis – This species is distinguished from its congeners by the presence of five pairs of dorsal hysterosomal setae (c_1, c_2, d_1, e_1 and f_1) on dorsal shield and six pairs of setae on membrane between ventral shields. Setae f_1 and f_2 are subequal in length.

Female – Dimension - Length of idiosoma 410-450 (436), width 270-300 (284); length of hypognathum 190-205 (199.17), width 113-125 (120.17); length of palp 175-193 (184.83); length of chelicera 180-190 (186.33); length of legs: I 285-310 (186.33); II 275-300 (284); III 300-325 (311.25); IV 325-360 (339.17).

Gnathosoma – Hypostome (Fig. 12D) subregtangular and coneshape distally; ventral surface of hypostome granulated with four pairs of *hg* setae, hg_4 longest, and two pairs of adoral setae. Palp with five segments (Fig. 12E) and palpal chaetotaxy as follows: Trochanter with no setae; basifemur with one dorsal simple seta; telofemur with one dorsal simple seta; genu with four simple setae; tibiotarsus with four simple setae, and one tubercle on inner margin, terminating with one long seta and a tridentate claw. Chelicera with two segments (Fig. 12C), segment I and II granulated, one long simple subterminal seta behind chela.

Dorsum (Fig. 12A) – Propodosoma with single granulated dorsal shield extending into hysterosoma region, bearing two pairs of simple propodosomal setae *ve* and *sce*, two pairs of setose sensillae and five pairs of dorsal simple hysterosomal setae c_1, c_2, d_1, e_1 and f_1; integument outside shield striate and granulated, bearing setae f_2, h_1, and h_2; setae f_1 subequal to f_2; the cupules *ip* anteriorlateral to f_2.

Venter (Fig. 12B) – Coxae I-II forming a sternal shield, granulated and with seven pairs of setae (including coxal setae); coxal III-IV forming a separated lateral

shield on each side with six pairs of setae (including coxal setae) each; genital shields granulated with four simple setae, g_4 longest, arranged as shown in figure 12B; twelve simple setae on integument between these shields; anal region with two pairs of anal setae, ps_1 and ps_2.

Legs (Fig. 13) – All leg shorter than idiosoma. Tarsi I-IV stout and without terminal lateral lobes. Number of setae on leg segments I-IV as follows: Coxae 3-3-3-3; trochanters 1-1-2-1; basifemora 5-6-5-2; telofemora 5-5-4-3; genu I, 4 attenuate solenidia, 1 micrcroseta + 4; genu II, 3 attenuate solenidia + 5; genu III, 1 attenuate solenidion + 5; genu IV, 2 attenuate solenidia + 5; tibia I, 1 blunt solenidion, 1 attenuate solenidion + 5; tibia II, 1 short blunt solenidion + 5; tibia III, 1 short blunt solenidion + 5; tibia IV, 1 trichobothrium + 4; tarsi I, 2 blunt solenidia, 2 attenuate solenidia, 1 peg-like seta + 22 [including "dt" and "tsl" of Den Heyer (1979a)]; tarsi II, 1 blunt solenidion + 22; tarsi III, 19; tarsi IV, 19.

Male – Thai materials unknown

Type – Female Holotype, Urbana, Illinois, US, in refuse hog hair, 24. VI. 1909, by J. Zetek. Type deposited in the United State National Museum, Acari Collection.

Material examined - 2FF, Bang Khan Taek, Samut Songkhram 13°22′39′′ N 99°57′18′′E, on litter under *Citrus grandis*, 25. III. 2003; 10FF, as previous data but on decomposing grass; 1FF, Pho Chon Kai, Bang Rachan, Sing Buri 15°10′16′′ N 100°05′33′′E, alt. 27 m., on *Tamarindus indicus* litter, 20. X. 2002.

Distributions – USA; Mexico; Guam; Japan; Tahiti; South Africa; The Philippines; Thailand, additional localities from this study (Fig. 14): Samut Songkhram and Sing Buri.

Remarks – Numbers of setae on membrane between ventral shields of Thai specimens vary from 11 – 14 setae.

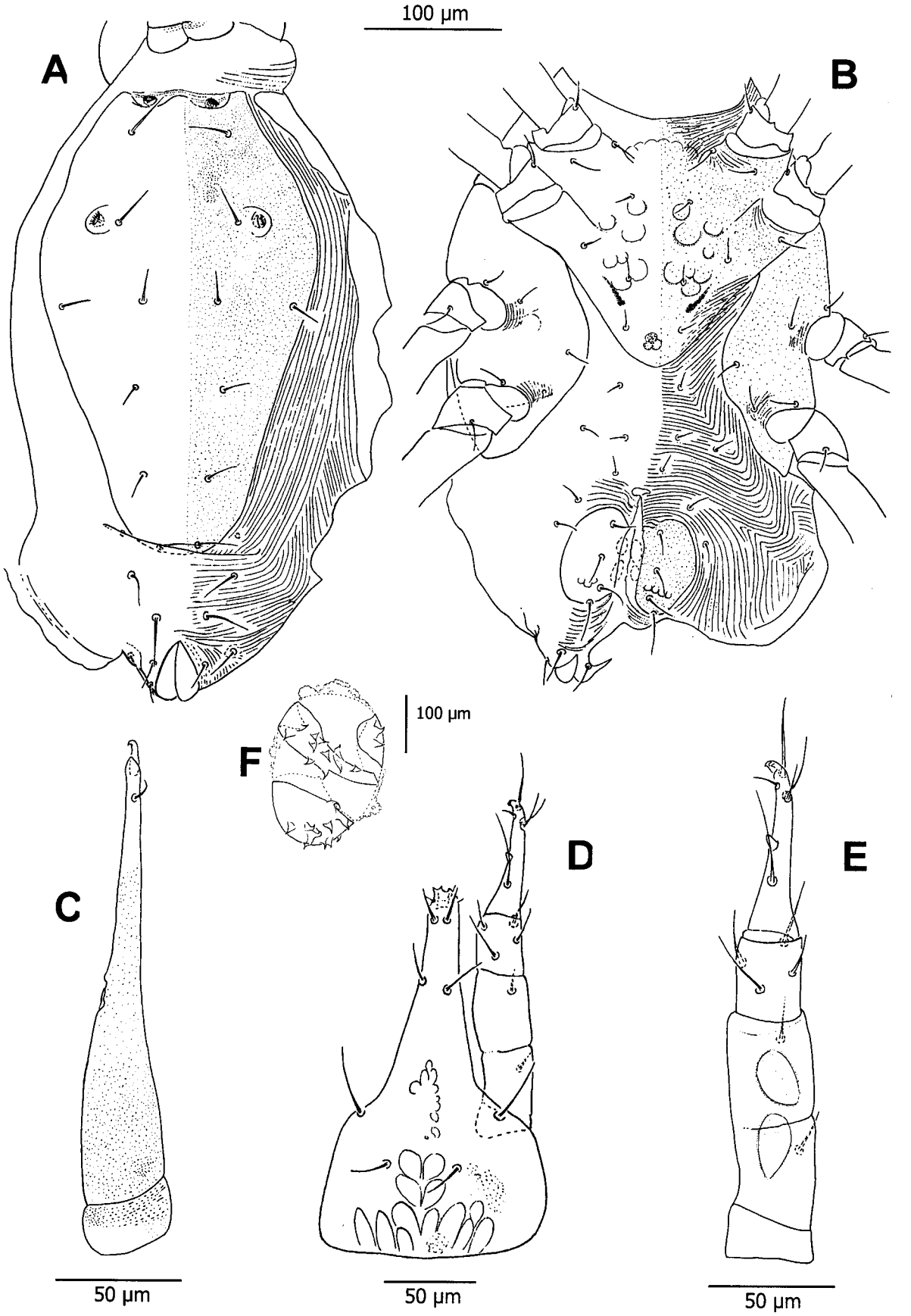

Figure 12. *Coleoscirus simplex,* female – A, dorsum; B, venter; C, chelicera; D, ventral hypostome; E, palp; F, egg.

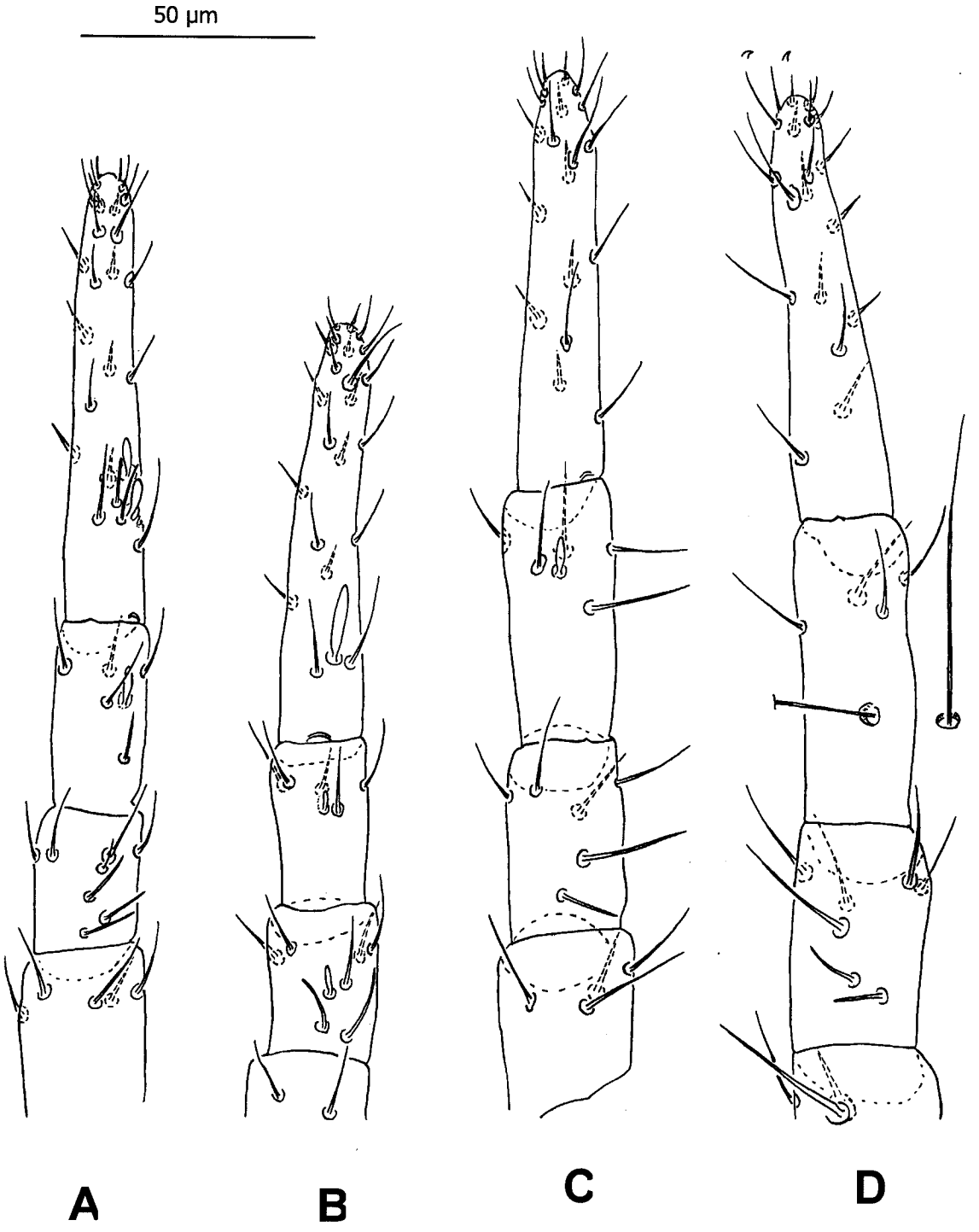

Figure 13. *Coleoscirus simplex*, female – A, leg I; B, leg II; C, leg III; D, leg IV.

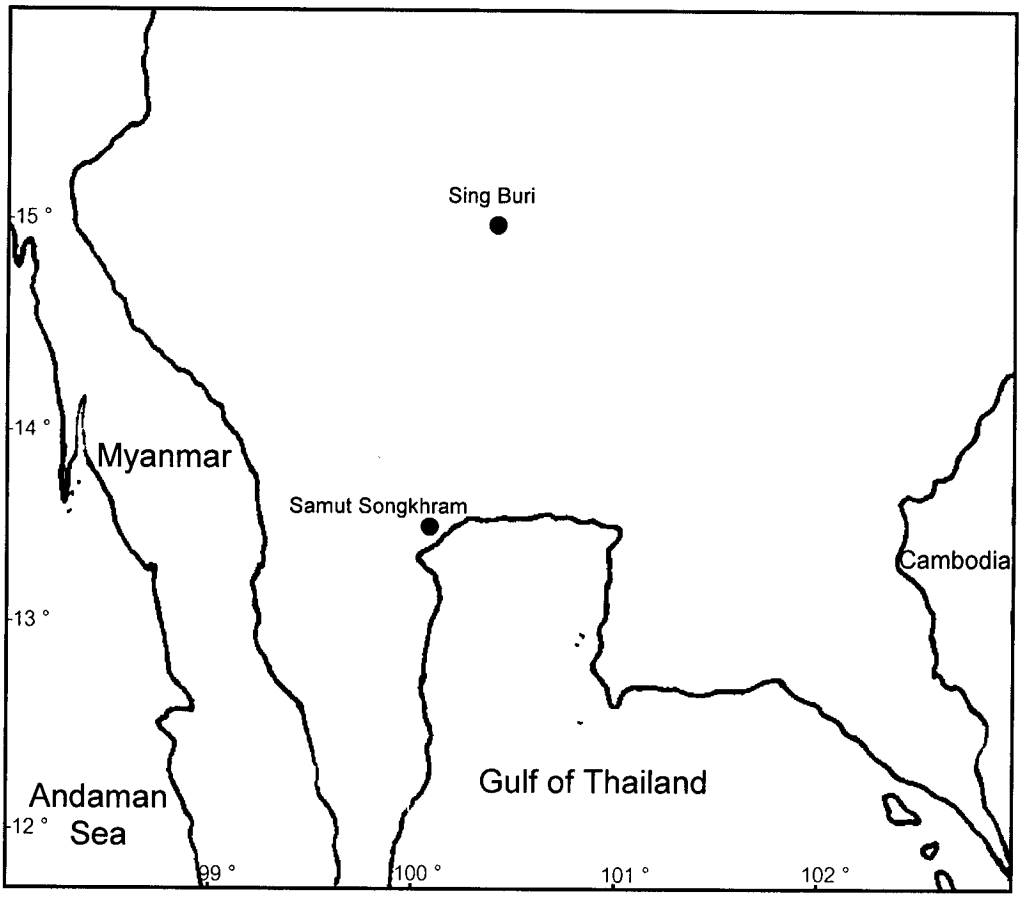

Figure 14. Collecting sites of *Coleoscirus simplex* in central Thailand.

5. *Coleoscirus tuberculatus* Den Heyer, 1978

(Figs. 15 and 16)

Coleoscirus tuberculatus Den Heyer, 1978a: 526; Smiley, 1992: 94; Corpuz-Raros, 1996a; 22.

Diagnosis – The large medial tubercle on inner margin of palp tibiotarsus and two pairs of setae on membrane between ventral shields are distinctive characters of this species.

Female – Dimension - Length of idiosoma 425-480 (451.67), width 260-335 (295); length of hypognathum 177-183 (169.83), width 120-143 (127.67); length of palp 165-175 (173.33); length of chelicera 168-173 (171); length of legs: I 300-310 (302.5); II 290-300 (296.67); III 305-330 (319); IV 350-360 (356.25).

Gnathosoma – Hypostome (Fig 15D) subregtangular and coneshape distally; ventral surface of hypostome granulated with four pairs of *hg* setae, hg_4 longest, and two pairs of adoral setae. Palp with five segments (Fig. 15E) and palpal chaetotaxy as follows: Trochanter with no setae; basifemur with one dorsal simple seta; telofemur with one dorsal simple seta; genu with four simple setae; tibiotarsus with four simple setae and one large median tubercle on inner margin, terminating with one long seta and small claw. Chelicera with two segments (Fig. 15C), segment I and II granulated, one long simple subterminal seta behind chela.

Dorsum (Fig. 15A) – Propodosoma with single granulated dorsal shield extending into hysterosoma region, bearing two pairs of simple propodosomal setae, ve and sce, two pairs of setose sensillae and four pairs of dorsal simple hysterosomal setae c_1, c_2, d_1, and e_1; integument outside shield striate and granulated, bearing setae f_1, f_2, h_1, and h_2; the cupules *ip* anteriolaterad of f_2.

Venter (Fig. 15B) – Coxae I-II forming a sternal shield, granulated and with seven pairs of setae (including coxal setae); coxal III-IV forming a separated lateral shield on each side with eight pairs of setae (including coxal setae) each; genital shields granulated with four simple setae, g_4 longest, arranged as shown in figure 15B; four setae on integument between these shields; anal region with two pairs of anal setae, ps_1 and ps_2.

Legs (Fig. 16) – All leg shorter than idiosoma. Tarsi I-IV stout and without terminal lateral lobes. Number of setae on leg segments I-IV as follows: Coxae 3-3-3-3; trochanters 1-1-2-1; basifemora 5-6-4-2; telofemora 5-5-4-3; genu I, 4 attenuate solenidia, 1 micrcroseta + 4; genu II, 3 attenuate solenidia + 5; genu III, 1 attenuate

solenidion + 5; genu IV, 1 attenuate solenidia + 5; tibia I, 2 short blunt solenidia + 5; tibia II, 1 short blunt solenidion + 5; tibia III, 1 short blunt solenidion + 5; tibia IV, 1 trichobothrium + 4; tarsi I, 4 solenidia + 24 [including "dt" and "tsl" of Den Heyer (1979a)]; tarsi II, 1 attenuate solenidion + 24; tarsi III, 21; tarsi IV, 20.

Male –Thai materials unknown.

Type – Female Holotype, campus of the University of The North, Sovenga, N. Transvaal, South Africa, collected from soil ang grass (*Panicum maximum)*, 5. V. 1971, by J. Den Heyer. Type deposited in Institute for Zoological Research, Potchefstroom University, South Africa.

Material examined - 6FF, Kaeng Sam Chan, Sarika, Nakhon Nayok 14°18′ 05′′N 101°18′17′′E, on litter under *Sandoricum koetjape*, 7. VI. 2003; 11FF, Khlong Sip Song, Pathum Thani, 14°06′42′′ N 100°52′37′′E, on *Acacia* sp. litter, 16. IX. 2003.

Distributions – South Africa; The Philippines; Thailand, additional localities from this study (Fig. 17): Nakhon Nayok and Pathum Thani.

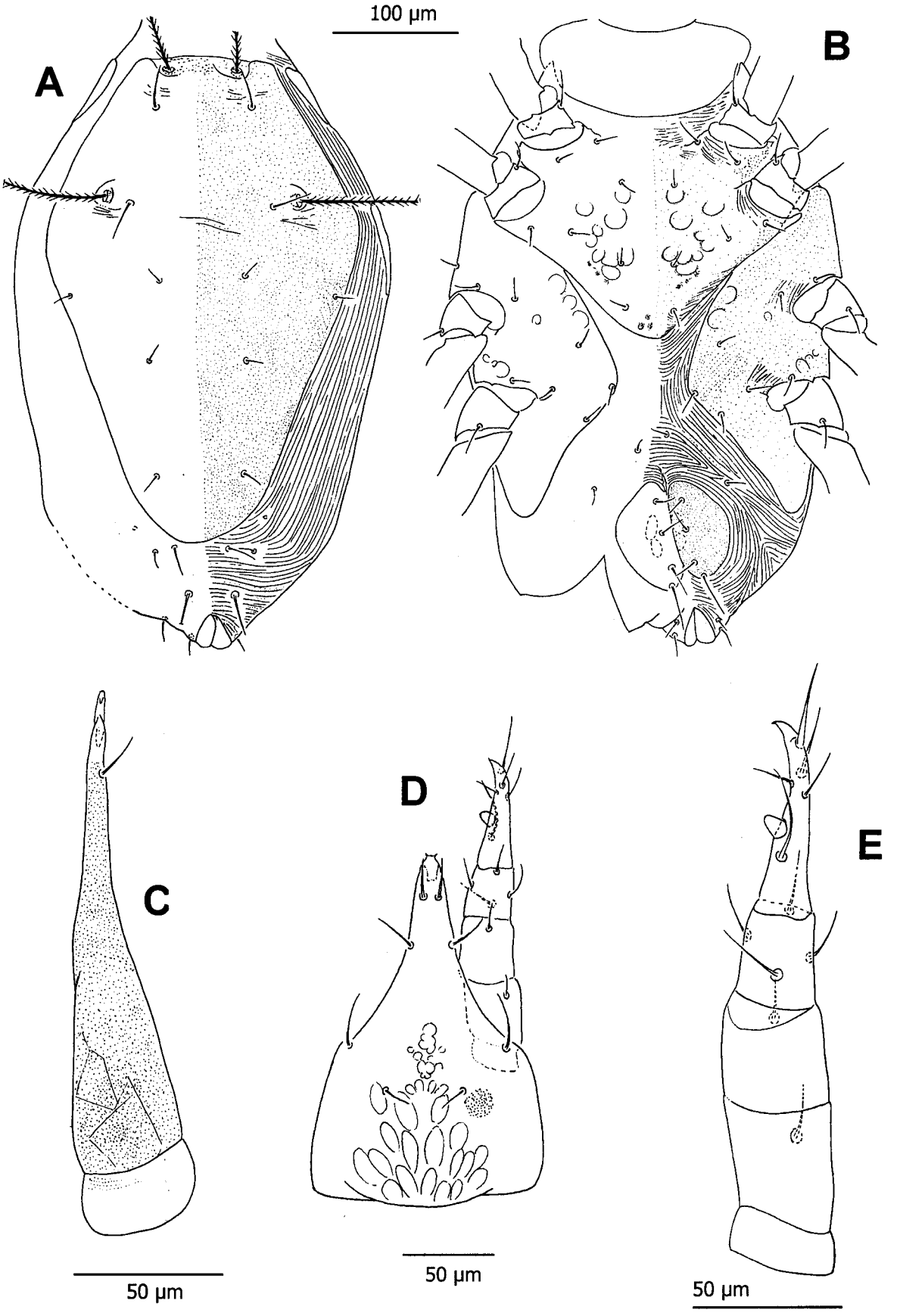

Figure 15. *Coleoscirus tuberculatus*, female – A, dorsum; B, venter; C, chelicera; D,ventral hypostome; E, palp.

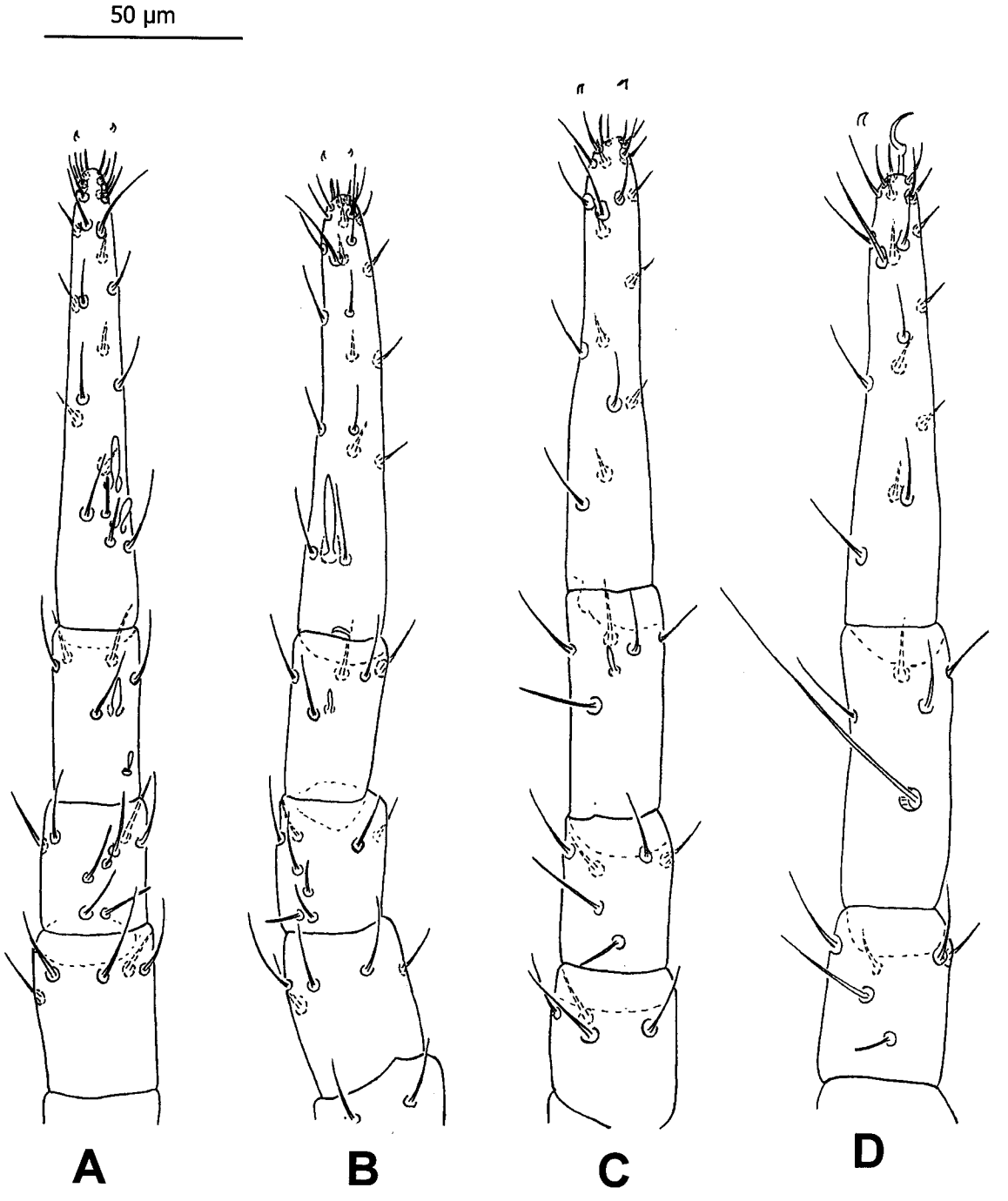

Figure 16. *Coleoscirus tuberculatus,* female – A, leg I; B, leg II; C, leg III; D, leg IV.

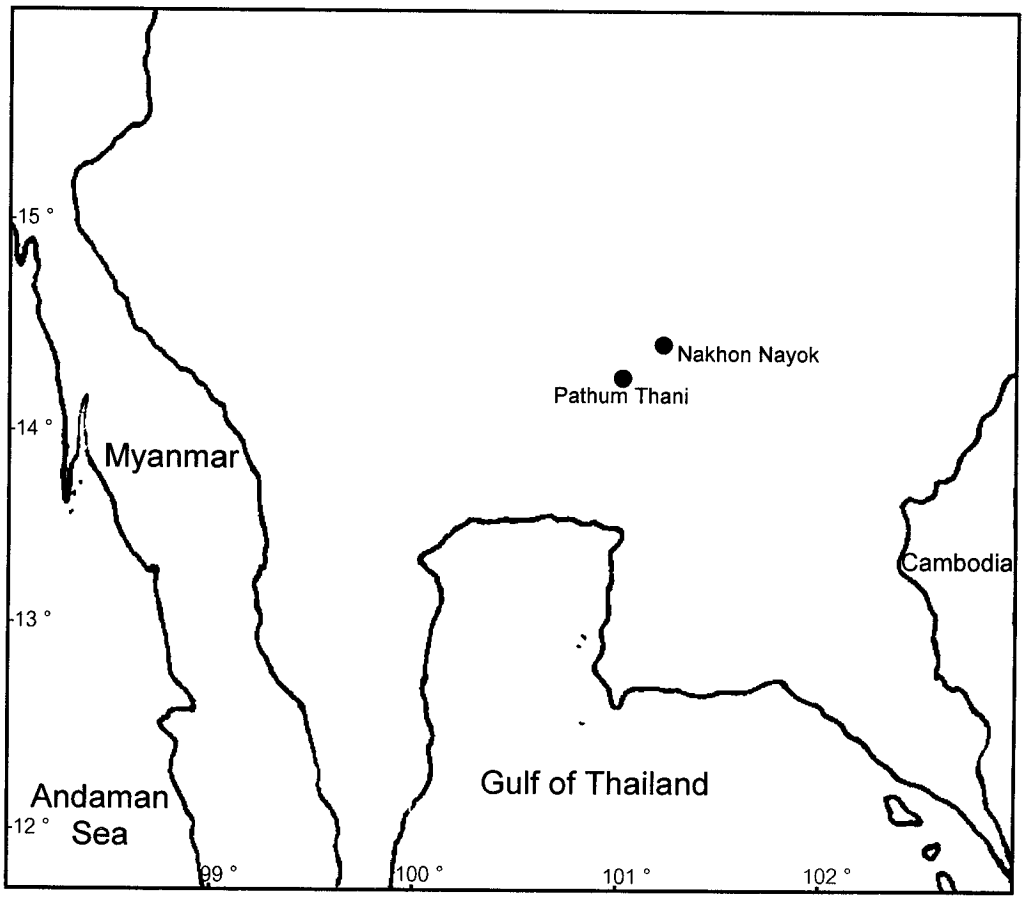

Figure 17. Collecting sites of *Coleoscirus tuberculatus* in central Thailand.

6. *Coleoscirus* sp. 1

(Figs. 18 and 19)

Diagnosis – This species resembles *C. philippinensis*, Corpuz-Raros, 1996a, in having six pairs of hysterosomal setae on dorsal shield, and five pairs of setae on membrane between ventral shields. However, they can be separated by the lateral region of dorsal shield possessing subcuticular reticulations in *Coleoscirus* sp. 1 whereas reticulation pattern is absent in *C. philippinensis*.

Female – Dimension - Length of idiosoma 385-435 (405.83), width 260-279 (266.5); length of hypognathum 105-200 (171.33), width 108-115 (111.5); length of palp 105-200 (172.67); length of chelicera 170-188 (178.5).

Gnathosoma – Hypostome (Fig. 18D) subregtangular and coneshape distally; ventral surface of hypostome granulated with four pairs of *hg* setae, hg_4 longest, and two pairs of adoral setae. Palp with five segments (Fig. 18E) and palpal chaetotaxy as follows: Trochanter with no setae; basifemur with one dorsal simple seta; telofemur with one dorsal slender simple seta; genu with four simple setae; tibiotarsus basally with one long simple seta, medially one small tubercle on inner margin, and apically with four setae and a tridentate claw. Chelicera with two segments (Fig. 18C), segment I granulated; segment II basally granulated with subcuticular reticulation, and one simple subterminal seta behind chela.

Dorsum (Fig. 18A) – Propodosoma with a large dorsal shield extending into hysterosoma region, surface granulated with subcuticular reticulation only on lateral regions, with two pairs of simple propodosomal setae, *ve* and *sce*, two pairs of setose sensillae, and six pairs of simple dorsal hysterosomal setae (c_1, *c2*, d_1, e_1, f_1 and f_2); integument outside shield striate and granulated, bearing setae h_1, and h_2; setae f_1 about two times f_2, and the cupules *ip* anteriolaterad of f_2.

Venter (Fig. 18B) – Coxae I-II forming a sternal shield, granulated with fine broken striae medially, with seven pairs of setae (including coxal setae), subcuticular cells presence; coxal III-IV forming a separated elongate lateral shield on each side with six pairs of setae (including coxal setae) each; genital shields granulated with two pairs of genital papillae and four simple setae, g_4 longest, arranged as shown in figure 18B; Five pairs simple setae on integument between ventral shields; anal region with three pairs of anal setae, ps_1, ps_2, and ps_3.

Legs (Fig. 19) – All leg shorter than idiosoma; tarsi I-IV stout and without terminal lateral lobes; number of setae on leg segments I-IV as follows: Coxae 3-3-3-

3; trochanters 1-1-2-1; basifemora 5-6-5-2; telofemora 5-5-4-3; genu I, 4 attenuate solenidia, 1 micrcroseta + 4; genu II, 3 attenuate solenidia + 5; genu III, 1 attenuate solenidion + 5; genu IV, 2 attenuate solenidia + 5; tibia I, 1 blunt solenidion, 1 attenuate solenidion + 5; tibia II, 1 short blunt solenidion + 5; tibia III, 1 short blunt solenidion + 5; tibia IV, 1 trichobothrium + 4; tarsi I, 2 blunt solenidia, 2 attenuate solenidia, 1 peg-like seta + 22 [including "dt" and "tsl" of Den Heyer (1979a)]; tarsi II, 1 blunt solenidion + 21; tarsi III, 18; tarsi IV, 20.

Male – Unknown

Material examined - 6FF, Bang Khan Taek, Samut Songkhram, on litter under *Leucaena leucocephala,* 6. IX. 2002; 5FF, Bang Khan Taek, Samut Songkhram 13°22′39′′N 99°57′18′′E, on litter under *Citrus grandis*, 23. VI. 2002; 5FF, Bang Khan Taek, Samut Songkhram 13°22′39′′ N 99°57′18′′E, on decomposing grasses and banana leaves, 25. III. 2003; 2FF, Sala Loy, Tha Ruae, Ayutthaya 14°37′73′′ N 100°42′14′′E, alt. 12 m., on litter under *Tamarindus indicus*, 31. XII. 2002; 2FF, Sala Loy, Tha Ruae, Ayutthaya 14°31′75′′ N 100°42′26′′E, alt. 27 m., on litter under *Poyalthai longifolia*, 23. III. 2003; 31FF, as previous data but on litter under *Tamarindus indicus*; 16FF, as previous data but on litter under *Streblus asper* Lour., and *Tamarindus indicus*; 2FF, Kaeng Sam Chan, Sarika, Nakhon Nayok 14°18′05′′N 101°18′17′′E, on litter under *Tamarindus indicus*, 7. VI. 2003; 3FF, Pho Chon Kai, Bang Rachan, Sing Buri (15°10′ 16′′ N 100°05′ 33′′E, alt. 27 m., on bamboo litter, 20. X. 2002; 4FF, as previous data but on unknown leaf litter; 2FF, Pho Chon Kai, Bang Rachan, Sing Buri, on litter under *Streblus asper*, 17. X. 2002; 1F, as previous data but on litter under *Baccaurea spida.*

Distributions – Thailand, additional localities from this study (Fig. 20): Sing Buri, Samut Songkhram, Ayutthaya and Nakhon Nayok.

Remarks – Hysterogastral setae vary from 9-14 setae. Most of them have five pairs of setae (Table 4-3)

Table 4-3. Variation in numbers of hysterogastral setae of *Coleoscirus* sp. 1

Numbers of hysterogastral setae	Number of Specimens	%
9	2	2.5
10	43	53.75
11	32	40
12	1	1.25
13	1	1.25
14	1	1.25

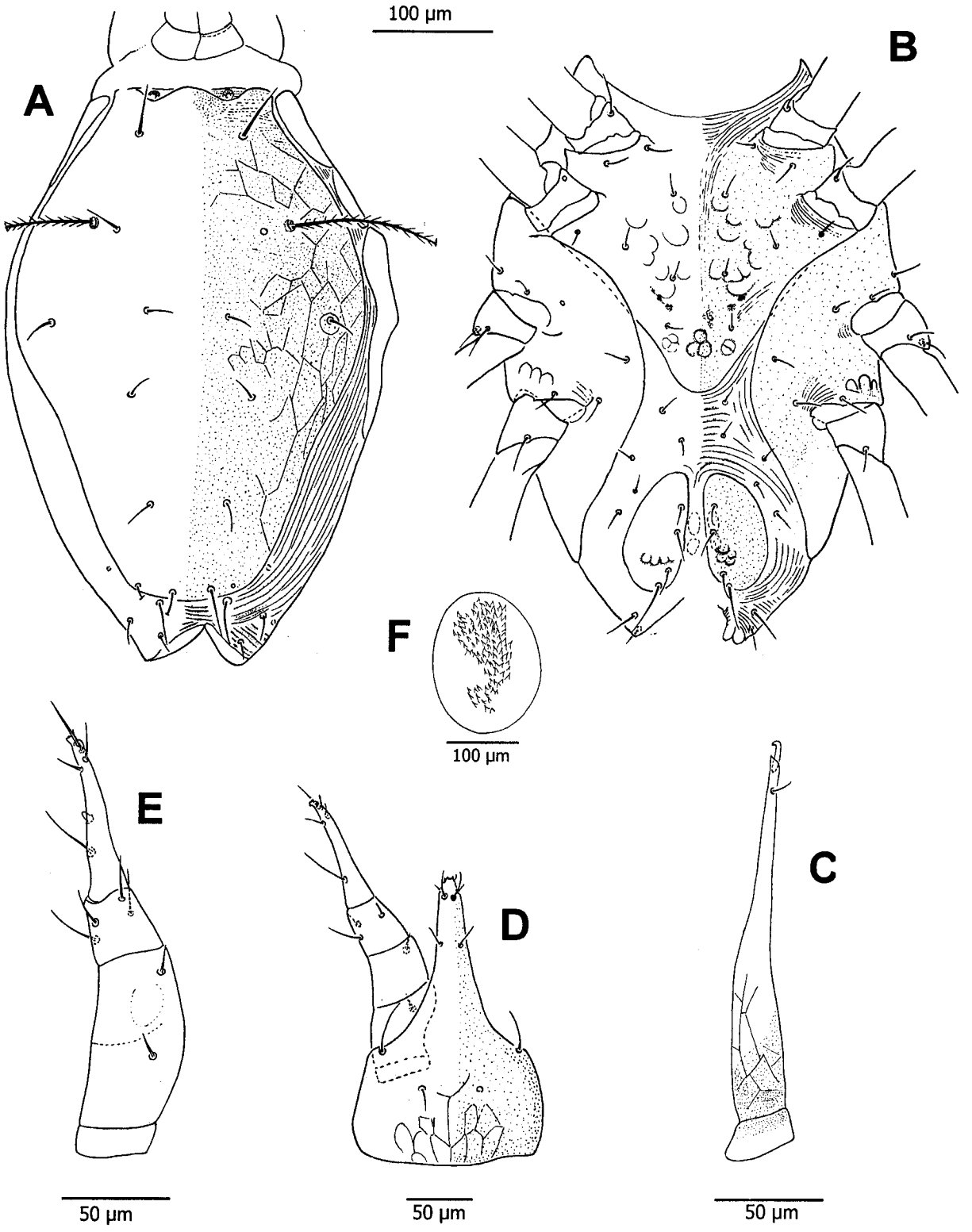

Figure 18. *Coleoscirus* sp.1, female – A, dorsum; B, venter; C, chelicera; D,ventral hypostome; E, palp; F, egg.

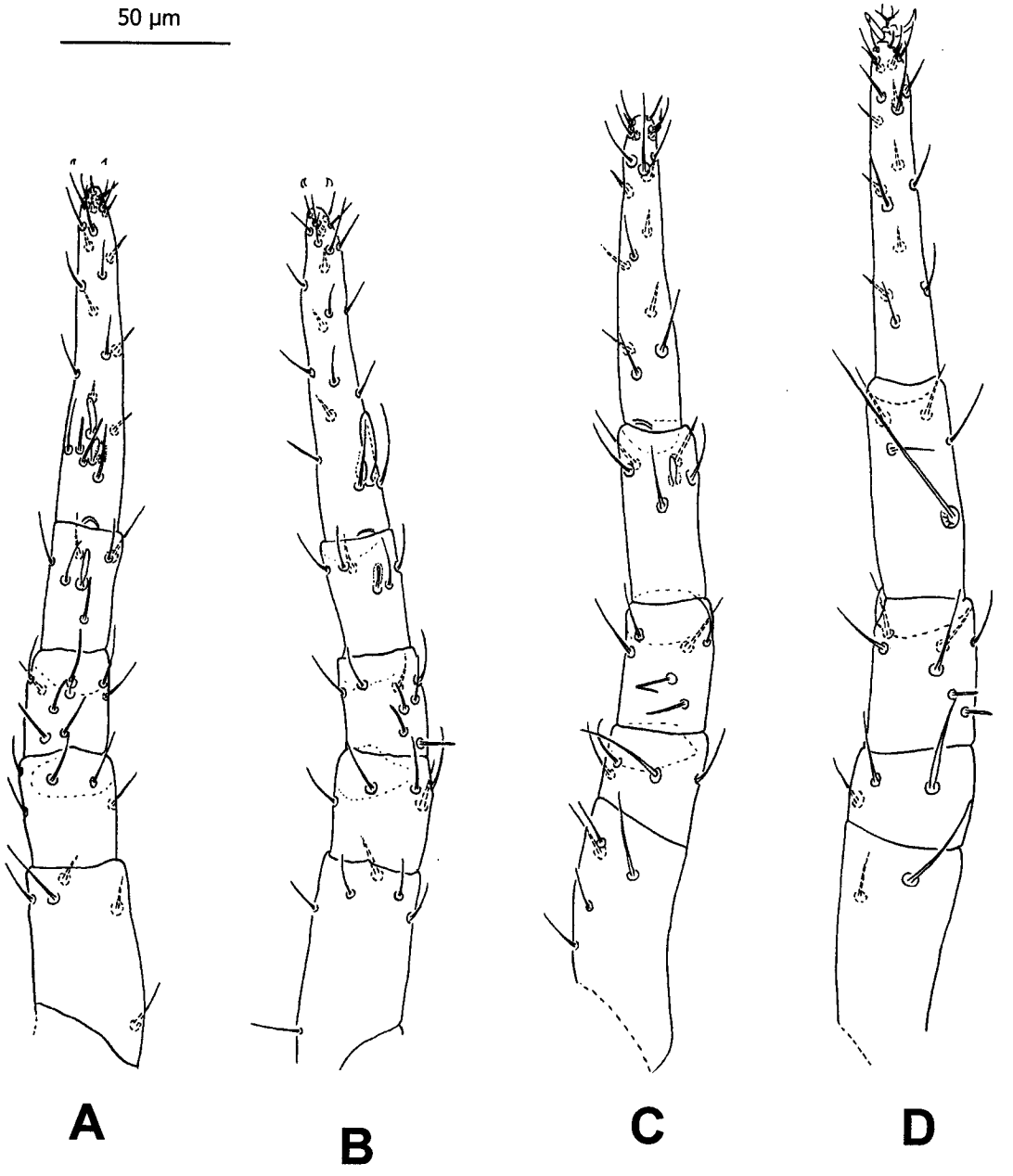

Figure 19. *Coleoscirus* sp 1, female – A, leg I; B, leg II; C, leg III; D, leg IV.

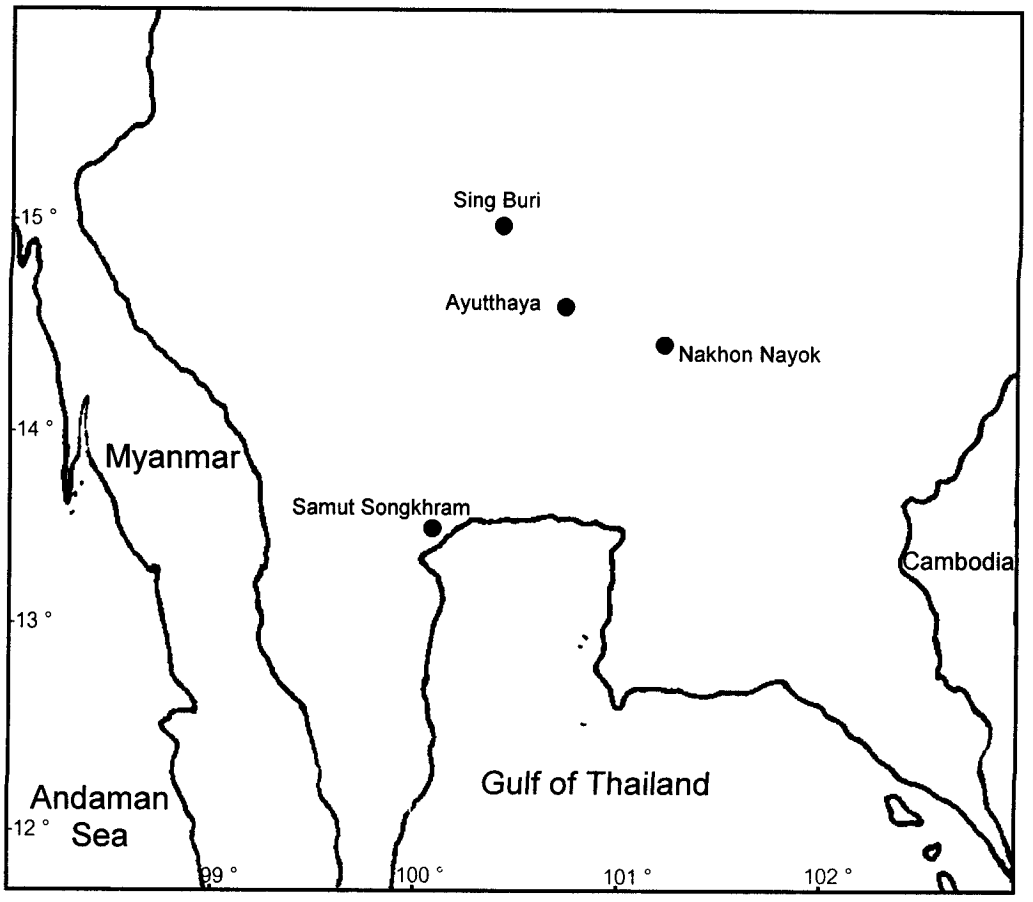

Figure 20. Collecting sites of *Coleoscirus* sp. 1 in central Thailand.

7. *Coleoscirus* sp. 2

(Figs. 21 and 22)

Diagnosis – This species resembles *C. coatesi* Den Heyer, 1980d, in having four pairs of hysterosomal setae on the dorsal shield and the posteriormedial portion of the sternal plate is truncated. However, they can be distinguished by the dorsal shield is equal sclerotization in *Coleoscirus* sp. 2 while the dorsal shield is unequal sclerotization in *C. coatesi*. In addition, the posterior portion of the shield of the *Coleoscirus* sp. 2 is narrower than the latter.

Female – Dimension - Length of idiosoma 410-475 (448.33), width 260-325 (290.83); length of hypognathum 163-175 (167), width 108-118 (115); length of palp 175-188 (177.17); length of chelicera 136-163 (156); length of legs: I 300-145 (274.17); II 290-300 (297.5); III 285-325 (315); IV 350-370 (358.33).

Gnathosoma – Hypostome (Fig. 21D) subrectangular and coneshape distally; ventral surface of hypostome granulated with four pairs of *hg* setae, hg_4 longest, and two pairs of adoral setae. Palp with five segments (Fig. 21E) and palpal chaetotaxy as follows: Trochanter with no setae; basifemur with one dorsal simple seta; telofemur with one dorsal simple seta; genu with four simple setae; tibiotarsus medially with one long simple setae and one small tubercle on inner margin, and apically with four setae and a tridentate claw. Chelicera with two segments (Fig. 21C), segment I granulated; segment II granulated with subcuticular ridged/line producing reticular appearance, and one simple subterminal seta behind chela.

Dorsum (Fig. 21A) – Propodosoma with a dorsal shield extending into hysterosoma region, equally sclerotized and densely granulated bearing two pairs of simple propodosomal setae, *ve* and *sce*, two pairs of setose sensillae, and four pairs of simple dorsal hysterosomal setae (c_1, c_2, d_1, and e_1); integument outside shield striate and granulated, bearing setae f_1, f_2, h_1, and h_2; setae f_1 about two times f_2, and the cupules *ip* anteriolaterad of f_2.

Venter (Fig. 21B) – Coxae I-II forming a sternal shield, densely granulated with seven pairs of setae (including coxal setae), subcuticular cells presence; coxal III-IV forming a separated elongate lateral shield on each side with six setae of coxal setae each; genital shields granulated with two pairs of genital papillae and four simple setae, g_4 longest, arranged as shown in figure 21B; eight simple setae on integument between ventral shields; anal region with two pairs of anal setae, ps_1 and ps_2, and one pair of cupule *ih*.

Legs (Fig. 22) – All leg shorter than idiosoma; tarsi I-IV stout and without terminal lateral lobes; number of setae on leg segments I-IV as follows: Coxae 3-3-3-3; trochanters 1-1-2-1; basifemora 5-6-4-2; telofemora 5-5-4-3; genu I, 4 attenuate solenidia, 1 micrcroseta + 4; genu II, 3 attenuate solenidia + 5; genu III, 1 attenuate solenidion + 5; genu IV, 1 attenuate solenidia + 5; tibia I, 2 blunt solenidia + 5; tibia II, 1 short blunt solenidion + 5; tibia III, 1 short blunt solenidion + 5; tibia IV, 1 trichobothrium + 4; tarsi I, 2 blunt solenidia, 2 attenuate solenidia, 1 peg-like seta + 24 [including "dt" and "tsl" of Den Heyer (1979a)]; tarsi II, 1 blunt solenidion + 24; tarsi III, 21; tarsi IV, 20.

Male – Unknown

Material examined - 13F, Kaeng Sam Chan, Sarika, Nakhon Nayok 14°18′ 05′′N 101°18′17′′E, on litter under *Citrus grandis*, 7. VI. 2003; 8FF, as previous data but on litter under *Sandoricum koetjape*; 2FF, Bang Plama, Suphan Buri, on *Acacia* sp. litter, 16. III. 2003; 1F, Sala Loy, Tha Ruae, Ayutthaya 14°31′75′′N 100°42′26′′E, alt. 27 m., on leef litter of *Cassia* sp., 23. III. 2003; 4FF, Ban Nong Pongnok, Kamphaeng Saen, Nakhon Pathom 14°02′57′′N 99°56′08′′E, alt. 20 m., on leaf litter of *Azadirachta indica,* and *Leucaena leucocephala,* 16. III. 2003; 1F,Tha Chai, Muang, Chai Nat 14°02′57′′N 99°56′08′′E, alt. 20 m., litter under *Streblus asper,* 28. III. 2003; 1F, near Sam Lan waterfall, Saraburi 14°25′56′′N 100° 57′51′′E, on forest litter, 7. IV. 2003; 1F, Bang Khan Taek, Samut Songkhram 13°22′39′′N 99°57′18′′E, on litter under *Citrus grandis*, 23. VI. 2002; 8FF, as previous data but on decomposing grass and banana leaves, 25. III. 2003; 2FF, Bang Khan Taek, Samut Songkhram, on litter under *Leucaena leucocephala*, 6. IX. 2002; 2FF, Bang Khan Taek, Samut Songkhram, on litter under *Tamarindus indicus*, 23. VI. 2002; 5FF, Khlong Sip Song, Pathum Thani, 14°06′42′′N 100°52′37′′E, on *Acacia* sp. litter, 16. IX. 2003.

Distributions – Thailand, additional localities from this study (Fig. 23): Ayutthaya, Chai Nat, Samut Songkhram, Saraburi, Nakhon Nayok, Pathum Thani and Suphan Buri.

Remarks – This species has the hysterogastral setae varying from 7 (6 specimens)- 8 (38 specimens) setae.

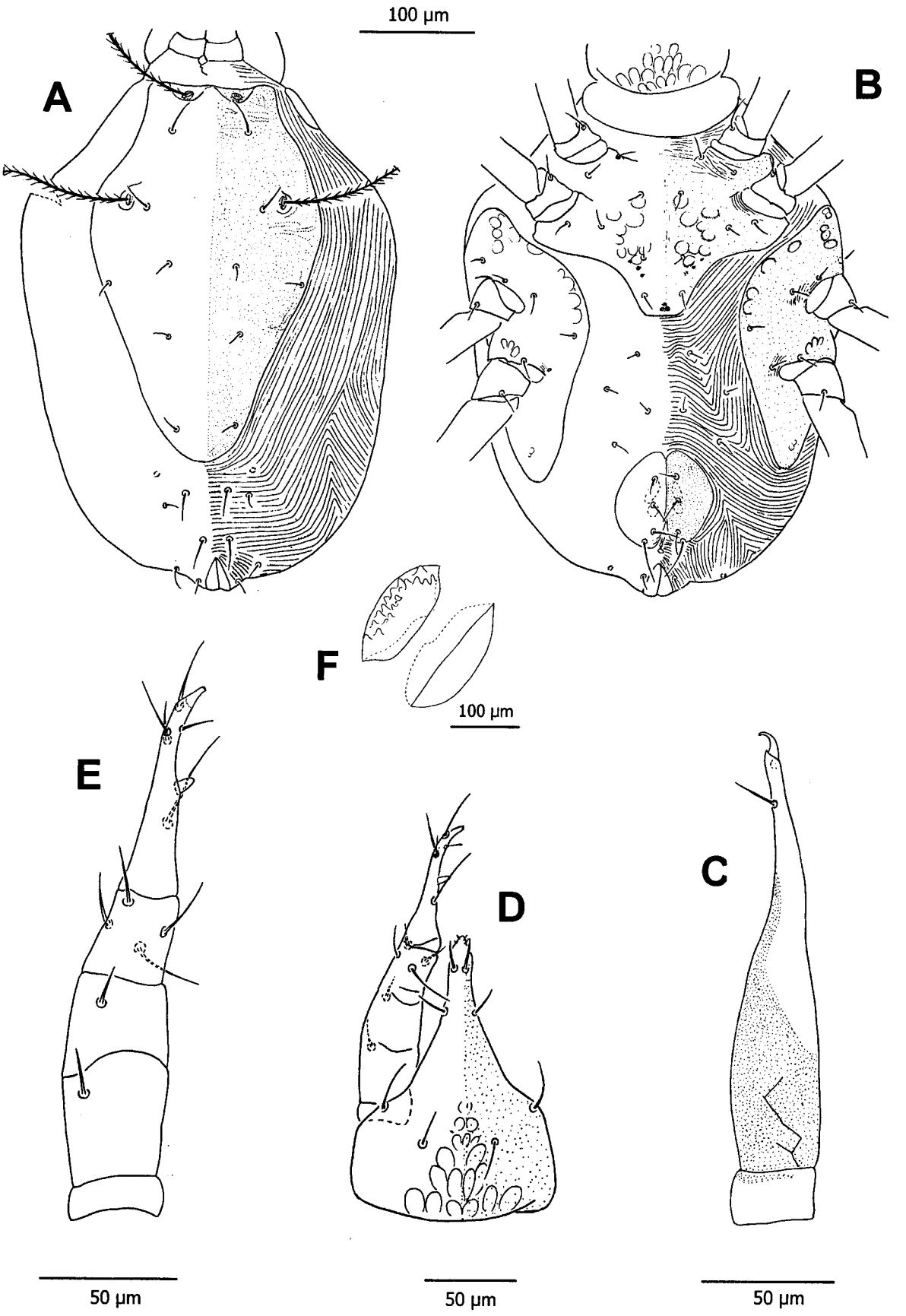

Figure 21. *Coleoscirus* sp. 2, female – A, dorsum; B, venter; C, chelicera; D,ventral hypostome; E, palp; F, egg.

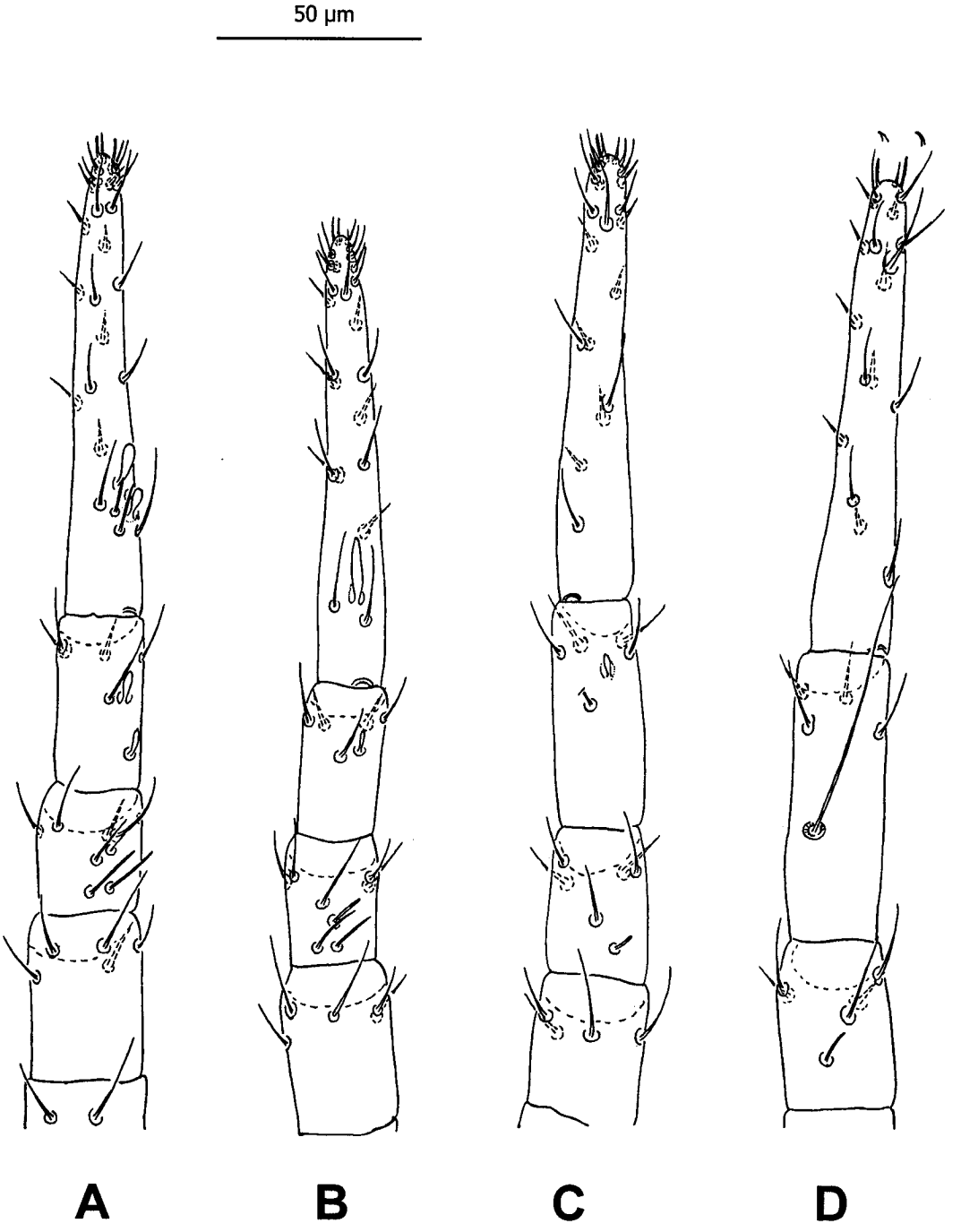

Figure 22. *Coleoscirus* sp. 2, female – A, leg I; B, leg II; C, leg III; D, leg IV.

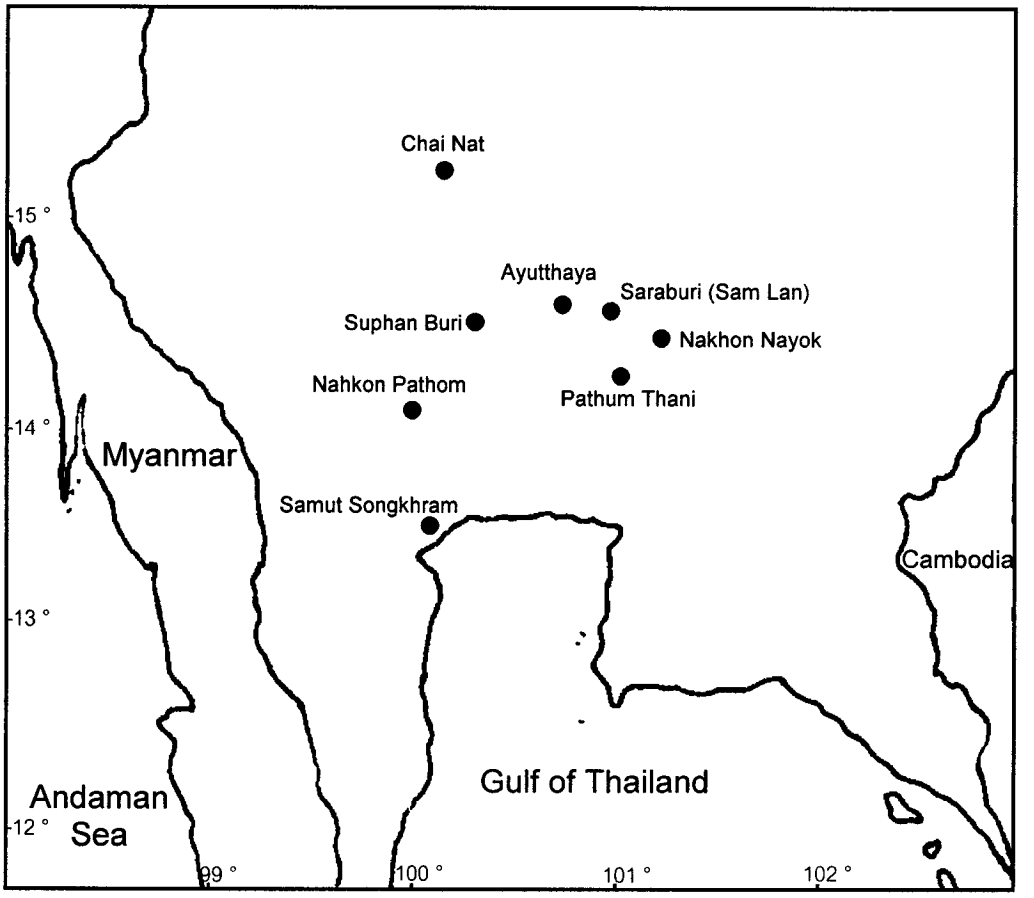

Figure 23. Collecting sites of *Coleoscirus* sp. 2 in central Thailand.

Table 4-4. A comparison of main characters between species belonging to the genus *Coleoscirus*.

Characters	*C. bakeri*	*C. tuberculatus*	*C. simplex*	*C.* sp. 1	*C.* sp. 2
seta on palp basifemur	spinelike	simple	simple	simple	simple
medial tubercle on palp tibiotarsus	normal	very large	normal	normal	normal
numbers of hyterosomal setae on dorsal shield	4	5	4	6	4
reticulation on dorsal shield	absent	absent	absent	present	absent
posterior edge of dorsl shield	concave	round	round	round	round
posterior edge of sternal shield	V shape	V shape	V shape	V shape	blunt end
numbers of ventral setae on membrane	6 pairs	2 pairs	6 pairs	5 pairs	4 pairs
chaetotaxy of basifemora I-II-III-IV	5-6-5-2	5-6-4-2	5-6-5-2	5-6-5-2	5-6-4-2
chaetotaxy of telofemora I-II-III-IV	5-5-4-3	5-5-4-3	5-5-4-3	5-5-4-3	5-5-4-3
number of solenidia on genu I-II-III-IV	4-2-1-2	4-3-1-1	4-3-1-2	4-3-1-2	4-3-1-1
number of solenidia on tibia I-II-III-IV	2-1-1-0	2-1-1-0	2-1-1-0	2-1-1-0	2-1-1-0

Genus *Pseudobonzia* Smiley, 1975

Pseudobonzia Smiley, 1975: 243; Den Heyer, 1977b: 171; 1980e: 121; Luxton, 1982: 325; Liang, 1983: 106; 1984: 19; Sepasgosarian, 1984: 138; Michoka, 1987: 92; Corpus-Raros and Garcia, 1996: 15. Type species: *Cunaxa reticulata* Heryford, 1965, by original designation.

Diagnosis: Palpus five segments, attenuate distally; dorsum with a single dorsal shield confined to the propodosoma region, setae f_2 presence, ps_3 presence.

Three species, 2 described species and 1 unidentified species, of this genus are recognized. Key to species of described species are given below and a comparison of main characters between these three species is present in Table 4-5.

Key to the Species of *Pseudobonzia* in Central Thailand

Propodosomal shield granulated..... *P. gruezoi*

Propodosomal shield totally reticulated. .....*P. clathratus*

8. *Pseudobonzia clathratus* (Shiba, 1976)

(Figs. 24 and 25)

Cunaxa clathratus Shiba, 1976: 112.

Pseudobonzia clathratus Smiley, 1992: 99; Corpuz-Raros and Garcia, 1996: 16.

Diagnosis - This species resembles *P. neoreticular* Den Heyer, 1977b, in having the strong reticular pattern on its propodosomal shield, posterior ventral hypostome, legs and genital shields. However, the propodosomal shield is uniformly reticulate in *P. clathratus* whereas fades out behind the posterior sensillae and forms an arch over non-reticulated posterior portion in *P. neoreticular*

Female – Dimension - Length of idiosoma 390-500 (450), width 230-340 (283.33); length of hypognathum 120-135 (126.83), width 70-85 (75.83); length of palp 93-110 (104.33); length of chelicera 115-125 (120.17); length of legs: I 195-220 (205.83); II 175-200 (189); III 210-250 (226); IV 240-310 (266).

Gnathosoma – Very samall gnathosoma, hypostome (Fig. 24D) subrectangular and coneshape distally, posterior ventral surface of hypostome reticulated with four pairs of *hg* setae, hg_4 longest, and two pairs of adoral setae. Palp with five segments (Fig. 24E) and palpal chaetotaxy as follows: Trochanter with no setae; basifemur with one dorsal simple seta; telofemur with one dorsal simple seta;

genu with four simple setae; tibiotarsus with four simple setae, one inconspicuos tubercle scar, terminating with a very long simple seta and a tridentate claw; chelicera with two segments (Fig. 24C), segment I and II granulated, and one simple subterminal seta behind chela.

Dorsum (Fig. 24A) – Propodosoma with a reticulated shield bearing two pairs of simple propodosomal setae, *ve* and *sce*, two pairs of setose sensillae; Hysterosoma smooth striae and granulate bearing simple dorsal hysterosomal setae c_1, c_2, d_1, e_1, f_1, f_2, h_1, and h_2, and a pair of cupules *ip* anteriorlaterad of f_2; setae h_1 longest,

Venter (Fig. 24B) – Coxae I-II, and III-IV contiguous and reticulate; genital shields reticulated with four pairs of simple setae, and two pairs of genital papillae; twelve setae born on integument between these shields; anal region with three pairs of anal setae, ps_1, ps_2, and ps_3, and one pair of cupule *ih*.

Legs (Fig. 25) – All leg shorter than idiosoma; tarsi I-IV stout and without terminal lateral lobes; number of setae on leg segments I-IV as follows: Coxae 3-3-3-3; trochanters 1-1-2-1; basifemora 3-3-2-1; telofemora 5-5-4-3; genu I, 3 attenuate solenidia, 1 micrcroseta + 4; genu II, 2 attenuate solenidia + 5; genu III, 1 attenuate solenidion + 5; genu IV, 1 attenuate solenidia + 5; tibia I, 2 attenuate solenidia + 5; tibia II, 1 attenuate solenidion + 5; tibia III, 1 attenuate solenidion + 5; tibia IV, 1 trichobothrium + 4; tarsi I, 4 attenuate solenidia + 21 [including "dt" and "tsl" of Den Heyer (1979a)]; tarsi II, 1 blunt and long solenidion + 20; tarsi III, 17; tarsi IV, 17.

Male – Thai materials unknown.

Type – Female Holotype, Pasoh Forest outside of Plot 1, West Malaysia, on litter, 4. III. 1971, by M. Shiba, Type deposited in the Biological Laboratory, Matsuyama Shinonome Junior College, Matsuyama, Japan.

Material examined - 15FF, Bang Khan Taek, Samut Songkhram (13° 22' 39'' N/ 99° 57' 18''E), on grass litter, 23. VI. 2002; 9FF, as previous data but on litter under *Citrus grandis*, 6. IX. 2002; 5FF, Bang Khan Taek, Samut Songkhram, on litter under *Leucaena leucocephala*, 6. IX. 2002.

Distributions – Malaysia; The Philippines; Thailand, additional localities from this study (Fig. 30): Samut Songkhram.

Remarks. Thai specimens vary from Smiley's redescription (Smiley, 1992) in that tuburcle scar is present on innersurface of palp tibiotarsus. A long solenidion on tarsi II is not unique in *clathratus*, at least, it is present in *neopecinatus* (See Den Heyer, 1977b).

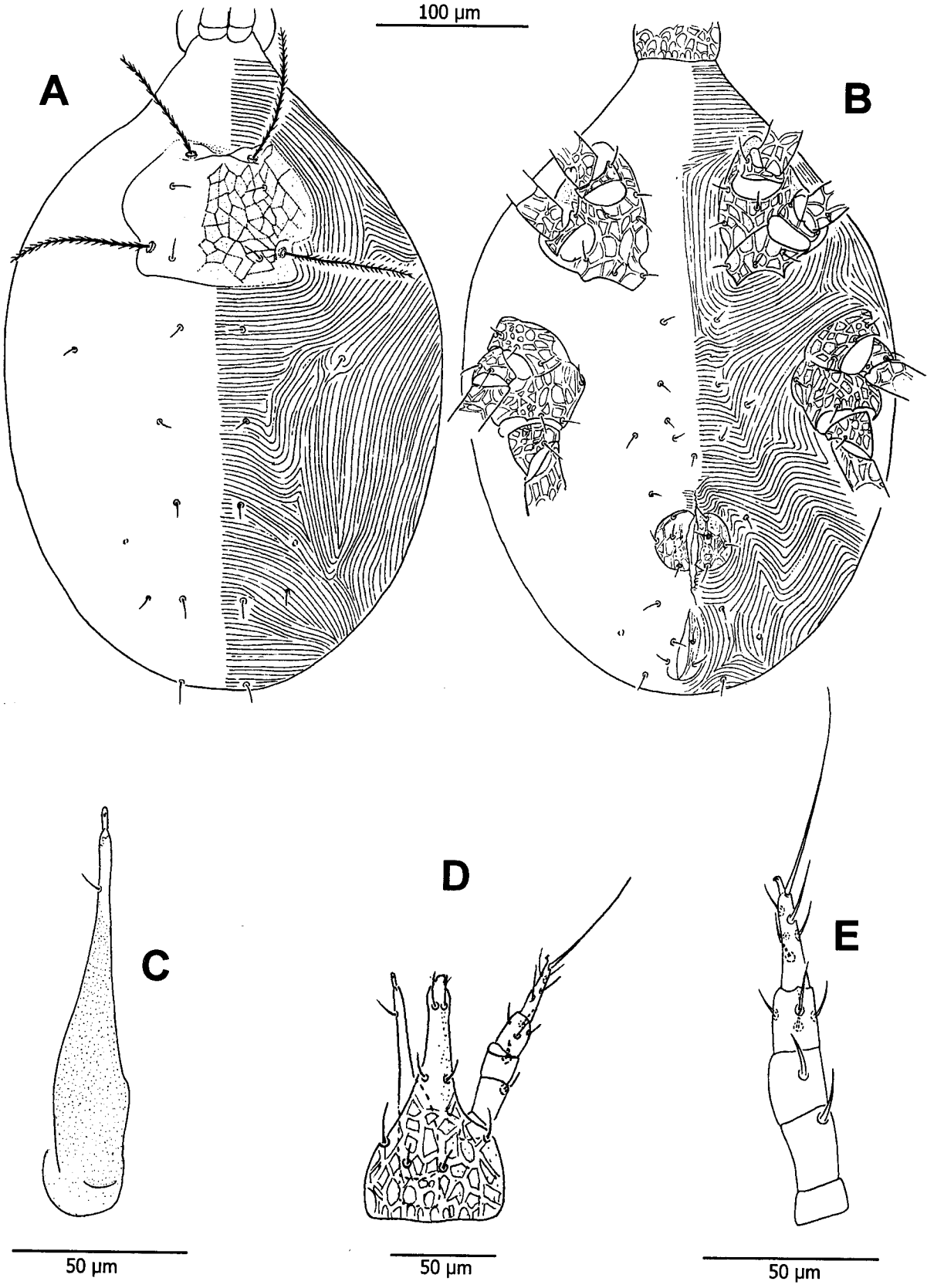

Figure 24. *Pseudobonzia clathratus*, female – A, dorsum; B, venter; C, chelicera; D, ventral hypostome; E, palp.

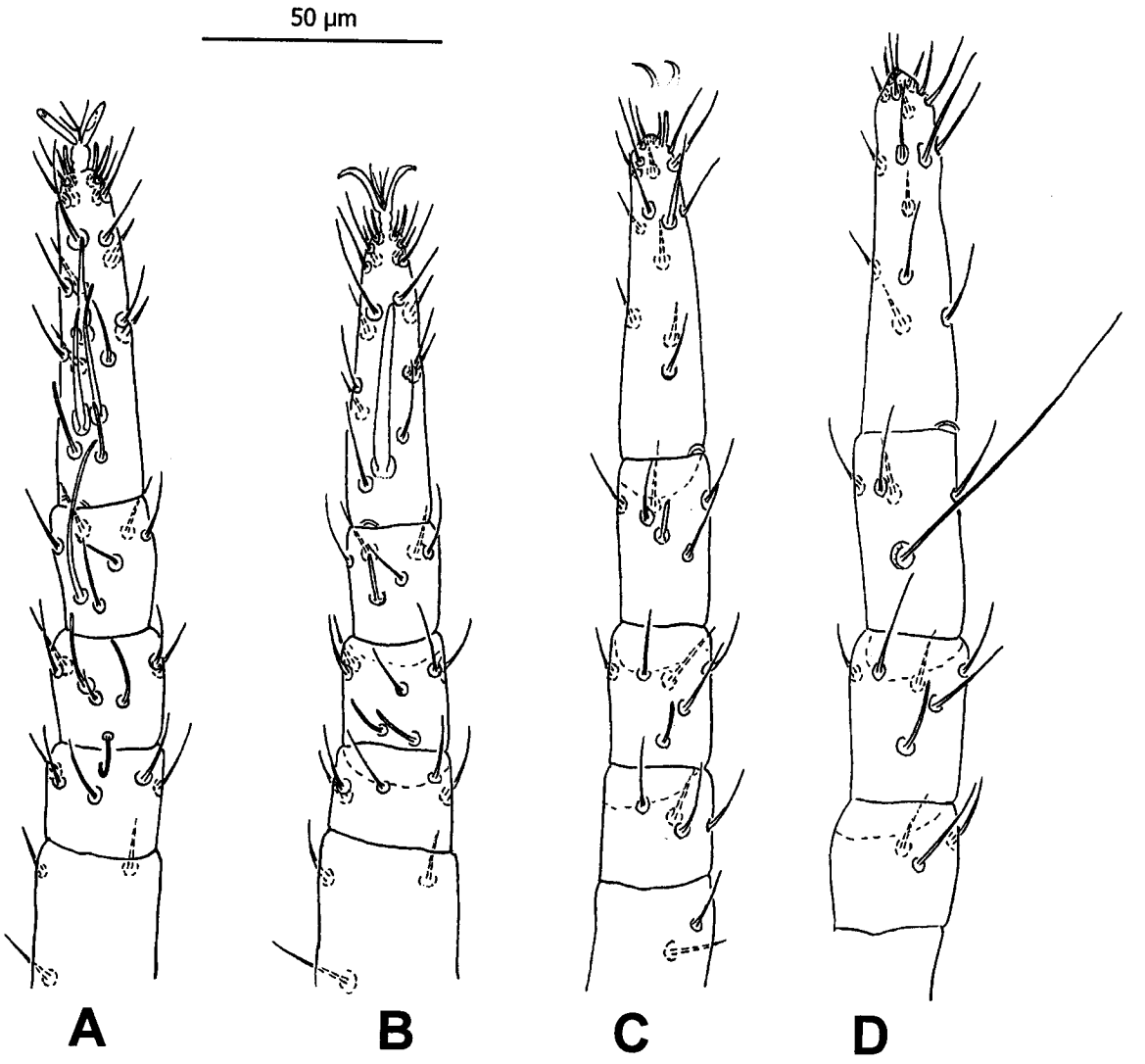

Figure 25. *Pseudobonzia clathratus*, female – A, leg I; B, leg II; C, leg III; D, leg IV.

9. *Pseudobonzia gruezoi* Corpuz-Raros and Garcia, 1996

(Figs. 26 and 27)

Pseudobonzia gruezoi Corpuz-Raros and Garcia, 1996: 18.

Diagnosis - This species recognized by the spinelike dorsal setae on basi- and telofemur, a simple seta just above the tubercle on inner surface of palpal tibiotarsus, according to Corpuz-Raros and Garcia, 1996, it differs from *P. yini* Smiley, 1992, in the position of the tubercle and associated seta which are located medially on palpal tibiotarsus in *P. yini* whereas these structures arise from distal third in *P. gruezoi*.

Female – Dimension - Length of idiosoma 320-390 (355), width 215-275 (245); length of hypognathum 145-163 (145), width 92-110 (101); length of palp 120-133 (126.5); length of chelicera 133-153 (143); length of legs: I 210-235 (222.5); II 200-230 (215); III 215-240 (227.5); IV 253-260 (256.5).

Gnathosoma - Hypostome (Fig. 26D) subrectangular, coneshaped distally; ventral surface of hypostome granulated with four pairs of *hg* setae, hg_4 longest. Palp with five segments (Fig. 26E) and palpal chaetotaxy as follows: Trochanter with no setae; basifemur with one dorsomedian spinelike seta; telofemur with one dorsomedian spinelike seta; genu with four simple setae; tibiotarsus subapically with one small turbercle associated with one simple seta on inner serface, two aciculate setae, two simple setae, terminating with a tridentate claw. Chelicera with two segments (Fig. 26C), segment I and II granulate with one simple subterminal seta behind chela.

Dorsum (Fig. 26A) – Propodosoma with a finely granulated shield, bearing, the chains of subcuticular cells, two pairs of propodosomal setae *ve* and *sce*, and two pairs of setose sensillae; setae *ve* simple and longer than setae *sce*. Hysterosoma without hysterosomal shield and surface with smooth striae with dotlike lobes; bearing dorsal hysterosomal setae c_1, c_2, d_1, e_1, f_1, f_2, h_1 and h_2; setae h_1 longest; the cupule *ip* posteriolaterad of e_1.

Venter (Fig. 26B) – Coxae I-II and III-IV contiguous, surface granulated with broken striae; seven pairs of ventral simple setae (except coxal, genital and anal setae); genital shields granulated with four pairs of simple setae, arranged as shown in figure 26B. Anal region with three pairs of anal setae ps_1, ps_2, and ps_3, and one pair of cupule *ih*.

Legs (Fig. 27) – All legs shorter than idiosoma. Tarsi I-IV stout and without terminal lateral lobes. Number of setae on leg segments I-IV as follows: Coxae 3-3-3-

3; trochanters 1-1-2-1; basifemora 5-5-4-2; telofemora 4-5-4-3; genu I, 4 attenuate solenidia, 1 micrcroseta + 4; genu II, 3 attenuate solenidia + 5; genu III, 1 attenuate solenidion + 5; genu IV, 2 attenuate solenidia + 5; tibia I, 2 attenuate solenidia + 5; tibia II, 1 attenuate solenidion + 5; tibia III, 1 attenuate solenidion + 5; tibia IV, 1 trichobothrium + 4; tarsi I, 2 attenuate solenidia, 2 blunt solenidia, 1 peglike seta, + 22 [including "dt" and "tsl" of Den Heyer (1979a)]; tarsi II, 1 blunt solenidion + 22; tarsi III, 21; tarsi IV, 21.

Male – Thai materials unknown.

Type – Female Holotype, Mt. Makiling at the Upland Hydroecology Program site, Putting Lupa, Calamba, Laguna, The Philippines, on secondary forest litter, 13. X. 1976, by R. C. Garcia. Type deposited in the Museum of Natural History of University of the Philippines, Los Banos.

Material examined - 1F, Pho Chon Kai, Bang Rachan, Sing Buri, on decomposing banana leaves, 20. X. 2002.

Distribution – The Philippines; Thailand, additional localities from this study (Fig. 30): Sing Buri.

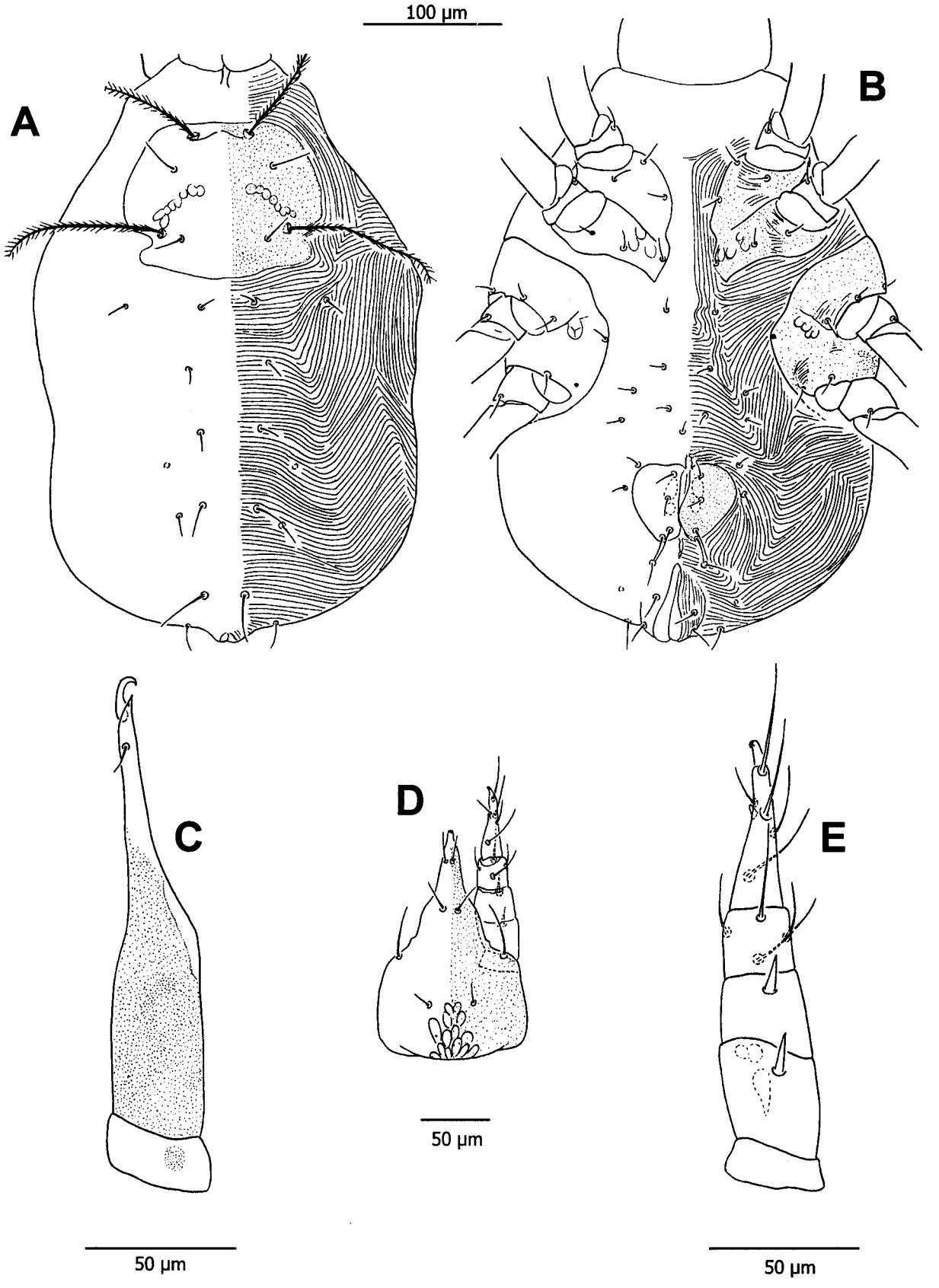

Figure 26. *Pseudobonzia gruezoi*, female – A, dorsum; B, venter; C, chelicera; D, ventral hypostome; E, palp.

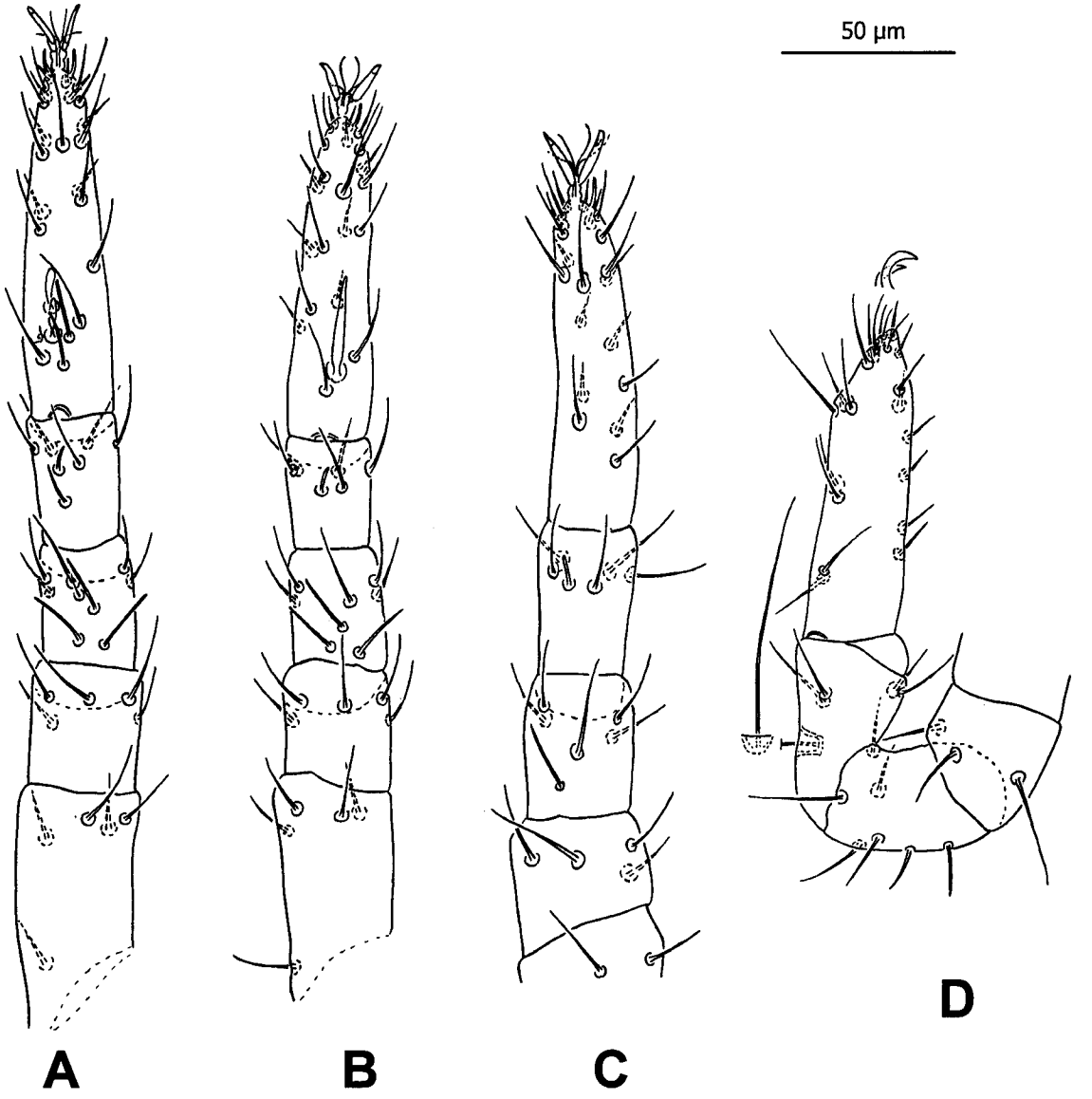

Figure 27. *Pseudobonzia gruezoi*, female – A, leg I; B, leg II; C, leg III; D, leg IV.

10. *Pseudobonzia* sp. 1

(Figs. 28 and 29)

Diagnosis - This species is readily recognized by the granulated propodosomal shield with subcuticular ridges, the strong reticular pattern only on coxae I-II and coxae III-IV.

Female – Dimension - Length of idiosoma 440-500 (477), width 310-350 (332); length of hypognathum 180-188 (185.80), width 105-120 (113.2); length of palp 160-178 (170.8); length of chelicera 170-183 (175.8); length of legs: I 265-285 (273); II 255-265 (260); III 300 (300); IV 320-335 (326.67).

Gnathosoma - Hypostome (Fig. 28D) subrectangular, coneshaped distally. Ventral surface of hypostome granulated with four pairs of *hg* setae, hg_4 longest. Palp with five segments (Fig. 28E) and palpal chaetotaxy as follows: Trochanter with no setae; basifemur with one dorsomedial simple seta; telofemur with one dorsomedian simple seta; genu with four simple setae; tibiotarsus with one long simple seta submedially and one small turbercle at distal 1/3 of the segment on inner surface, one short simple seta at the level of tubercle on outer surface, apically with one dorsal and one ventral simple setae, one long aciculate setae, terminating with a tridentate claw. Chelicera with two segments (Fig. 28C), segment I and II granulated with one simple subterminal seta behind chela.

Dorsum (Fig. 28A) – Propodosoma with a finely granulated shield with subcuticular band around anterior sensillum and running to nearly posterior sensillum; two pairs of propodosomal setae *ve* and *sce*, and two pairs of setose sensillae on the shield; setae *ve* and *sce* simple and subequal. Hysterosomal surface striate with dotlike lobes; bearing dorsal hysterosomal setae c_1, c_2, d_1, e_1, f_1, f_2, h_1 and h_2; setae h_1 longest; the cupule *ip* posteriolaterad of e_1.

Venter (Fig. 28B) – Coxae I-II and III-IV contiguous and with subcuticular reticulation except the anterior half region of coxae III which granulated, nine pairs of ventral simple setae (except coxal, genital and anal setae); genital shields granulated, reticulation absence, with four pairs of simple setae, arranged as shown in figure 28B. Anal region with three pairs of anal setae ps_1, ps_2, and ps_3, and one pair of cupule *ih*.

Legs (Fig. 29) – All legs shorter than idiosoma. Tarsi I-IV stout and without terminal lateral lobes. Number of setae on leg segments I-IV as follows: Coxae 3-3-3-2; trochanters 1-1-2-1; basifemora 5-6-5-2; telofemora 5-5-4-3; genu I, 4 attenuate

solenidia, 1 micrcroseta + 4; genu II, 3 attenuate solenidia + 5; genu III, 1 attenuate solenidion + 5; genu IV, 2 attenuate solenidia + 5; tibia I, 1 attenuate solenidion, 1 blunt solenidion + 5; tibia II, 1 blunt solenidion + 5; tibia III, 1 blunt solenidion + 5; tibia IV, 1 trichobothrium + 4; tarsi I, 2 attenuate solenidia, 2 blunt solenidia, 1 peglike seta, + 24 [including "dt" and "tsl" of Den Heyer (1979a)]; tarsi II, 1 blunt solenidion + 24; tarsi III, 21; tarsi IV, 21.

Male – Unknown.

Material examined - 1F, Pho Chon Kai, Bang Rachan, Sing Buri, on decomposing banana leave, 20. X. 2002. 1F, as previous data but on litter under *Streblus asper*; 2FF, Bang Khan Taek, Samut Songkhram 13°22′39′′ N 99°57′18′′E, on litter under *Citrus grandis*, 6. IX. 2002.

Distribution – Thailand, additional localities from this study (Fig 30): Sing Buri and Samut Songkhram.

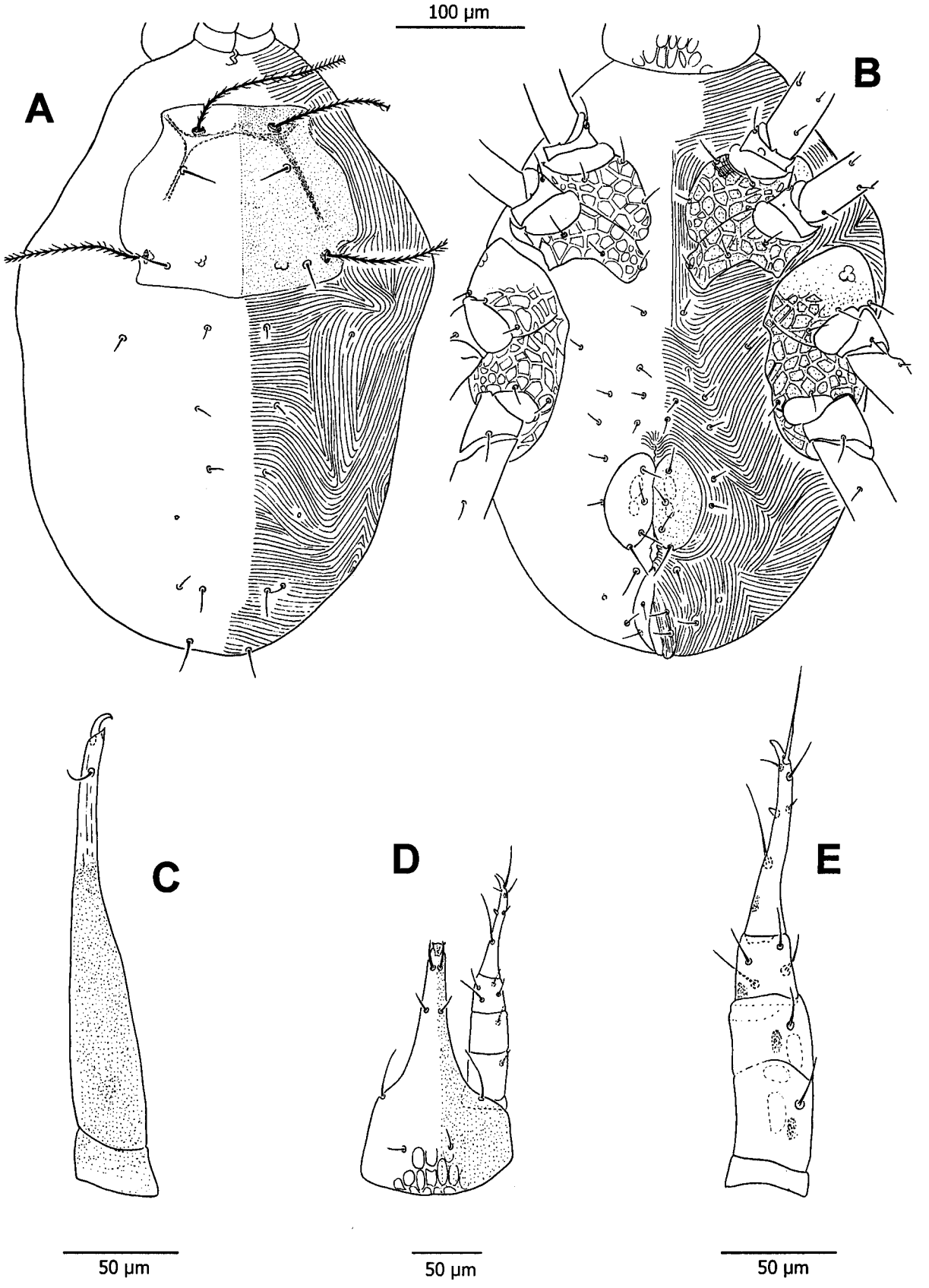

Figure 28. *Pseudobonzia* sp.1, female – A, dorsum; B, venter; C, chelicera; D, ventral hypostome; E, palp.

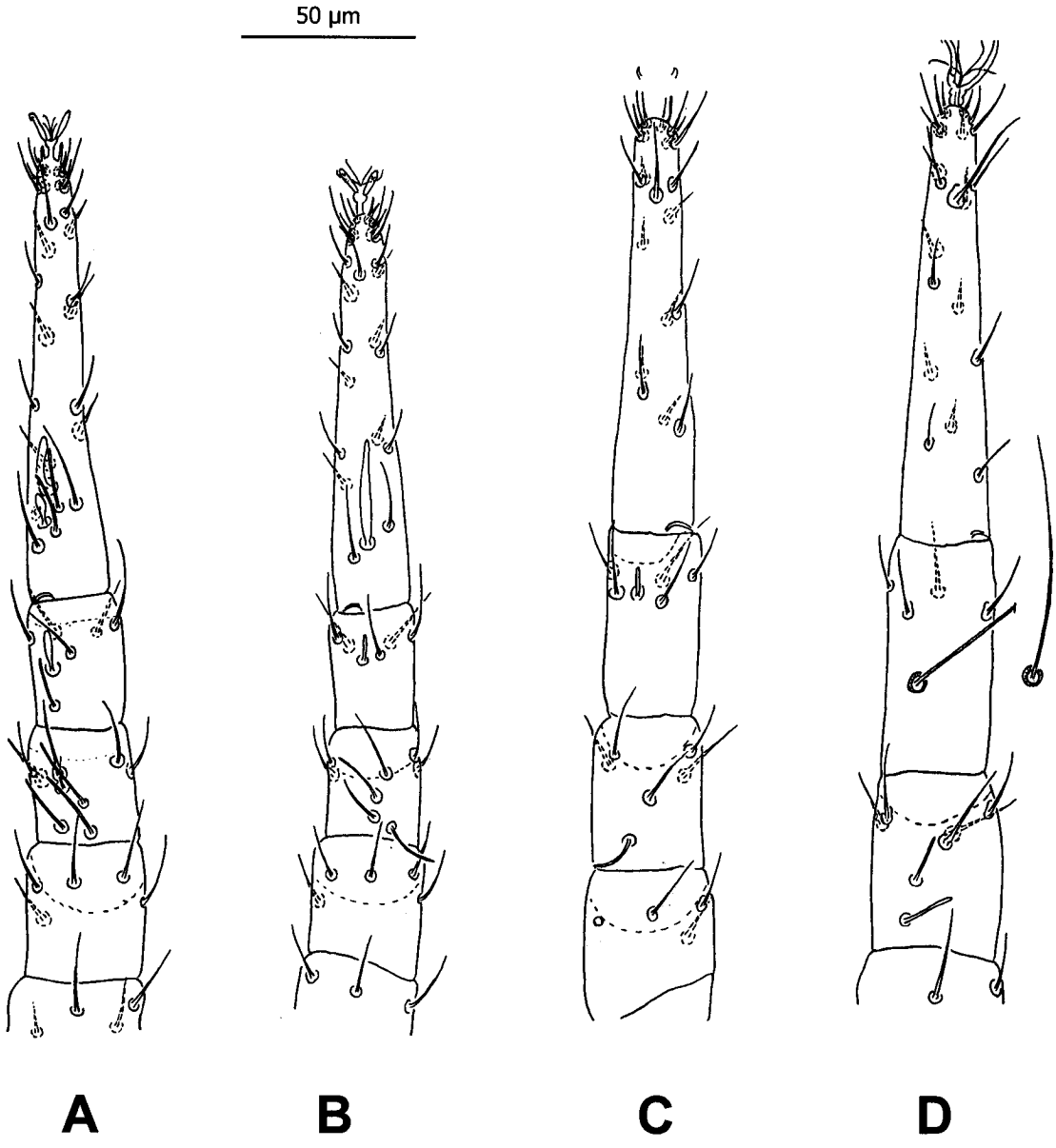

Figure 29. *Pseudobonzia* sp. 1, female – A, leg I; B, leg II; C, leg III; D, leg IV.

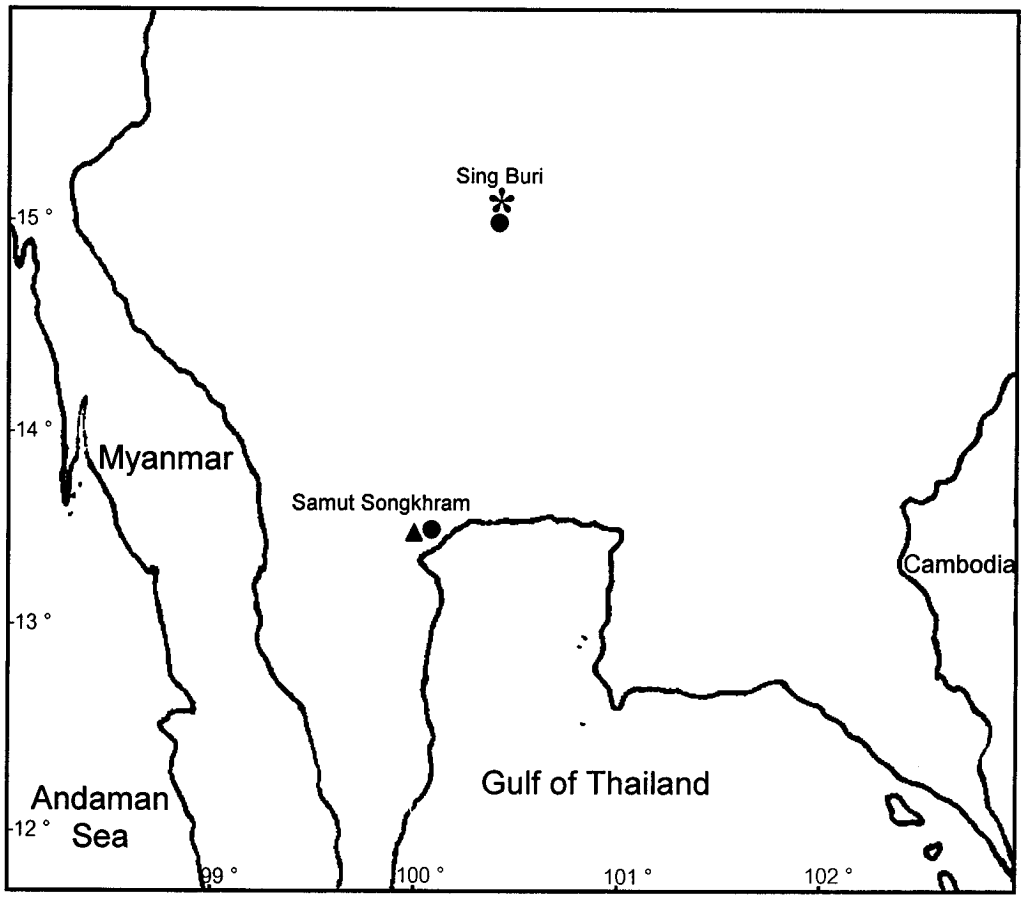

Figure 30. Collecting sites of *Pseudobonzia* sp.1 (circle), *P. clathratus* (triangle), and *P. gruezoi* (asterisk) in central Thailand.

Table 4-5. A comparison of main characters between species belonging to the genus *Pseudobonzia*.

Characters	*P. clathratus*	*P. gruezoi*	*P.* sp.1
seta on palp basifemur	spinelike	spinelike	simple
seta on palp telofemur	spinelike	spinelike	simple
tubercle on palp tibiotarsus	reduced	normal	normal
propodosomal shield	reticulate	granulate	granulate
ventral hypostome	reticulate	non-reticulate	non-reticulate
coxae I-II	reticulate	granulate	reticulate
coxae III-IV	reticulate	granulate	reticulate
genital shields	reticulate	granulate	granulate
Chaetotaxy of basifemora I-II-III-IV	3-3-2-1	5-5-4-2	5-6-5-2
Chaetotaxy of telofemora I-II-III-IV	5-5-4-3	4-5-4-3	5-5-4-3
number of solenidia on genu I-II-III-IV	3-2-1-1	4-3-1-2	4-3-1-2
number of solenidia on tibia I-II-III-IV	2-1-1-0	2-1-1-0	2-1-1-0

Genus *Scutascirus* Den Heyer, 1976

Scutascirus Den Heyer, 1976: 1; 1978c: 523; 1980e: 120; Sepasgosarian, 1984: 140; Corpuz-Raros and Garcia, 1996: 15; Lin *et al.*, 2001: 145. Type species: *Scutascirus polyscutosus,* Den Heyer 1976, by original designation.

Diagnosis: The palpus is five segments. Body is extensive sclerotization with numbers of reticulate plates on dorsum and venter. This genus is easily recognized by the coxae I and II fused as a sternal shield and by metapodal plates adjacent to lateral and genital plates.

Only one species was discovered in this study.

11. *Scutascirus pentascutellus* Corpuz-Raros and Garcia, 1996

(Figs. 31 and 32)

Scutascirus pentascutellus Corpuz-Raros and Garcia, 1996: 26.

Diagnosis - This species is recognized by the presence of a slender bifurcate tubercle on apical third of inner margin of palp tibiotarsus; five pairs of dorsolateral scutellar shields; and the distinct subcuticular reticulations on the sternal shield.

Female – Dimension - Length of idiosoma 260-295 (281.67), width 150-160 (153.33); length of hypognathum 85-90 (88.33), width 63-73 (68.67); length of palp 65-73 (68.67); length of chelicera 85-90 (83.33); length of legs: I 130-145 (140); II 130-140 (135); III 150-150 (150); IV 160-160 (160).

Gnathosoma - Hypostome (Fig. 31D) subrectangular, coneshaped distally. Ventral surface of hypostome granulated with subcuticular cells and four pairs of *hg* setae, hg_4 longest. Palp with five segments (Fig. 31E) and palpal chaetotaxy as follows: Trochanter with no setae; basifemur with one dorsomedial simple seta; telofemur with one dorsomedian simple seta; genu with four simple setae; tibiotarsus with one long basal simple seta, apical third of the segment with a bifercate tubercle, three simple setae, terminating with one long simple seta and a tridentate claw. Chelicera with two segments (Fig. 31C), segment I granulate, segment II dosobasal half reticulated, apical half granulated with one simple subterminal seta behind chela.

Dorsum (Fig. 31A) – Idiosoma with five pairs of dosolateral and two dorsomedial reticulated shields; the anterior dosomedial shield very large covering most part of idiosoma and bearing two pair of sensillar setae, setae *ve*, *sce*, c_1, c_2, d_1, e_1, f_1, f_2 and a pair of cupule *ip* forming slit structures posteriorly on lateral margins; the posterior dorsomedial shield subrectangular and bearing h_1; setae h_2 on a small reticulated platelet.

Venter (Fig. 31B) – Coxae I-II forming pentagonal-shaped sternal plate with seven pair of setae (including coxal setae); coxae III-IV forming lateral plates with a pore and three pairs of setae each; a pair of subtrianguar plates posteriorly lateral plates; genital plates reticulate with four pairs of simple setae, arranged as shown in figure 31B; all ventral plates reticulated; seven simple setae on membrane between these plates; anal region with two pairs of anal setae ps_1 and ps_2 on reticulated anal shields, and one pair of cupule *ih*.

Legs (Fig. 32) – All legs shorter than idiosoma; tarsi I-IV stout and without terminal lateral lobes. Number of setae on leg segments I-IV as follows: Coxae 3-3-3-3; trochanters 1-1-2-1; basifemora 4-6-4-2; telofemora 5-5-4-3; genu I, 4 attenuate solenidia, 1 micrcroseta + 4; genu II, 3 attenuate solenidia + 5; genu III, 1 attenuate solenidion + 5; genu IV, 1 attenuate solenidion 5; tibia I, one blunt solenidion + 5; tibia II, 1 blunt solenidion + 5; tibia III, 1 blunt solenidion + 5; tibia IV, 1 trichobothrium + 4; tarsi I, 2 attenuate solenidia, 2 blunt solenidia, 1 peglike seta, + 24

[including "dt" and "tsl" of Den Heyer (1979a)]; tarsi II, 1 blunt solenidion + 23; tarsi III, 19; tarsi IV, 20.

Male – Thai materials unknown.

Type – Female Holotype, Makiling Botanical Gardens, Los Banos, Laguna, the Philippines, on topsoil from mixed plantation of dipterocarps, 8. V. 1976, by R. C. Garcia. Type deposited in the Museum of Natural History of the University of the Philippines, Los Banos.

Material examined - 2FF, near Sam Lan waterfall, Saraburi 14° 25′56′′ N 100°57′51′′E, on forest topsoil-litter, 7. IV. 2003; 1F, Bang Khan Taek, Samut Songkhram 13°22′39′′N 99°57′18′′E, on topsoil -litter under *Citrus grandis*, 6. IX. 2002.

Distribution – The Philippines; Thailand, additional localities from this study (Fig. 33): Saraburi and Samut Songkhram.

Remarks – Thai specimens slightly differ from original description of *Scutascirus pentascutellus* in that setae h_2 are located on a small platelet. These plates are absent in original description (Corpuz-Raros and Garcia, 1996)

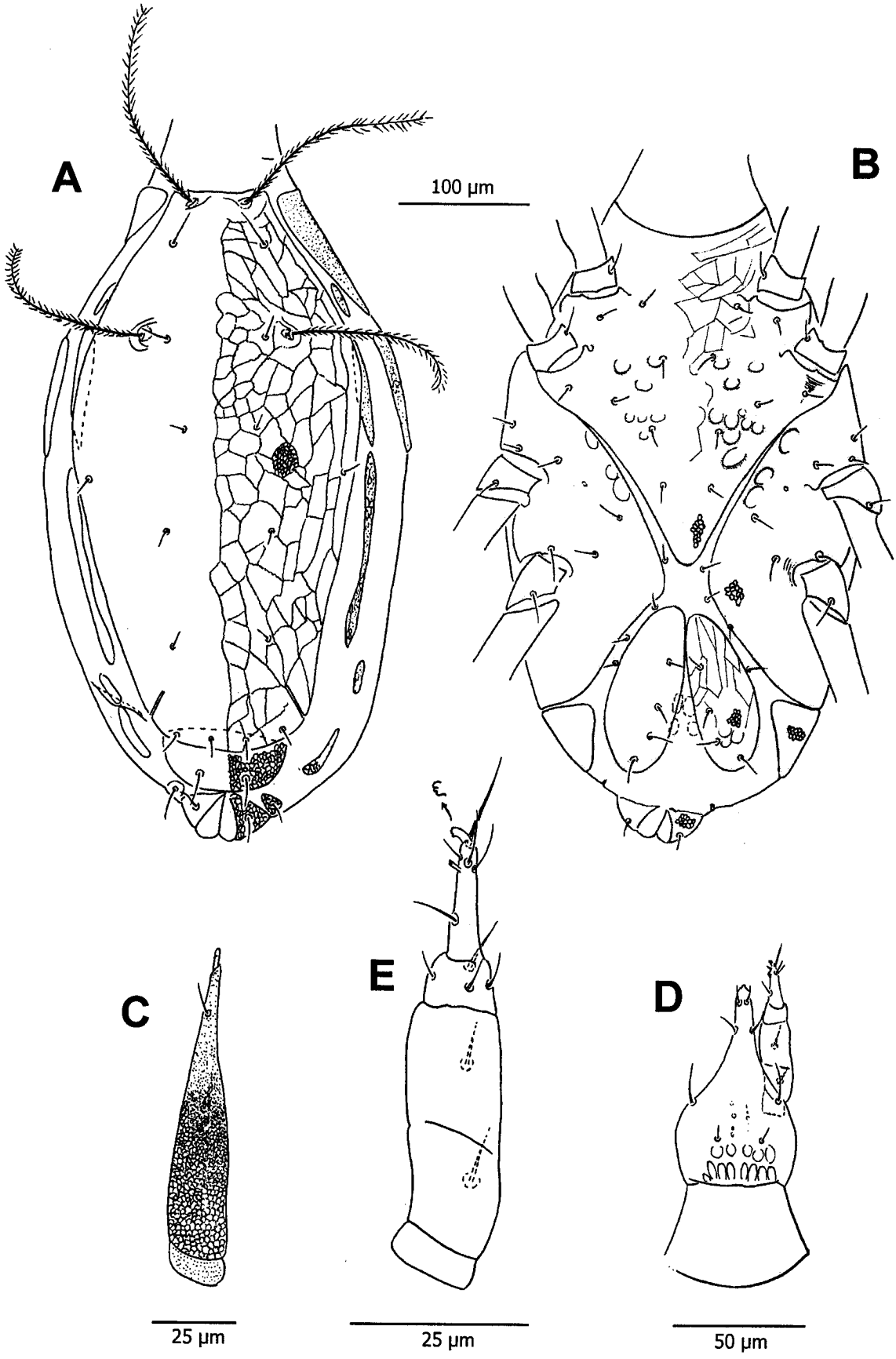

Figure 31. *Scutascirus pentascutellus*, female – A, dorsum; B, venter; C, chelicera; D, ventral hypostome; E, palp.

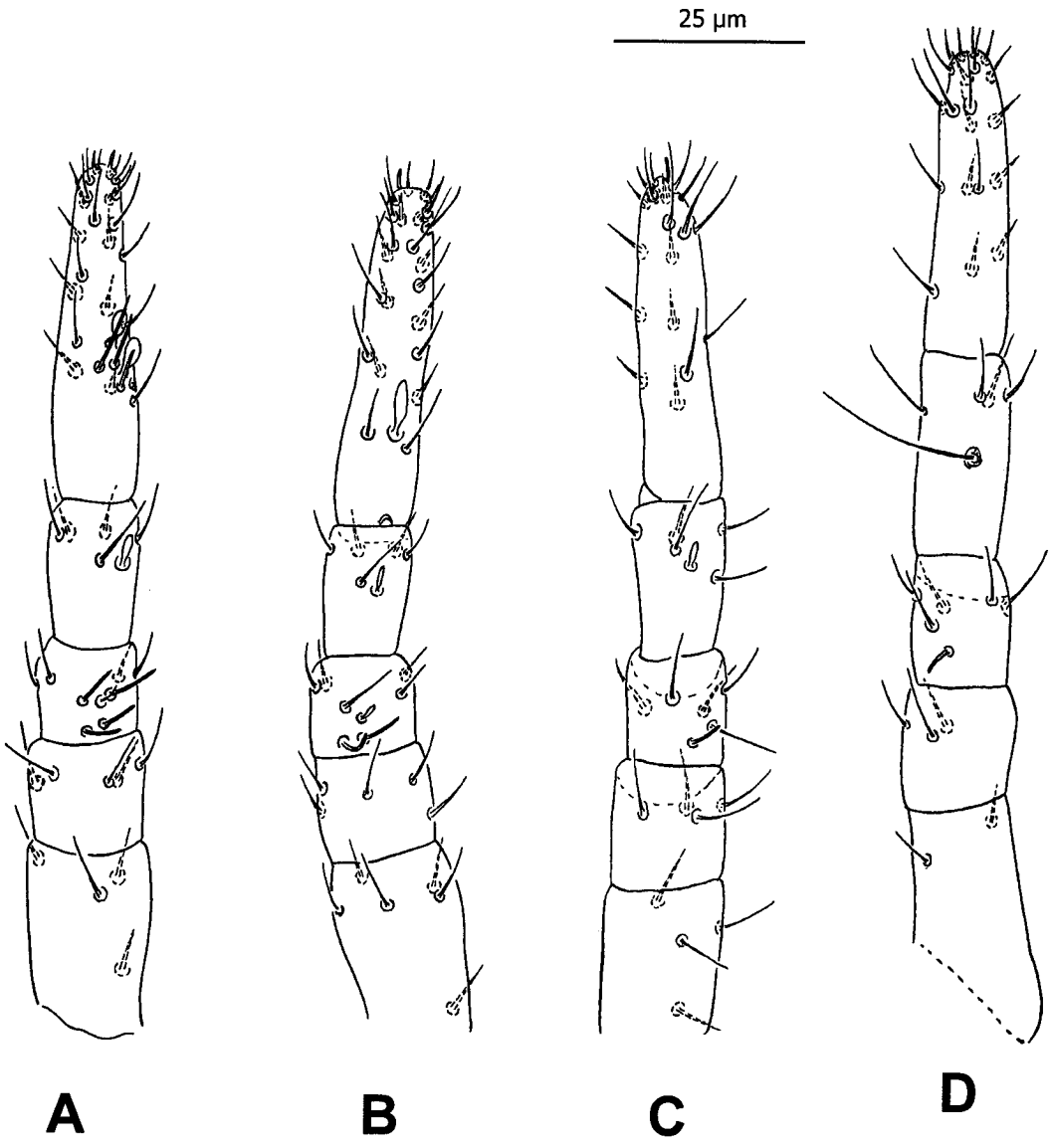

Figure 32. *Scutascirus pentascutellus*, female – A, leg I; B, leg II; C, leg III; D, leg IV.

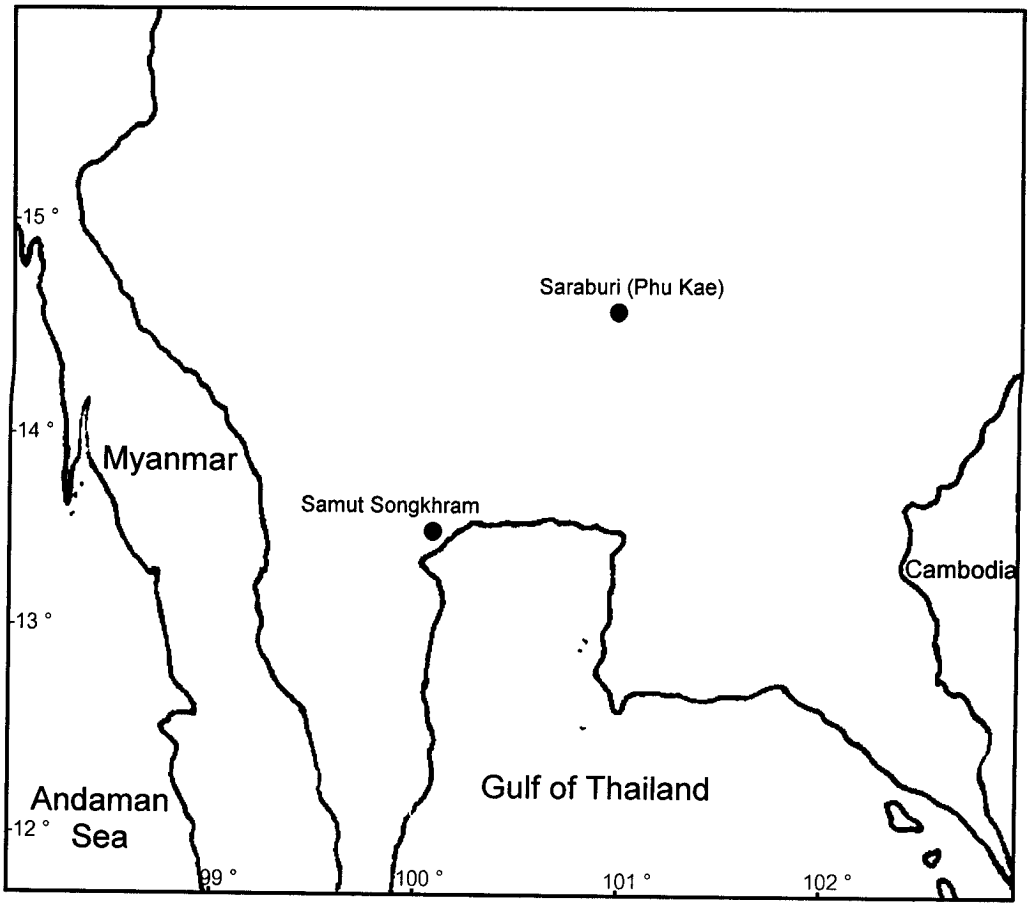

Figure 33. Collecting sites of *Scutascirus pentascutellus* in central Thailand.

Subfamily Cunaxiinae Oudemans, 1902

Cunaxiinae Oudemans, 1902: 58.

Diagnosis: Palpi slender, five segments. Palpi tibiotarsus terminating with a short seta and a small claw. Setae hg_1 simple. Dorsal propodosoma with a single shields. Dorsal hysterosoma with 1-3 shields or without shields. Setae f_2 absent. Legs long and slender, tarsi I-IV with lateral lobed or flanges.

Key to the Genera of Cunaxiinae

1. Palpal genu apically with elongate apophysis..... 2
   Palpal genu apically without elongate apophysis .....*Cunaxa*
2. Tarsi I with an elongate base solenidion.....*Dactyloscirus*
   Tarsi I without an elongate base solenidion..... *Armascirus*

Genus *Armascirus* Den Heyer, 1978

Armascirus Den Heyer, 1978b: 217; 1979c: 70; 1981c: 4; Sepagosarian, 1984: 142; Liang, 1985: 79; Smiley, 1992: 135; Corpuz-Raros, 1995: 160. Type-species: *Armascirus huyssteeni* Den Heyer, by original designation.

Diagnosis – Palpal five segments, extending beyond the apex of the hypostome, and with an apophysis on the palpal telofemur and palpal genu; propodosomal shield reticulate; tarsi I-IV long and slender, terminating with large, conspicuous lateral bilobed flanges; tarsi I without an elongate base solenidion.

Armascirus taurus and 1 unidentified species were recognized in this study. A comparison of their main characters is present in Table 4-6.

12. *Armascirus taurus* (Kramer, 1881)

(Figs. 34 and 35)

Scirus taurus Kramer, 1881: 17; Berlese 1888: 65.

Scirus quadripilus Banks, 1894: 220.

Cunaxa taurus (Kramer) Thor, 1902: 160; 1912: 389; Vitzthum, 1929: 60; Womersley, 1933: 111; Thor and Willmann, 1941: 168; Baker and Hoffmann, 1984: 232; Baker and Wharton, 1952: 322; Hughes, 1961: 174; 1976: 258; Shiba, 1969: 93; Kuznetzov and Livshitz, 1979b: 1233; Tseng, 1980: 257.

Cunaxa armata Bank, 1914: 55.

Armascirus taurus (Kramer), Den Heyer, 1978b: 216; Sepasgosarian, 1984: 144; Liang, 1985: 79; Smiley, 1992; 149; Corpuz-Raros, 1995: 163.

Indocunaxa smileyi Gupta and Ghosh, 1980: 193.

Diagnosis – This species is recognized from other congeneric species by the presence of two stout spines on inner surface of palp genu, reticulate propodosomal and lateral hysterosomal shields, and a median hysterosomal shield associated with one pair of setae d_1.

Female – Dimension - Length of idiosoma 370-855 (554), width 268-577 (379); length of hypognathum 220-295 (238), width 115-135 (118); length of palp 275-375 (295); length of chelicera 210-275 (213.5); length of legs: I 371-546 (409.1); II 330-484 (365.56.); III 401-567 (428.75); IV 433-618 (472.78).

Gnathosoma - Dorsolateral and ventrolateral surface of hypostome (Fig. 34D) reticulated with four pairs of *hg* setae, hg_4 longest, and two pairs of adoral setae. Palp with five segments (Fig. 34E) and palpal chaetotaxy as follows: Trochanter with no setae; basifemur with one dorsal simple seta; telofemur with one elongate apophysis on inner surface and one apical dorsomedian spinelike seta; genu apically with one elongate subtriangular apophysis and one stout spinelike setae on inner surface, one short simple seta and spinelike setae on outer surface, and basally with one stout longer spinelike seta on inner surface; tibiotarsus basally with one long simple seta on inner surface, medially with one stout spinelike seta on inner surface and two short simple setae on outer surface, terminating with one short seta and small claw. Chelicera with two segments (Fig. 34C), segment I granulated, segment II dorsobasally reticulate, one long simple subterminal seta behind chela.

Dorsum (Fig. 34A) – Propodosoma with a reticulated shield, bearing two pairs of simple propodosomal setae, *ve* and *sce*, and two pairs of setose sensillae; setae *sce* and *ve* subequal; Hysterosoma with a pair of reticulated lateral shields and a medial hysterosomal shield which associated with one pair of setae d_1; integument striae densely granulate; dorsal hysterosomal setae simple, f_1 and h_1 about two times of anterior setae.

Venter (Fig. 34B) – Coxae I-II and III-IV contiguous. Coxa I and coxa II mainly reticulate with small portion granulate, coxae III-IV totally reticulate. Six pairs of ventral simple setae: ag_1, ag_2 and four setae (except coxal, genital and anal setae). Genital shields granulated with a band of reticulation each, four pairs of subequal

simple setae, arranged as shown in figure 34B. Anal region with h_1, ps_1, ps_2, and one pair of cupule *ih*.

Legs (Fig. 35) – Leg IV longest, and longer than idiosoma. Tarsi I-IV gradually tapering with small conspicuous terminal lateral lobes. Number of setae on leg segments I-IV as follows: Coxae 3-2-3-3; trochanters 1-1-2-1; basifemora 5-5-4-2; telofemora 4-4-4-4; genu I, 4 attenuate solenidia, 1 micrcroseta + 4; genu II, 2 attenuate solenidia + 5; genu III, 1 attenuate solenidion + 5; genu IV, 2 attenuate solenidia + 5; tibia I, 2 attenuate solenidia, 1 microseta + 4; tibia II, 1 attenuate solenidion + 5; tibia III, 1 short blunt solenidion + 5; tibia IV, 1 trichobothrium + 4; tarsi I, 4 solenidia, 1 peg-like seta, 1 microseta + 22 [including "dt" and "tsl" of Den Heyer (1979a)]; tarsi II, 1 short blunt solenidion + 21; tarsi III, 19; tarsi IV, 18.

Male – According to Smiley (1992), male is similar to female, but differs in having longer and finer sensory setae.

Type – Location of type is not known (Smiley, 1992).

Material examined - 3FF, Chulalongkorn University Campus 13°44′40′′N 100°31′69′′E, on litter *Sananea saman*, 9. II. 2003; 1F, Bueng Chawak, Suphan Buri 14°55′49′′ N 100°02′49′′E, alt. 29 m., on litter *Muntingia* sp., 28. III. 2003; 1F, Bueng Chawak, Suphan Buri 14°55′49′′ N 100°02′49′′E, alt. 29 m., on litter *Delonix* sp., 28. III. 2003; 2FF, Kaeng Sam Chan, Sarika, Nakhon Nayok 14°18′05′′N 101°18′17′′E, on litter of *Citrus grandis*, 7. VI. 2003; 10FF, Pho Chon Kai, Bang Rachan, Sing Buri, on litter under *Citrus grandis*, 17. X. 2002; 1F, near Sam Lan waterfall, Saraburi 14°25′56′′N 100°57′51′′E, on forest litter, 7. IV. 2003; 1F, near Sarika waterfall, Nakhon Nayok 14°18′17′′ N 101°15′ 33′′E, on forest litter, 7. IV. 2003; 3FF, Bang Khan Taek, Samut Songkhram 13°22′46′′N 99°57′24′′E, alt. 1 m., on coconut litter, 25. III. 2003; 3FF, Bang Khan Taek, Samut Songkhram, on coconut litter, 23. XI. 2002.

Distributions – Cosmopolitan –Thailand, additional localities from this study (Fig. 38): Bangkok, Nakhon Nayok Suphan Buri, Sing Buri, Saraburi and Samut Songkhram.

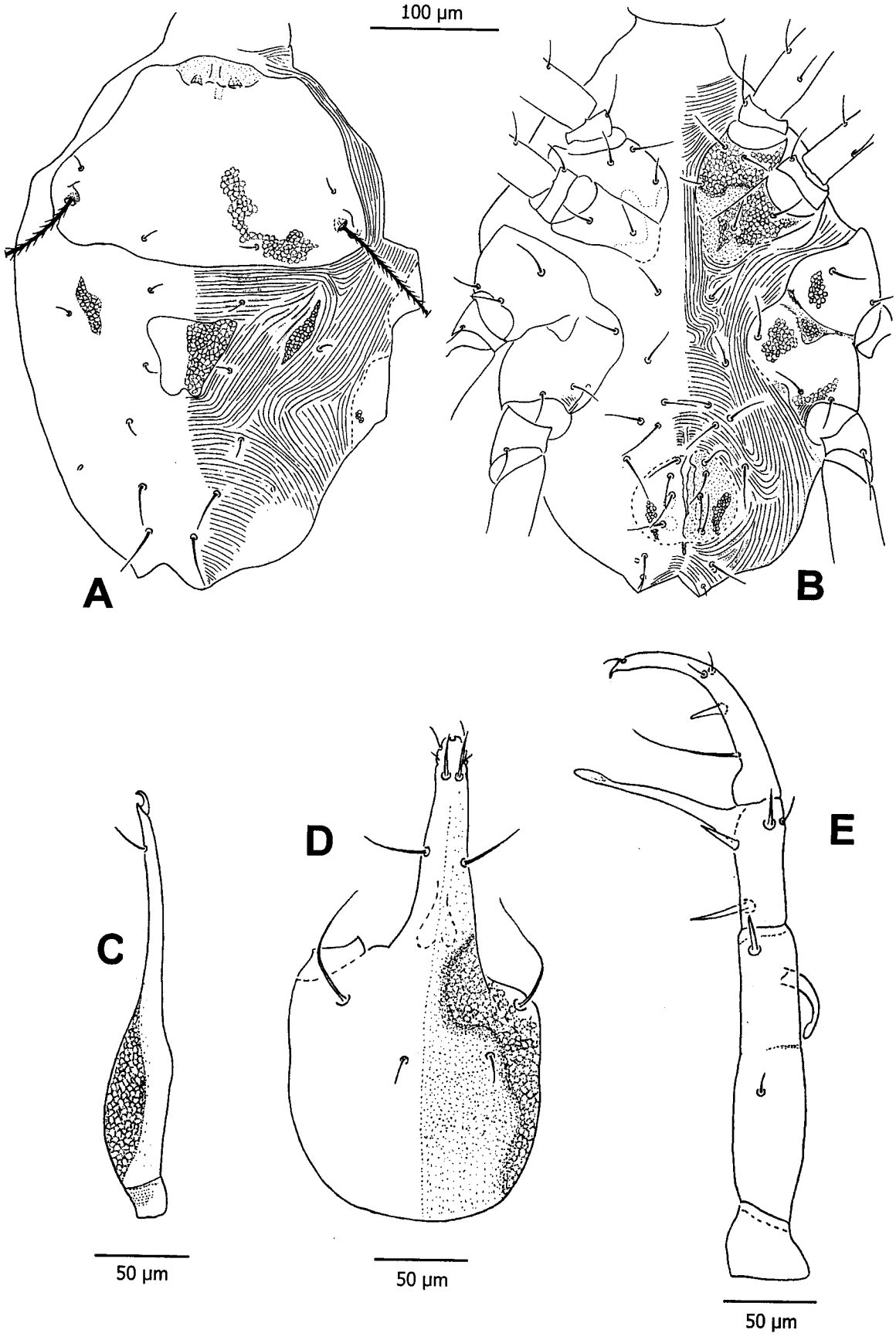

Figure 34. *Armascirus taurus*, female – A, dorsum; B, venter; C, chelicera; D, ventral hypostome; E, palp.

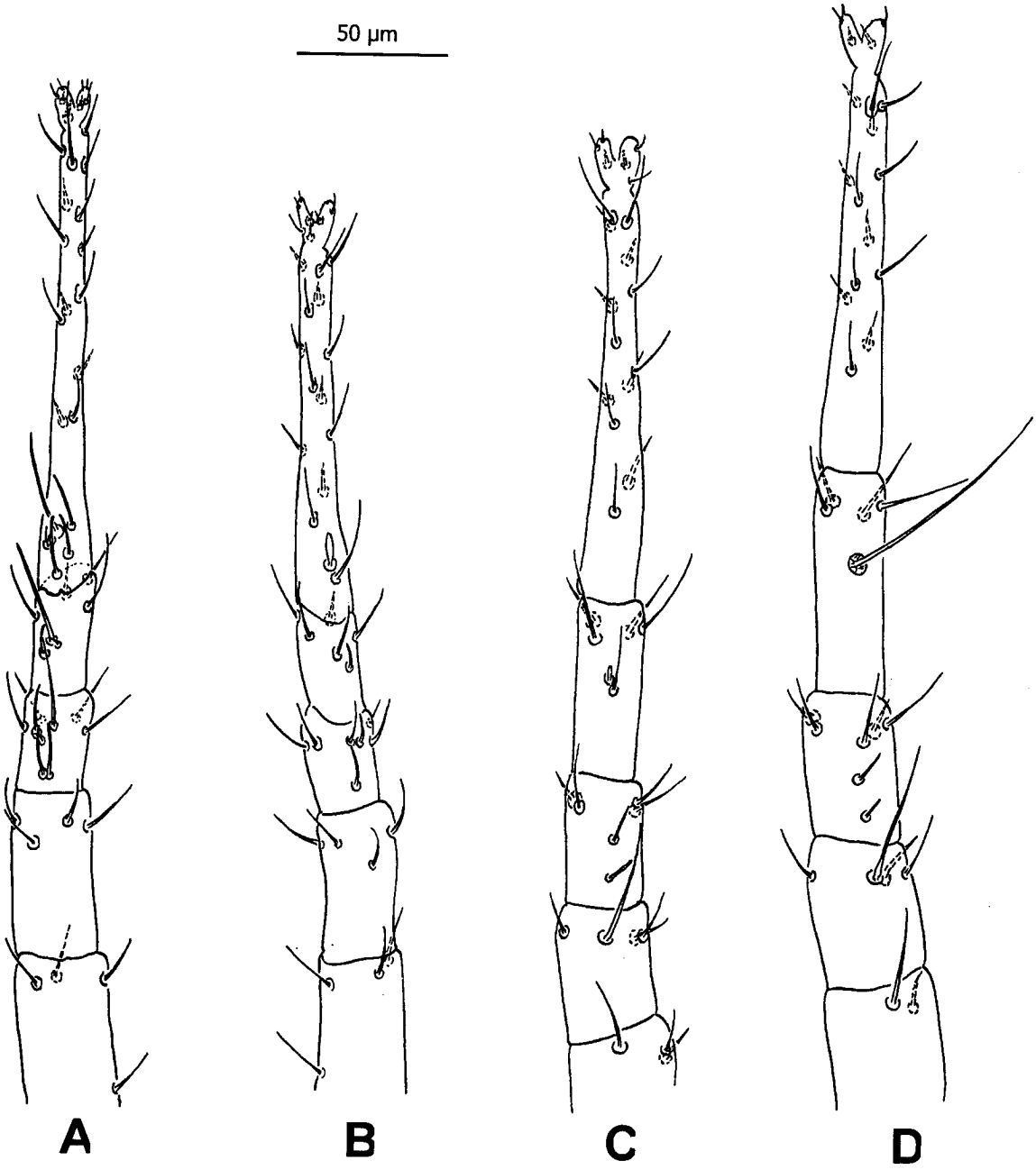

Figure 35. *Armascirus taurus*, female – A, leg I; B, leg II; C, leg III; D, leg IV.

13. *Armascirus* sp. 1

(Figs. 36 and 37)

Diagnosis – This species mostly resemble *A. huyssteeni* Den Heyer, 1978b, in the configurations of palpal chaetotaxy and in having two lateral and one median hysterosomal shield. However, they can be distinguished by the median hysterosomal shield, which is smaller and without setae d_1 in *Armascirus* sp. 1 while a pair of setae d_1 is on the median hysterosomal shield in *A. huyssteeni*.

Female – Dimension - Length of idiosoma 557-639 (598), width 350-412 (381); length of hypognathum 235-300 (263.33), width 105-120 (112.5); length of palp 325-350 (341.67); length of chelicera 213-250 (231.5); length of legs: I 464-516 (490); II 433 (433); III 525-567 (546); IV 567-845 (706).

Gnathosoma - Dorsolateral and ventrolateral surface of hypostome (Fig. 36D) reticulated with four pairs of *hg* setae, hg_4 longest, and two pairs of adoral setae. Palp with five segments (Fig. 36E) and palpal chaetotaxy as follows: Trochanter with no setae; basifemur with one dorsal simple seta; telofemur with one elongate apophysis and one spinelike apophysis on inner surface and one apical dorsomedian spinelike seta; genu apically with one elongate subtriangular apophysis and one spinelike seta on inner surface, one short ventral simple seta and dorsal spinelike seta on outer surface, and basally with one long simple seta on inner surface; tibiotarsus basally with one short simple seta on inner surface, medially with one stout spinelike seta on inner surface and two short simple setae on outer surface, terminating with one short seta and small claw. Chelicera with two segments (Fig. 36C), segment I granulated, segment II dorsobasally reticulate, one long simple subterminal seta behind chela.

Dorsum (Fig. 36A) – Propodosoma with a reticulated shield, bearing two pairs of simple propodosomal setae, *ve* and *sce*, and two pairs of setose sensillae; setae *sce* and *ve* subequal; Hysterosoma with a pair of reticulated lateral shields and a medial reticulated hysterosomal shield; integument striae densely granulate; dorsal hysterosomal setae simple, h_1 longest and thickest, about two times of anterior seta.

Venter (Fig. 36B) – Coxae I-II and III-IV contiguous and totally reticulate. Six pairs of ventral setae (except coxal, genital and anal setae), of which two pairs of setae anterior to genital shields long and thickest. Genital shields granulated with four pairs of simple setae, increase in length posteriorly and arranged as shown in figure 36B. Anal region with setae h_1, ps_1, ps_2, and one pair of cupule *ih*.

Legs (Fig. 37) – Leg IV longest, and longer than idiosoma. Tarsi I-IV gradually tapering with small conspicuous terminal lateral lobes. Number of setae on leg segments I-IV as follows: Coxae 3-2-3-3; trochanters 1-1-2-1; basifemora 5-5-4-2; telofemora 4-4-4-4; genu I, 4 attenuate solenidia, 1 micrcroseta + 4; genu II, 2 attenuate solenidia + 5; genu III, 1 attenuate solenidion + 5; genu IV, 2 attenuate solenidia + 5; tibia I, 2 attenuate solenidia, 1 microseta + 4; tibia II, 1 attenuate solenidion + 5; tibia III, 1 short blunt solenidion + 5; tibia IV, 1 trichobothrium + 4; tarsi I, 4 solenidia, 1 peg-like seta, 1 microseta + 21 [including "dt" and "tsl" of Den Heyer (1979a)]; tarsi II, 1 attenuate solenidion + 23; tarsi III, 20; tarsi IV, 20.

Male – Unknown

Material examined - 2 FF, Bang Khan Taek, Samut Songkhram 13°22′56″ N 99°57′36″E, alt. 1 m., on mango leaves, 21. XI. 2002; 1F, Phukae Botanical garden, Saraburi 14°40′30″N 100°53′10″E, on litter, 7. IV. 2003.

Distributions – Thailand, additional localities from this study (Fig. 38): Samut Songkhram and Saraburi.

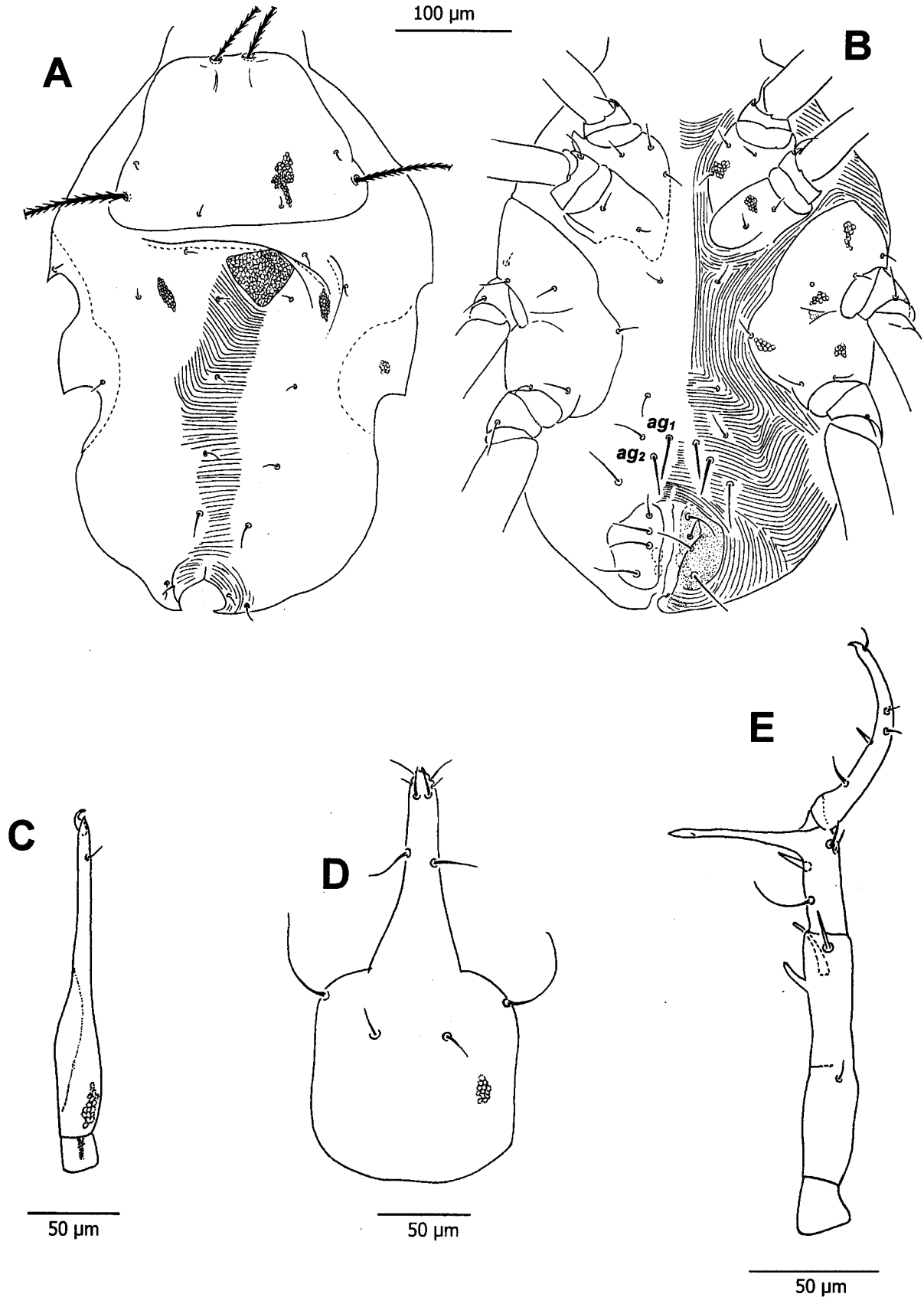

Figure 36. *Armascirus* sp. 1., female – A, dorsum; B, venter; C, chelicera; D, ventral hypostome; E, palp.

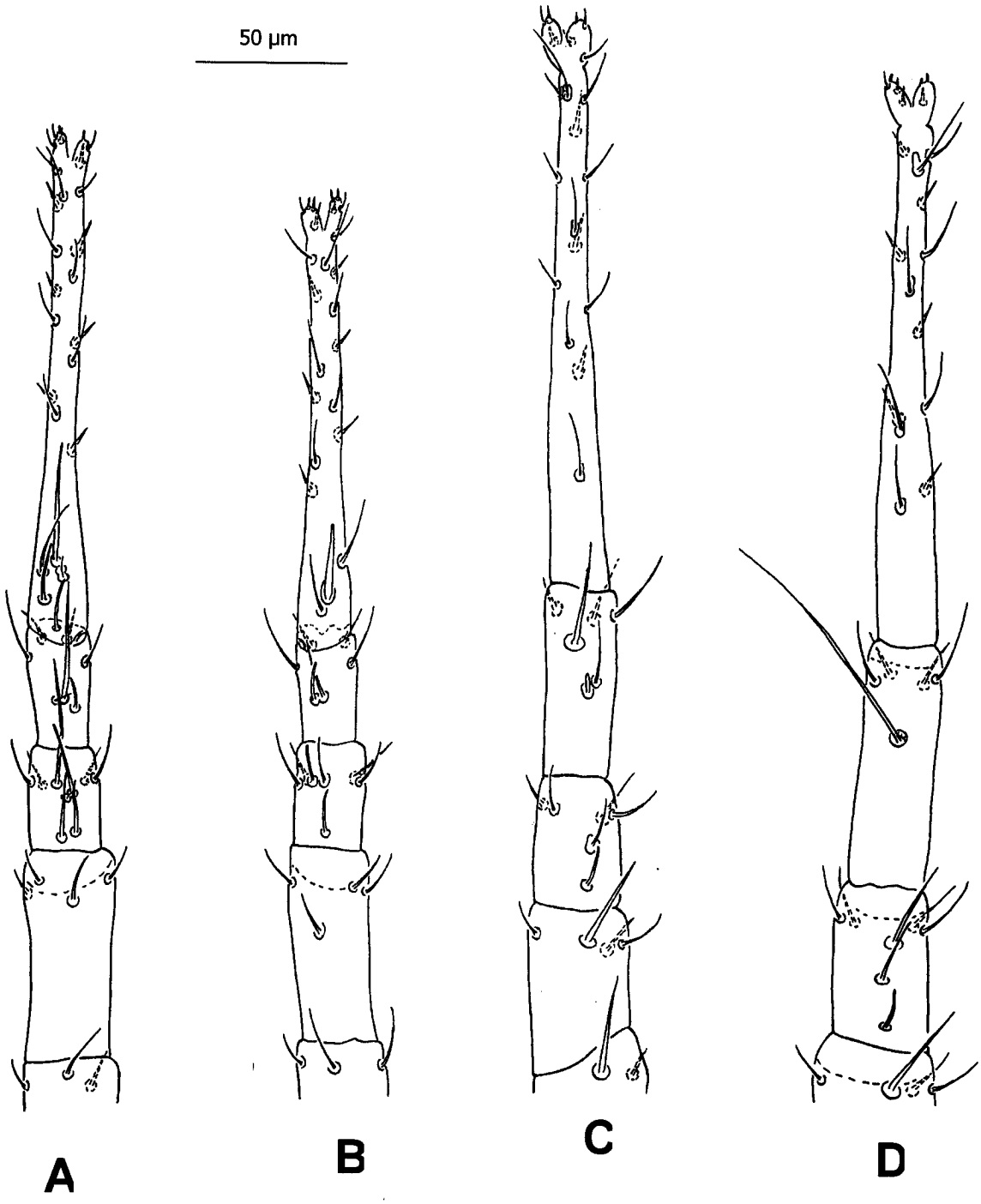

Figure 37. *Armascirus* sp. 1, female – A, Leg I; B, Leg II; C, Leg III; D, Leg IV.

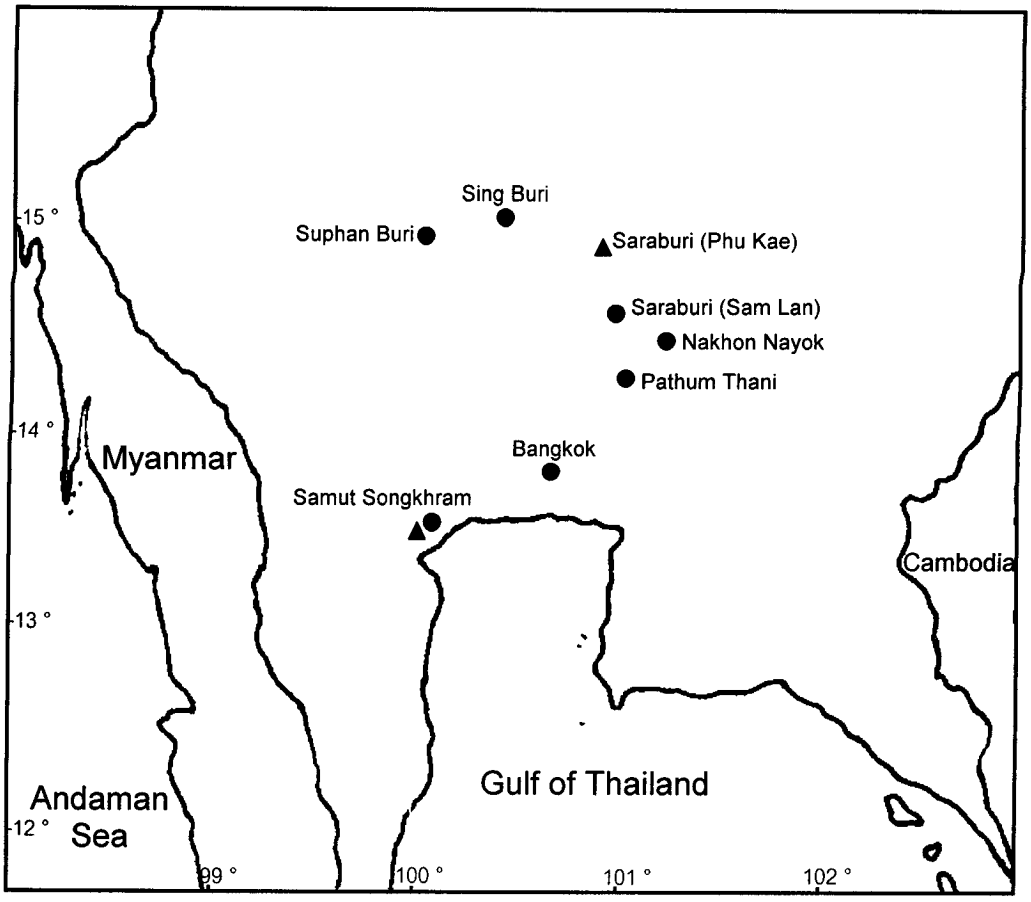

Figure 38. Collecting sites of *Armascirus taurus* (circle), and *Armascirus* sp.1 (triangle) in central Thailand.

Table 4-6. A comparison of main characters between species belonging to the genus *Armascirus*.

Characters	*A. taurus*	*A.* sp. 1
propodosomal shield	reticulate	reticulate
medial shield on hysterosoma	present	present
lateral shields on hysterosoma	present	present
apohysis on palp telofemur	1	2
basal seta on palp telofemur	spinelike	simple
basal seta on palp tibiotarsus	very long	short
setae *ag*	simple	thick
reticulation on genital shields	present	absent
setae f_1	short, simple	long, thick
ratio f_1/e_1	2	1
Chaetotaxy of basifemora I-II-III-IV	5-5-4-2	5-5-4-2
Chaetotaxy of telofemora I-II-III-IV	4-4-4-4	4-4-4-4
number of solenidia on genu I-II-III-IV	4-2-1-2	4-2-1-2
number of solenidia on tibia I-II-III-IV	2-1-1-0	2-1-1-0

Genus *Cunaxa* Von Heyden, 1826

Cunaxa Von Heyden, 1826: 609; Thor and Willmann, 1941: 165; Baker and Hoffmann, 1948: 230; Baker and Wharton, 1952: 193; Atyeo 1958: 173; Meyer and Ryke, 1959: 370; Muma, 1960: 322; Hughes, 1976: 257-258. Heryford, 1965: 310; Shiba, 1969: 91-93; Shiba, 1976: 106; Krantz, 1978: 153; Smiley, 1975:238; Den Heyer, 1978b: 218; 1979a: 24; 1979e: 159; 1980c: 6; Tseng, 1980: 253; Gupta and Ghosh, 1980: 194: Sepasgosarian, 1984: 139; Michoka, 1987: 92; Simley, 1992: 153; Gupta, 1991: 228-230; Gupta, 1992: 135-140; Corpuz-Raros and Garcia, 1995; 605; Khaustov and Kuznetsov, 1998: 1332-1341; Chinniah and Mohanasundaram, 2001: 529; Sionti and Papadoulis, 2003b: 319. Type species: *Scirus setirostris* Hermann, 1804, by original designation.

Scirus Hermann, 1804: 62; Gervias, 1841: 6; Koch, 1842: 76-77; Kramer 1877: 245; Berlese, 1887, 64; Berlese, 1897 138; Hull, 1981: 37. Type species: *Scirus longirostris* Hermann, 1804 by original designation.

Scirus Duges, 1834: 42. Type species: *Scirus setiroatris* Hermann, 1804, by original designation.

Rubroscirus Den Heyer, 1979b: 70-92. Type species: *Rubroscirus africanus* Den Heyer, 1979b by original designation.

Diagnosis: Palpus is five segments. Palpal genu apically without large subrectangular apophysis; tarsi I-IV long, slender, tapering and without large conspicuous lateral bilobed flanges.

Six described species of *Cunaxa* and three unidentified species were recognized in this study. Key to described species is given below, and a comparison of main characters between these species is present in Table 4-7.

Key to the Species of *Cunaxa* in Central Thailand

1. Propodosomal shield smooth 2
   Propodosomal shield reticulate.....4
2. Hystherosomal shield present.....3
   Hystherosomal shield absent.... .....*C. setirostris*
3. Hystherosomal shield distinctly defined..... *C. grobleri*
   Hystherosomal shield indistinctly defined .....*C. romblonensis*
4. Setae *sce* simple.....5
   Setae *sce* spiculate .....*C. venusae*
5. Reticulations of propodosomal shield composed of large cells; setae f_1 long, reaching over the base of setae h_1..... *C. lukoschusi*
   Reticulations of propodosomal shield composed of small cells; setae f_1 short, reaching the base of setae h_1..... .....*C. vizcayana*

14. *Cunaxa grobleri* Den Heyer, 1979

(Figs. 39 and 40)

Cunaxa grobleri Den Heyer, 1979a: 37; Smiley, 1992: 175.

Diagnosis - This species is similar to *Cunaxa womersleyi* (Baker and Hoffman, 1948). They can be separated by setae e_1 not extending past the edge of the hysterosomal shield in *C. womersleyi*, whereas setae e_1 extends past the hysterosomal shield in *C. grobleri*.

Female – Dimension - Length of idiosoma 345-375 (365), width 225-275 (257); length of hypognathum 123-138 (132), width 72.5-82.5 (76.25); length of palp 155-168 (161.8); length of chelicera 108-123 (118.4).

Gnathosoma - Hypostome (Fig. 39D) subrectangular, coneshaped distally; ventral surface papiliated with subcuticular ridges and four pairs of *hg* setae, hg_4 longest, and two pairs of adoral setae. Palp with five segments (Fig. 39E) and palpal chaetotaxy as follows: Trochanter with no setae; basifemur with one dorsomedial simple seta; telofemur with one fingerlike apophysis on inner surface and one dorsomedian simple seta; genu with one long spinelike seta on inner surface and two simple setae, one dorsal and one ventral, on outer surface; tibiotarsus with one long dorsal simple seta on inner surface close to posterior edge, medially one long spinelike setae associated with a small spurlike process, one long simple ventral seta in middle of this segment, one short dorsolateral seta on external surface, terminating with one simple seta and small claw. Chelicera with two segments (Fig. 39C), segment I with dense papillae, segment II with few papillae basally and with one simple subterminal seta behind chela.

Dorsum (Fig. 39A) – Propodosoma with a smooth subrectangular shield bearing two pairs of propodosomal setae, *ve* and *sce*, and two pairs of setose sensillae. Setae *sce* as long as distance between their bases. Hysterosoma separated from propodosoma by smooth striae. Hysterosoma with a smooth subrectangular medial shield bearing simple setae c_1, c_2, d_1, and e_1. Setae c_1 longest. Setae f_1 and h_1 born on smooth striae integument.

Venter (Fig. 39B) – Totally covered by smooth striae which are denser on coxal regions. Coxae I-II and III-IV contiguous with subcuticular punctuation. Five pairs of simple setae (except coxal, genital and anal setae). Genital shields not clearly demarcated, covered by finer smooth striae with a group of subcuticular punctuation

each. Genital shields with four pairs of subequal simple setae arranged as shown in figure 39B. Anal region with one pair of anal and one pair of paraanal setae.

Legs (Fig. 40) – All legs shorter than idiosoma. Legs IV longest. Tarsi tapering with inconspicuous terminal lateral lobes. Number of setae on leg segments I-IV as follows: Coxae 3-1-3-2; trochanters 1-1-2-1; basifemora 4-4-2-1; telofemora 4-4-4-4; genu I, 3 attenuate solenidia and a base without solenidion, 1 micrcroseta + 4; genu II, 2 attenuate solenidia + 5; genu III, 1 attenuate solenidion +5; genu IV, 1 attenuate solenidia + 5; tibia I, 2 attenuate solenidia, 1 microseta + 4; tibia II, 1 attenuate solenidion + 5; tibia III, 1 short blunt solenidion + 5; tibia IV, 1 trichobothrium + 4; tarsi I, 4 attenuate solenidia,1 peglike seta, 1 microseta + 23 [including "dt" and "tsl" of Den Heyer (1979a)]; tarsi II, 1 blunt solenidion + 24; tasi III, 25; tasi IV, 20.

Male – Thai materials unknown.

Type – Female holotype, on *Ananas* sp., Malkens, Swaziland, during 1968, by D. G. Grobler. Type deposited in mite collection of the Institute for Zoological Research, Potchefstroom University, Republic of South Aftrica.

Material examined - 9FF, Pho Chon Kai, Bang Rachan, Sing Buri 14°54′ 56′′ N 100°17′27′′E, alt. 17 m., on litter of *Tamarindus indicus*, Linn., 28. III. 2003; 6FF, Pho Chon Kai, Bang Rachan, Sing Buri, on soil under *Citrus grandis*. 17. VIII. 2002; 9FF, Phatthana Nikhom, Lop Buri 14°51′18′′N 101°00′11′′E, alt. 64 m., on coconut litter, 7. IV. 2003; 3FF, Bueng Chawak, Suphan Buri 14°′55′49′′N 100°02′49′′E, alt. 17 m., on litter under *Delonix* sp., 28. III. 2003; 6FF, Tha Ruea, Ayutthaya 14°33′03′′N 100°41′91′′E, alt. 18 m., on *Samanea saman* litter, 28. III. 2003; 1F, Sala Loy, Tha Ruea, Ayutthaya, on grasses, 25, VIII, 2002; 12FF, Phu Muang, U Thong, Suphan Buri 14°20′91′′N 99°51′60′′E, alt. 27 m., on forest litter, 16. III. 2003; 1F, Ban Nong Pongnok, Kamphaeng Saen, Nakhon Pathom 14°02′57′′N 99°56′08′′E, alt. 20 m., on litter under *Tamarindus indicus*, Linn., 16. III. 2003.

Distributions – South Africa; Thailand, additional localities from this study (Fig. 41): Suphan Buri, Ayutthaya, Nakhon Pathom, Lop Buri and Sing Buri.

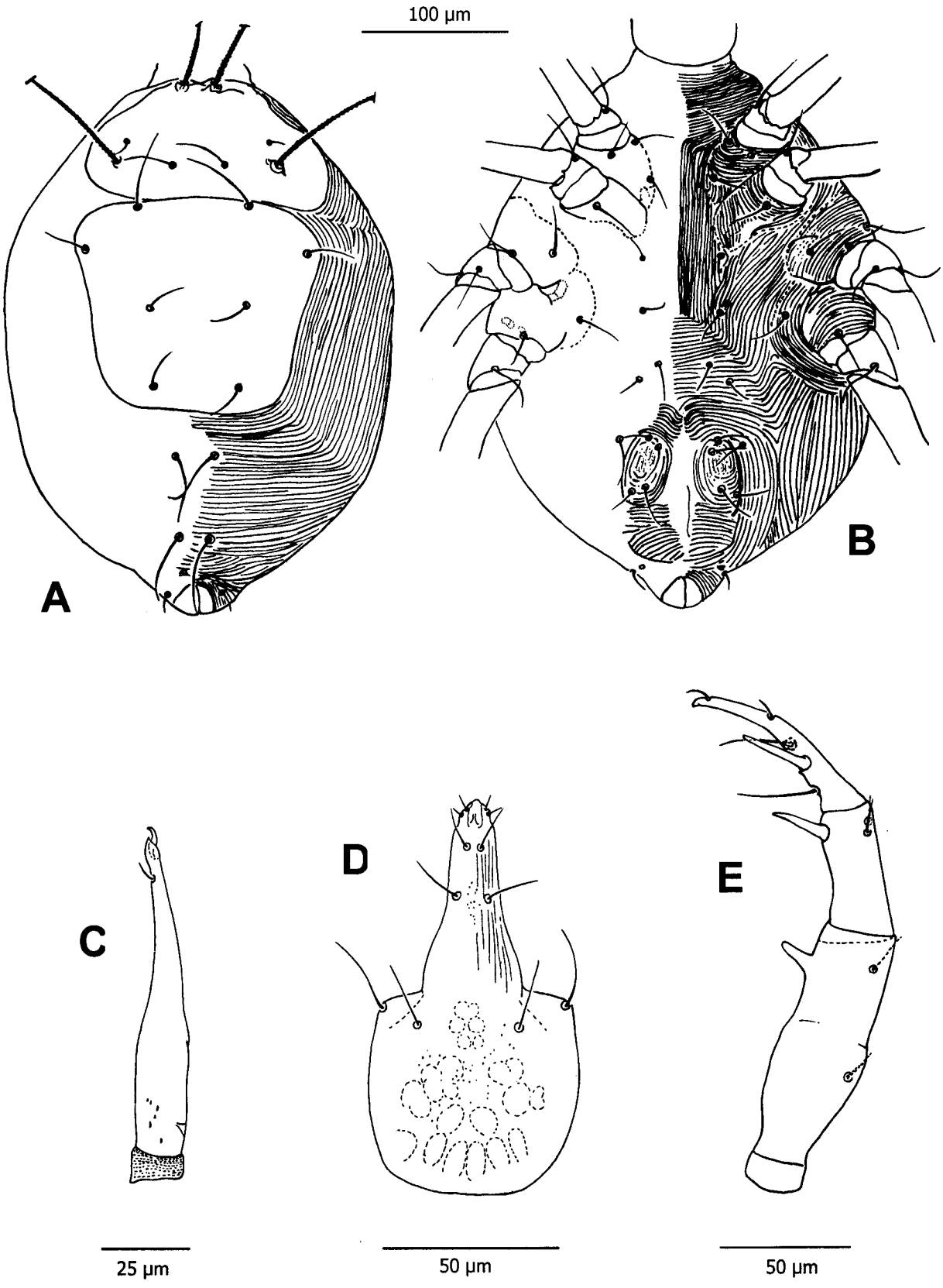

Figure 39. *Cunaxa grobleri*, female – A, dorsum; B, venter; C, chelicera; D, ventral hypostome; E, palp.

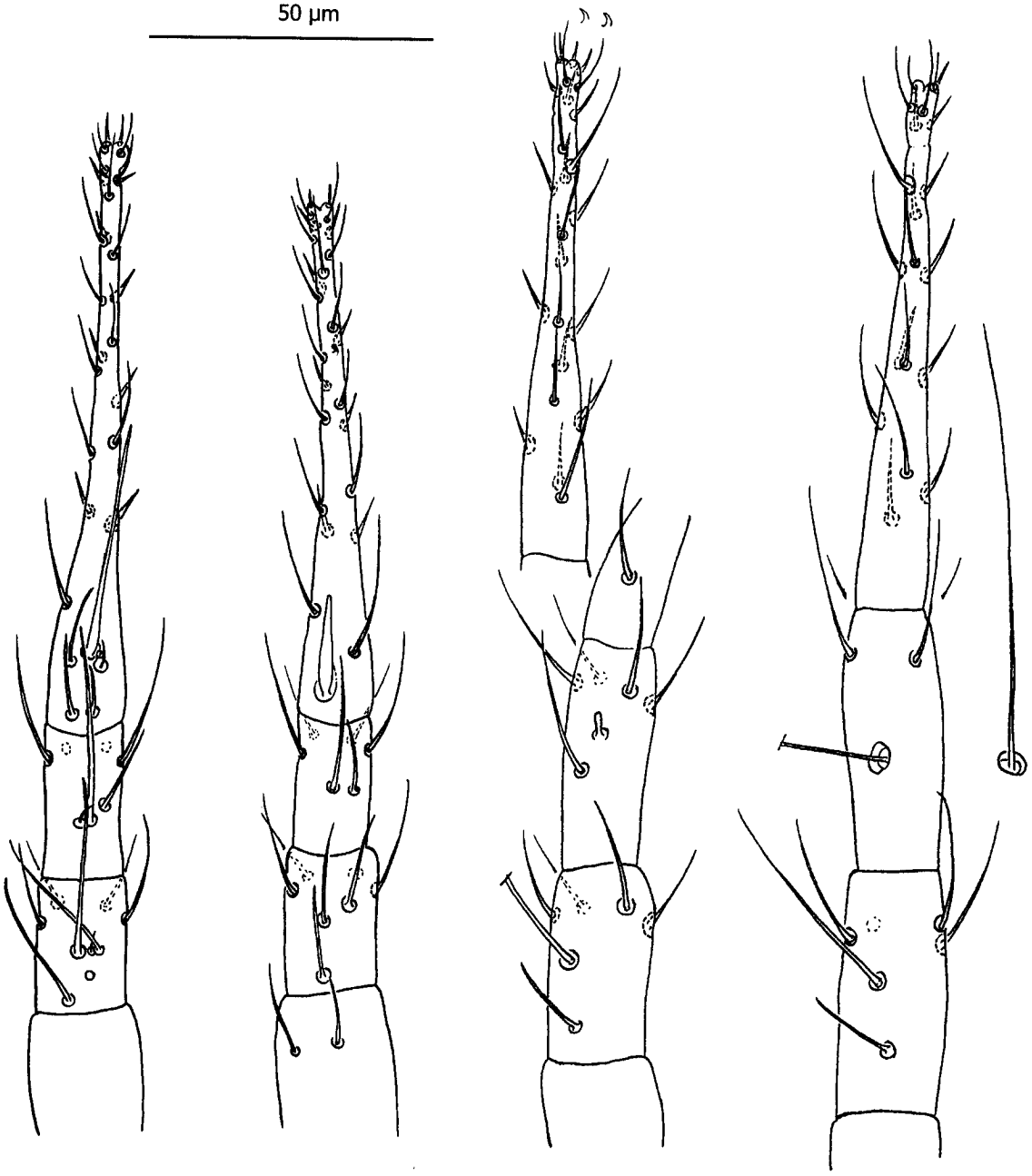

Figure 40. *Cunaxa grobleri*, female – A, leg I; B, leg II; C, leg III; D, leg IV.

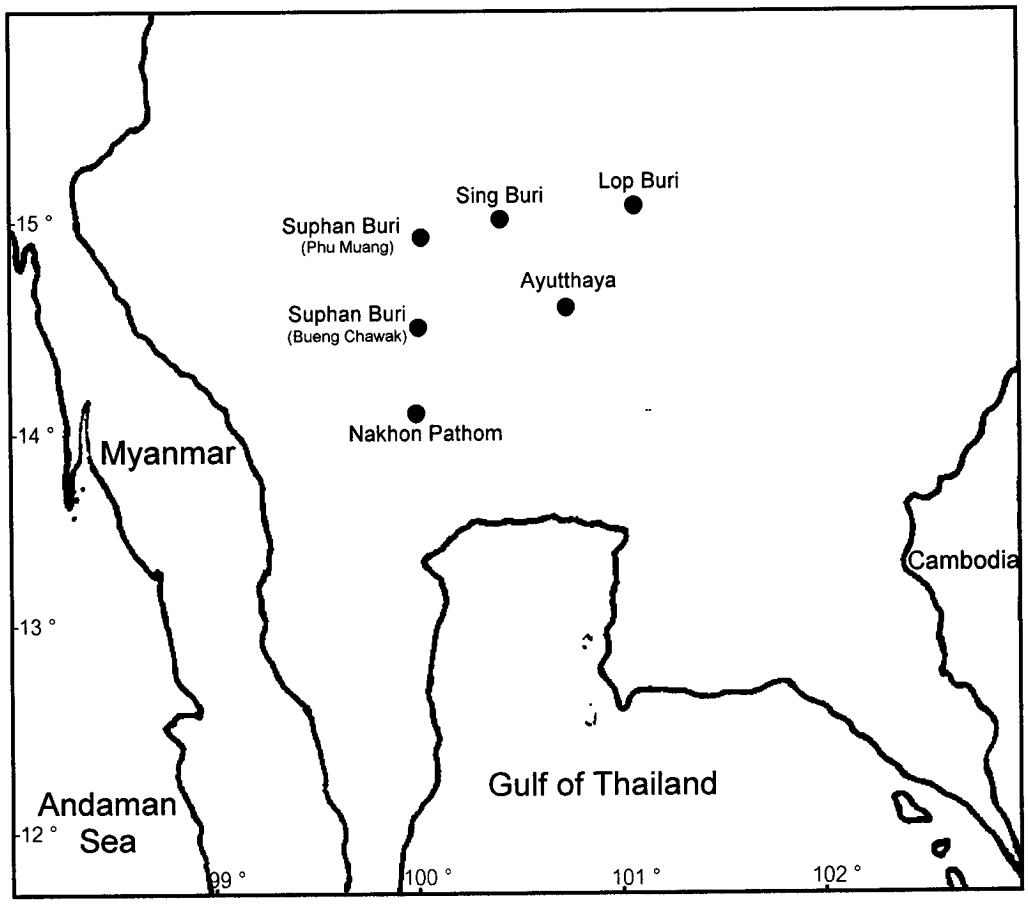

Figure 41. Collecting sites of *Cunaxa grobleri* in central Thailand.

15. *Cunaxa lukoschusi* Smiley, 1992

(Figs. 42 and 43)

Cunaxa lukoschusi Smiley, 1992: 175; Corpuz-Raros and Garcia, 1995: 609.

Diagnosis - This species is most closely related to *Cunaxa vizcayana* Corpuz-Raros and Garcia, 1995 in that setae f_1 and h_1 are spiculate, a small spur is adjacent to the median spinelike seta on inner margin of palp tibiotarsus, and a propodosomal shield is reticulated. However, setae f_1 are shorter, not reaching the base of setae h_1 in *C. vizcayana* while setae f_1 reach the base of setae h_1 in *C. lukoschusi.*

Female – Dimension - Length of idiosoma 350-440 (381.67), width 235-275 (255); length of hypognathum 130-170 (154.33), width 82.5-97.5 (90); length of palp 133-170 (155.33); length of chelicera 133-145 (138.67); length of legs: I 335; II 265-335 (300); III 310; IV 420.

Gnathosoma - Hypostome (Fig. 42D) subrectangular, granulated ventrally, coneshaped distally and with four pairs of *hg* setae, hg_4 longest, and two pairs of adoral setae. Palp with five segments (Fig. 42C) and palpal chaetotaxy as follows: Trochanter with no setae; basifemur with one dorsomedial simple seta; telofemur with one thick pointed apophysis on inner surface and one dorsomedian slender simple seta; genu with one long spinelike seta on inner surface, one ventral simple seta and one dorsal spinelike seta on outer surface; tibiotarsus with one long dorsal simple seta on inner surface close to posterior edge, medially one long spinelike seta associated with a spurlike process, one long simple ventral seta on the middle of this segment, one short dorsolateral seta on external surface, terminating with one short simple seta and a small claw. Chelicera with two segments (Fig. 42E), segment I with dense papillae, segment II dorsobasally papillate, and with one simple subterminal seta behind chela.

Dorsum (Fig. 42A) – Propodosoma with a reticulate subrectangular shield bearing two pairs of simple propodosomal setae, *ve* and *sce*, and two pairs of setose sensillae; reticulations of propodosomal shield composed of large cells which contain many small cells. Hysterosoma without neither median nor lateral shields and surface densely striate-granulate. Setae c_1, d_1, e_1, and c_2 simple, subequal in length. Setae f_1 and h_1 spiculate about twice as long as setae c_1, c_2, d_1, and e_1. Setae f_1 reach the base of setae h_1. One pair of cupule *ip* present, anteriolaterad of setae f_1

Venter (Fig. 42B) – Coxae I-II and III-IV contiguous, granulate. Intercoxal and opisthosomal integument striate with dotlike lobes; five pairs of simple setae

(except coxal, genital and anal setae). Genital shields granulate with four pairs of simple subequal setae arranged as shown in figure 42B. Anal region with one pair of anal and one pair of paraanal setae. One pair of cupule *ih* present.

Legs (Fig. 43) – Legs IV longest and longer than idiosoma. Tarsi tapering without conspicuous terminal lateral lobes. Number of setae on leg segments I-IV as follows: Coxae 3-1-3-2; trochanters 1-1-2-1; basifemora 3-3-3-1; telofemora 4-4-4-4; genu I, 4 attenuate solenidia, 1 micrcroseta + 4; genu II, 2 attenuate solenidia + 5; genu III, 1 attenuate solenidion + 5; genu IV, 2 attenuate solenidia + 5; tibia I, 2 attenuate solenidia, 1 microseta + 4; tibia II, 1 attenuate solenidion + 5; tibia III, 1 short blunt solenidion + 5; tibia IV, 1 trichobothrium + 4; tarsi I, 4 attenuate solenidia, 1 peglike seta, 1 microseta + 24 [including "dt" and "tsl" of Den Heyer (1979a)]; tarsi II, 1 blunt solenidion + 22; tarsi III, 20; tarsi IV, 18.

Male – Thai materials unknown

Type – Female holotype, collected from *Rhaphidura leucopy gidialis*, Bukit Fraser, Australia, 9. VIII. 1982, by F. S. Lukoschus. Type deposited in the United States National Museum, Washington, D.C.

Material examined - 1F, Bang Khan Taek, Samut Songkhram 13°22′46′′N 99°57′24′′E, alt. 1 m., on coconut litter, 25. III. 2003; 2FF, Bang Khan Taek, Samut Songkhram, on litter, 13. II. 2002.

Distributions – Dominican Republic; Autralia; The Philippines, Thailand, additional localities from this study (Fig. 44): Samut Songkhram.

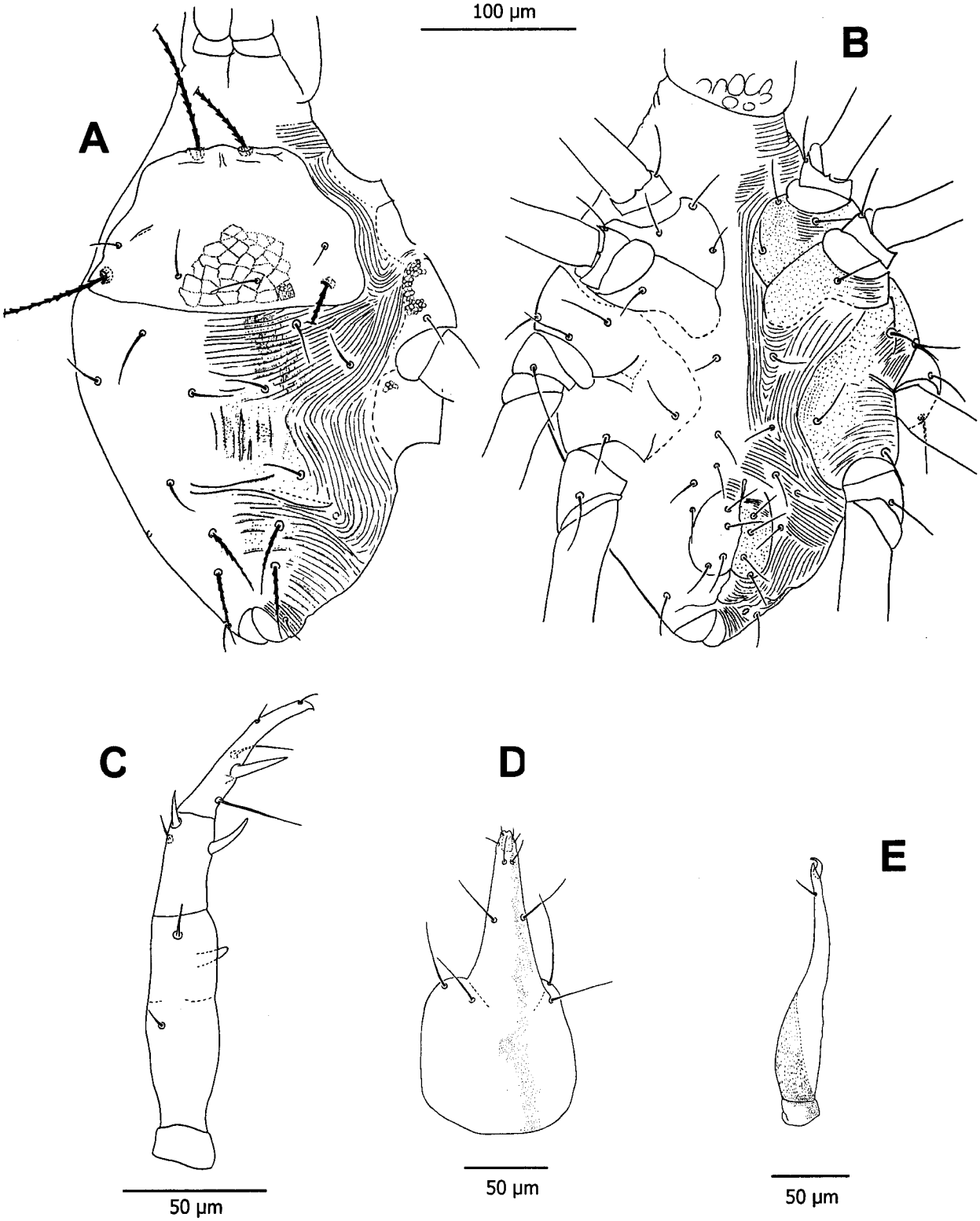

Figure 42. *Cunaxa lukoschusi*, female – A, dorsum; B, venter; C, palp; D,ventral hypostome; E, chelicera.

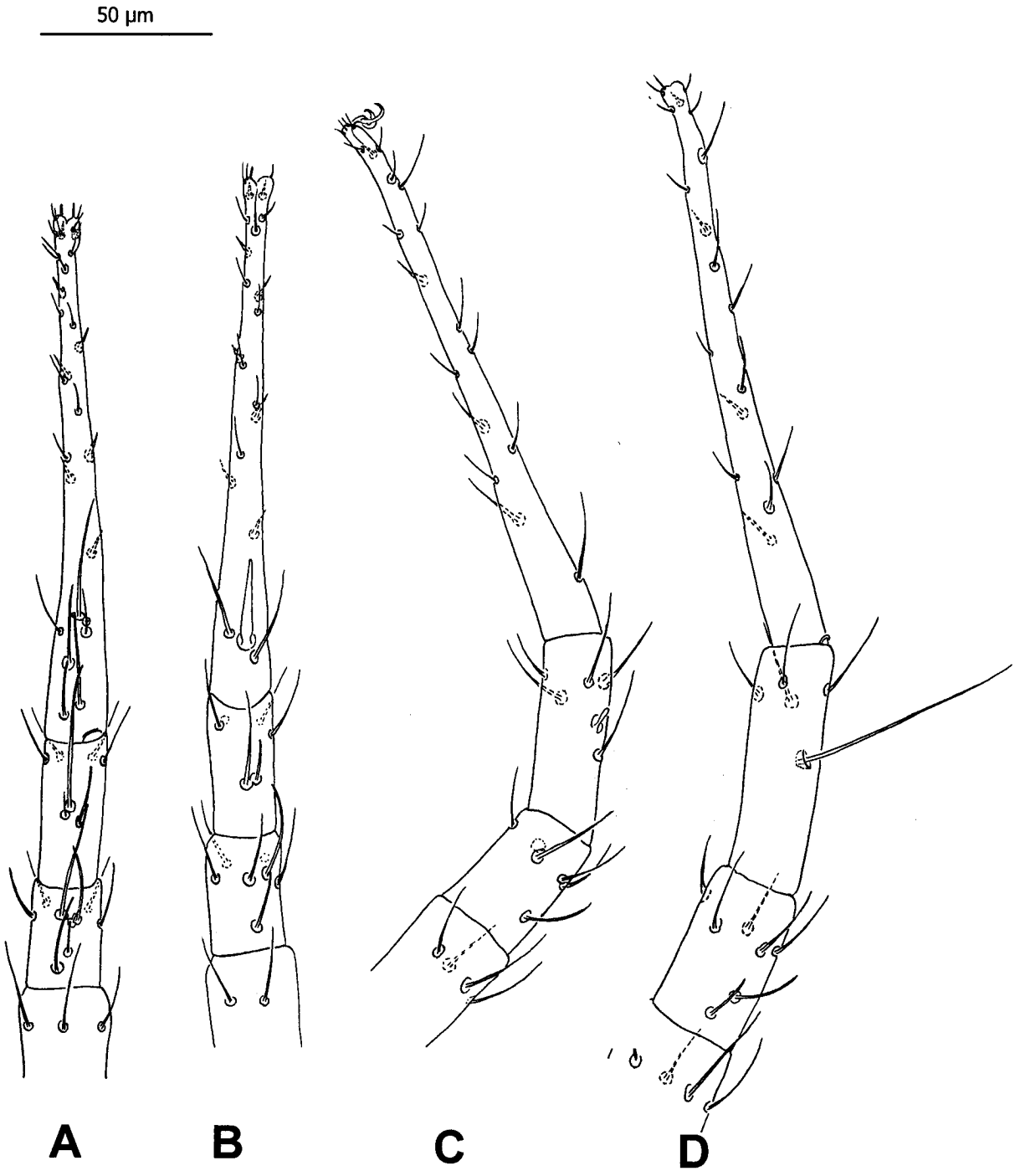

Figure 43. *Cunaxa lukoschusi,* female – A, leg I; B, leg II; C, leg III; D, leg IV.

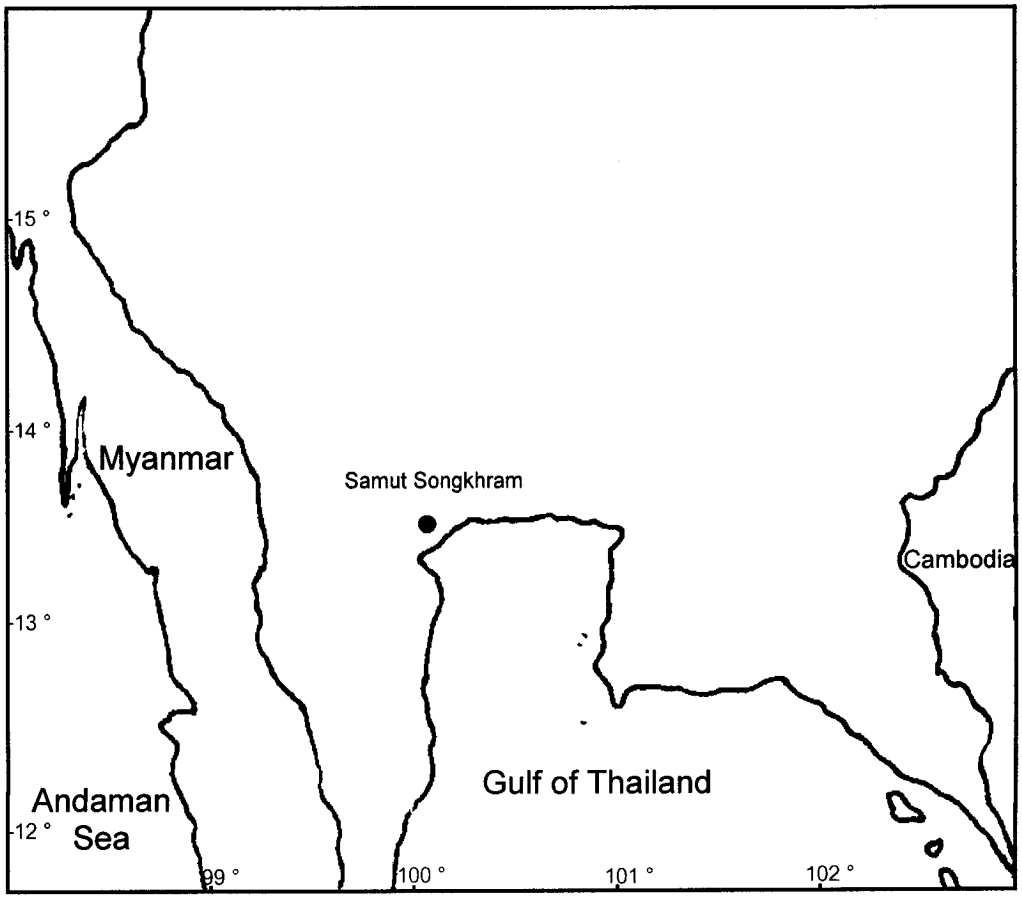

Figure 44. Collecting sites of *Cunaxa lukoschusi* in central Thailand.

16. *Cunaxa romblonensis* Corpuz-Raros and Garcia, 1995

(Figs. 45 and 46)

Cunaxa romblonensis Corpuz-Raros and Garcia, 1995: 613.

Diagnosis – This species is most closely related to *C. sordwanaensis* Den Heyer, 1979e, in having a smooth indistinctly demarcated hysterosomal shield. They can be separated by the setae f_1 and h_1. Setae f_1 and h_1 are finely setose in C. *sordwanaensis* while setae f_1 and h_1 are simple in *C. romblonensis*.

Female – Dimension – Length of idiosoma 305-375 (332.86), width 208-250 (232.57); length of hypognathum 128-135 (132.30), width 65-75 (71.4); length of palp 130-158 (144.5); length of chelicera 113-120 (117.57); length of legs: I 250-265 (254.17); II 225-230 (226); III 240-265 (253.75); IV 285-300 (293.75).

Gnathosoma - Hypostome (Fig. 45C) subrectangular, coneshaped distally with four pairs of *hg* setae, hg_4 longest, and two pairs of adoral setae. Palp with five segments (Fig. 45D) and palpal chaetotaxy as follows: Trochanter with no setae; basifemur with one dorsomedial simple seta; telofemur with one short stout and apical rounded apohysis on inner surface and one dorsomedian simple seta; genu with one long spinelike seta on inner surface, two simple setae (one dorsal and one ventral) on outer surface; tibiotarsus with one long dorsal simple seta on inner surface close to posterior edge, medially one long spinelike seta, one small spurlike process, one simple ventral seta on inner surface, one short dorsolateral seta on external surface, terminating with one short simple seta and a small claw. Chelicera with two segments (Fig. 45E), segment I papillate, segment II with one simple subterminal seta behind chela.

Dorsum (Fig. 45A) – Propodosoma with a smooth subrectangular shield bearing two pairs of simple propodosomal setae, *ve* and *sce*, and two pairs of setose sensillae. Hysterosomal shield indistinctly demarcated posteriorly, bearing setae c_1, c_2, d_1, but position of e_1 uncertain; areas outside shield with smooth striae; all dorsal setae simple.

Venter (Fig. 45B) – Totally covered by smooth striae, with dense striation on coxal region. Coxae I-II and III-IV contiguous. Five pairs of simple setae (except coxal, genital and anal setae) on intercoxal and opisthosomal integument. Genital shield striate with four pairs of simple subequal setae arranged as shown in figure 45B. Anal region with one pair of anal and one pair of paraanal setae.

Legs (Fig. 46) – All legs shorter than idiosoma. Tarsi tapering without conspicuous terminal lateral lobes. Number of setae on leg segments I-IV as follows: Coxae 3-1-3-2; trochanters 1-1-2-1; basifemora 4-4-3-1; telofemora 4-4-4-4; genu I, 4 attenuate solenidia, 1 micrcroseta + 4; genu II, 2 attenuate solenidia + 5; genu III, 1 attenuate solenidion + 5; genu IV, 1 attenuate solenidia + 5; tibia I, 2 attenuate solenidia, 1 microseta + 4; tibia II, 1 attenuate solenidion + 5; tibia III, 1 short blunt solenidion + 5; tibia IV, 1 trichobothrium + 4; tarsi I, 4 attenuate solenidia, 1 peglike seta, 1? Microseta + 24 [including "dt" and "tsl" of Den Heyer (1979a)]; tasi II, 1 blunt solenidion + 26; tarsi III, 25; tasi IV, 18.

MALE – Thai material unknown.

Type – Female Holotype, Romblon Islands, the Philippines, on leaf litter, 3. V. 1984, by A. M. Almeroda and F. Godoy. Type deposited in the Museum of Natural History of University of the Philippines, Los Baños.

Material examined - 2FF, near Sarika waterfalls, Nakhon Nayok 14°18′17′′ N 101°15′33′′E, on forest litter, 7. IV. 2003; 15FF, near Sam Lan waterfalls, Saraburi 14°25′56′′N 100°57′51′′E, on forest litter, 7. IV. 2003; 18FF, Phu Kae Botanical garden 14°40′30′′ N 100°53′10′′E, alt. 92 m., on leaf litter, 7. IV. 2003; 1F, Bang Khan Taek, Samut Songkhram, debris under bee nest, *A. cerana,* in coconut tree-hole, 6. IX. 2002.

Distributions – The Philippines; Thailand, additional localities from this study (Fig. 47): Nakhon Nayok, Saraburi and Samut Songkhram.

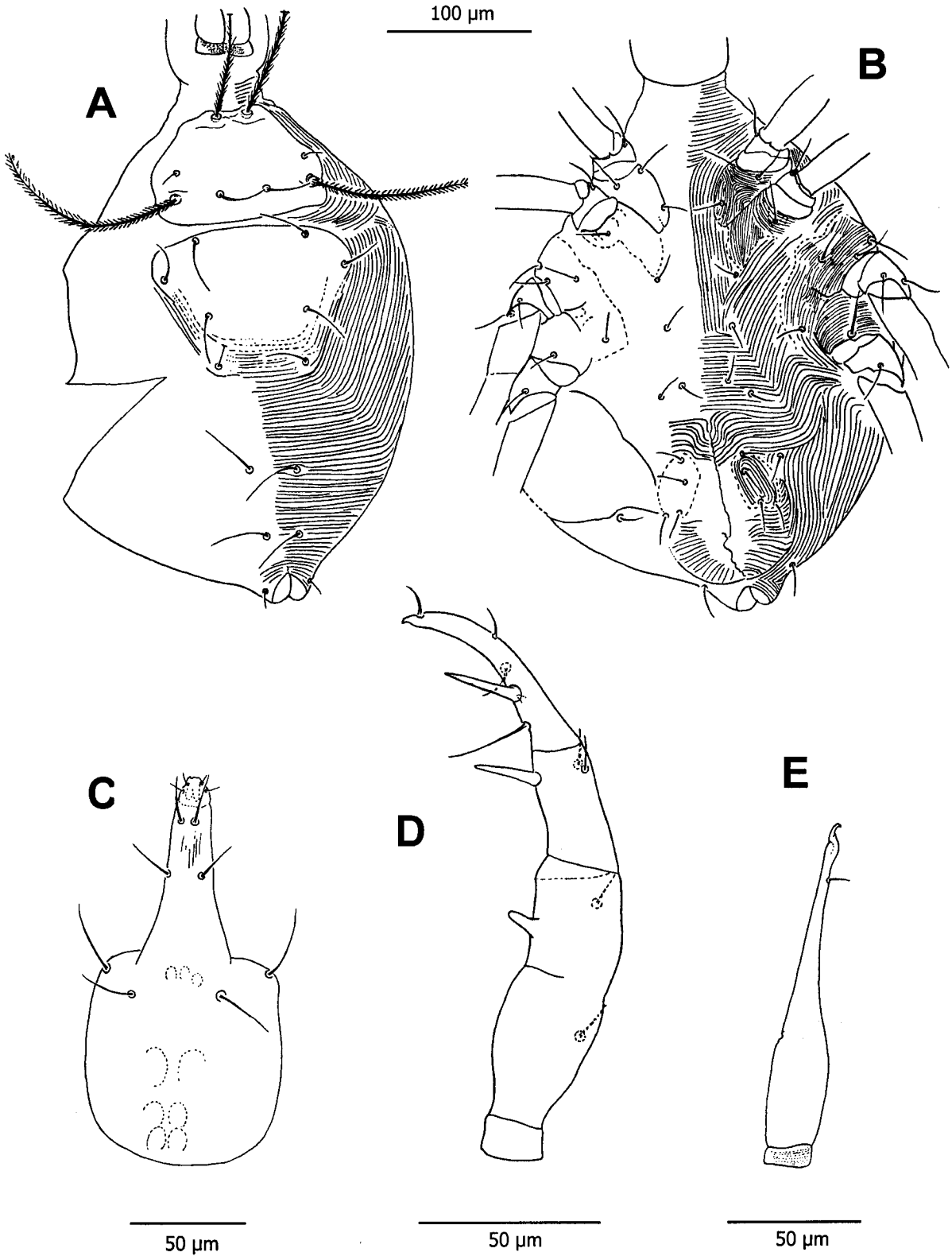

Figure 45. *Cunaxa romblonensis*, female – A, dorsum; B, venter; C, ventral hypostome; D, palp; E, chelicera.

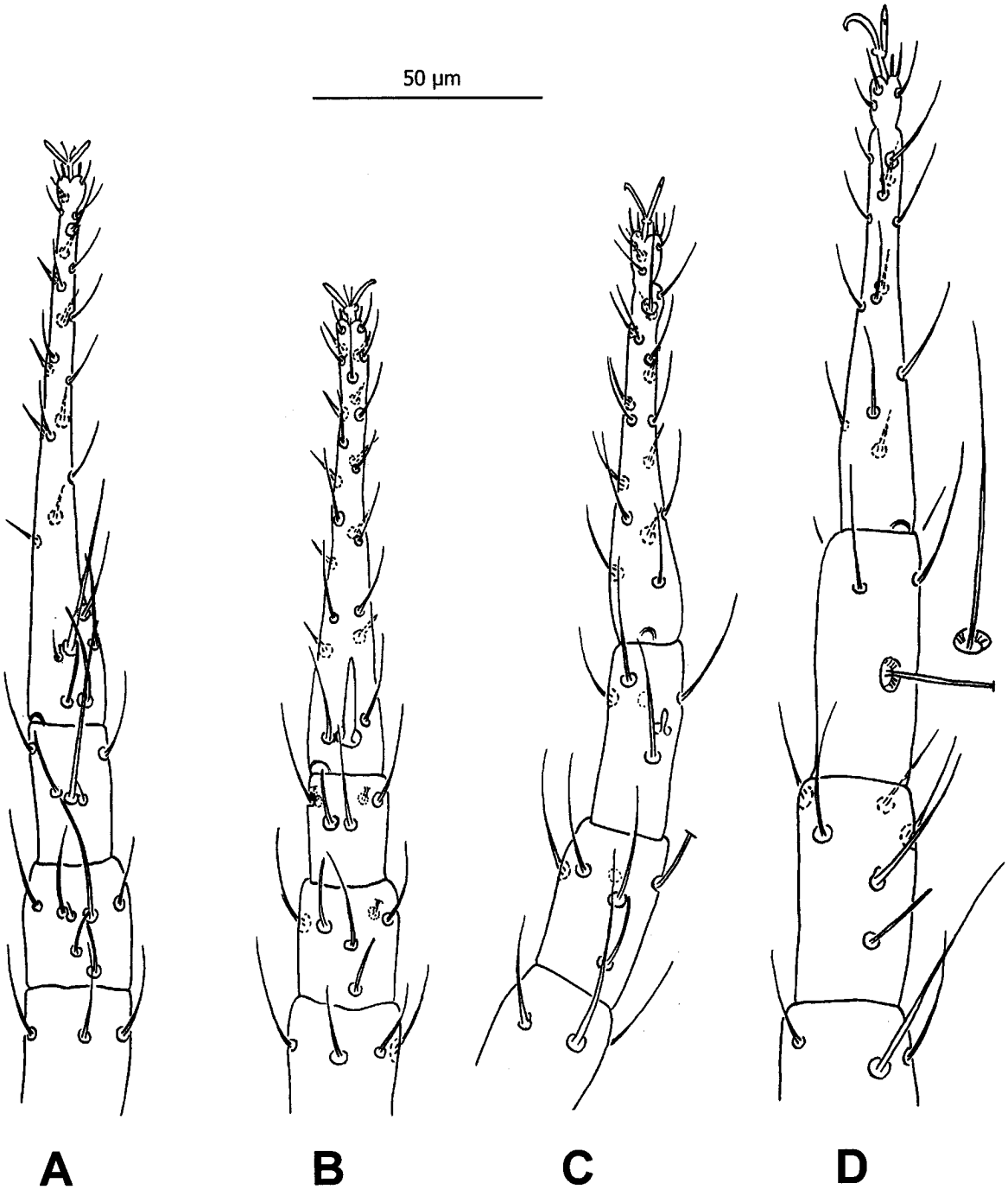

Figure 46. *Cunaxa romblonensis*, female – A, leg I; B, leg II; C, leg III; D, leg IV.

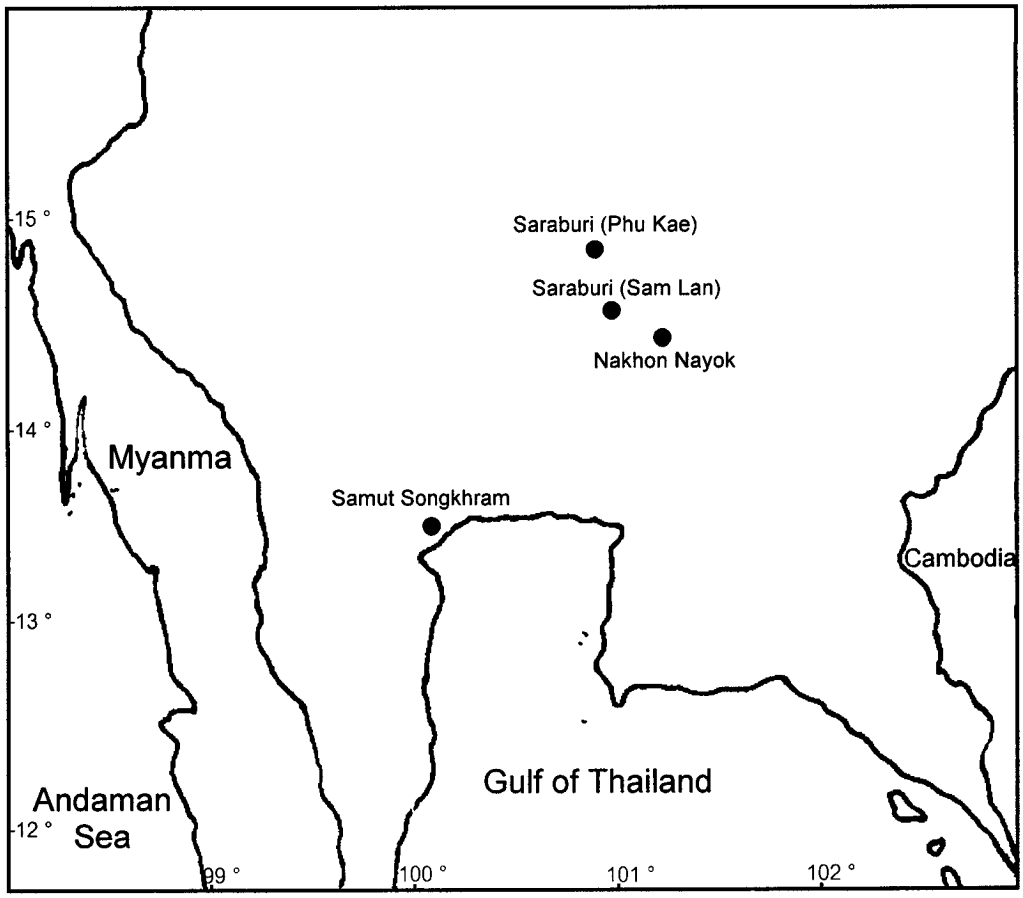

Figure 47. Collecting sites of *Cunaxa romblonensis* in central Thailand.

17. *Cunaxa setirostris* (Hermann, 1804)

(Figs. 48 and 49)

Scirus setirostris Hermann, 1804: 62; Gervais, 1841: 6; Koch, 1842: 76; Kramer, 1877: 245; Berlese, 1887: 64, 1897: 138; Den Heyer, 1980c: 6; Hull, 1981: 37.

Cunaxa setirostris Von Heyden, 1826: 608; Oudemans, 1937: 1244; Thor, 1931: 76; Womersley, 1933: 3; Thor and Willmann, 1941: 167; Baker and Hoffmann, 1948: 237; Baker and Wharton, 1952: 193; Meyer and Ryke, 1959: 370; Muma, 1960: 324; Rasmy et al., 1972: 182; Shiba, 1969: 108; Smiley, 1975: 239; Hughes, 1976: 258; Alberti and Ehrnsberger, 1977: 56; Kielczewski and Wisniewski, 1978: 619; Den Heyer, 1979a: 24; 1979e: 159; Kuznetzov and Livshitz, 1979a: 51: Tseng, 1980: 256; Gupta and Ghosh, 1980: 194; Sepasgosarian, 1984: 142; Michoka, 1987: 107. Boonkong *et. al.*, 1986; Gupta, 1991: 230; 1992: 136; Smiley, 1992: 202; Corpuz-Raros and Garcia, 1995: 614.

Scirus tenuirostris Duges, 1834: 43; Oudemans, 1937: 1246; Thor and Willmann, 1941: 167; Baker and Hoffmann, 1948: 237.

Scirus elaohus Duges, 1834: 21; Oudemans, 1937: 1264; Thor and Willmann, 1941: 167; Baker and Hoffmann, 1948: 237.

Scirus sagax Koch, 1835: 64; Oudemans, 1937: 1264; Thor and Willmann, 1941: 167; Baker and Hoffmann, 1948: 237.

Scirus stabulicola Koch, 1838: 23; Oudemans, 1937: 1249; Berlese, 1887: 64; Thor and Willmann, 1941: 167; Baker and Hoffmann, 1948: 237.

Scirus paludicola Kock, 1838: 20; Oudemans, 1937: 1243; Berlese, 1887: 64; Thor and Willmann, 1941: 167; Baker and Hoffmann, 1948: 237.

Scirus obisium Gervais, 1841: 6; Thor and Willmann, 1941: 167; Baker and Hoffmann, 1948: 237.

Diagnosis - This species is recognized by and the presence of a smooth propodosomal shield, finely striated hysterosoma absence of hysterosomal shields,.

Female – Dimension - Length of idiosoma 365 (365), width 225 (225); length of hypognathum 143 (143), width 72.5; length of palp 145-163 (154); length of chelicera 125-130 (127.5); length of legs: I 245 (245); II 205-225 (215); III 225-250 (287.5); IV 260-275 (267.5).

Gnathosoma - Hypostome (Fig. 48C) subrectangular, cone-shaped distally with four pairs of *hg* setae, hg_4 longest, and two pairs of adoral setae. Palp with five

segments (Fig. 48D) and palpal chaetotaxy as follows: Trochanter with no setae; basifemur with one dorsomedian simple seta; telofemur with one fingerlike apophysis on inner surface and one dorsomedian simple seta; genu with one long spinelike seta on inner surface, two simple setae (one dorsal and one ventral) on outer surface; tibiotarsus with one long dorsal simple seta on inner surface close to posterior edge, medially one long spinelike seta associated with spurlike process ventrally on inner surface, one simple ventral seta on inner surface, one short dorsolateral seta on outer surface, terminating with one short simple seta and small claw. Chelicera with two segments (Fig. 48E), segment I papillate, segment II with subcuticular ridges and one simple subterminal seta behind chela.

Dorsum (Fig. 48A) – Propodosoma with a smooth subrectangular shield bearing two pairs of simple propodosomal setae, *ve* and *sce*, and two pairs of setose sensillae. Hysterosomal shields absent, smooth striae on surface of hysterosoma and complemented with setae c_1, c_2, d_1, e_1, f_1, and h_1, all simple. Setae *sce*, c_1, c_2, d_1, and e_1 about equal in length but shorter than setae f_1 and h_1.

Venter (Fig. 48B) – Totally covered by smooth striae with dense striation on coxal region. Coxae I-II and III-IV contiguous. Five pairs of simple setae (except coxal, genital and anal setae) on intercoxal and opisthosomal integument. Genital shield striated with four pairs of simple subequal setae arranged as shown in figure 48B. Anal region with one pair of anal and one pair of paraanal setae.

Legs (Fig. 49) – All legs shorter than idiosoma. Tarsi tapering without conspicuous terminal lateral lobes. Number of setae on leg segments I-IV as follows: Coxae 3-1-3-2; trochanters 1-1-2-1; basifemora 4-4-3-1; telofemora 4-4-4-4; genu I, 4 attenuate solenidia, 1 micrcroseta + 4; genu II, 2 attenuate solenidia + 5; genu III, 1 attenuate solenidion + 5; genu IV, 1 attenuate solenidion + 5; tibia I, 2 attenuate solenidia, 1 microseta + 4; tibia II, 1 attenuate solenidion + 5; tibia III, 1 short blunt solenidion + 5; tibia IV, 1 trichobothrium + 4; tarsi I, 4 attenuate solenidia, 1 peglike seta, 1 microseta + 26 [including "dt" and "tsl" of Den Heyer (1979a)]; tasi II, 1 blunt solenidion + 27; tarsi III, 25; tasi IV, 21.

Male – Thai material unknown

Type – Holotype - Strasbourg, France: Type locality. The location of type is not known. It is belived to have been destroyed during World War II (Smiley, 1992).

Material examined - 1F, Sala Ya, Phuthamonthon, Nakhon Pathom 13°48′ 45′′N 100°17′29′′E, alt. 5 m., on litter under *Citrus grandis*, 16. III. 2003; 1F, Bang Khan Taek, Samut Songkhram 13°22′46′′N 99°57′24′′E, alt. 1 m., on coconut litter, 25. III. 2003; 39FF, Khlong Sip Song, Pathum Thani, 14°06′42′′N 100°52′37′′E, on litter under Leguminosae, 16. IX. 2003.

Distributions – Cosmopolitan – Thailand, additional localities from this study (Fig. 50): Nakhon Pathom, Pathum Thani and Samut Songkhram.

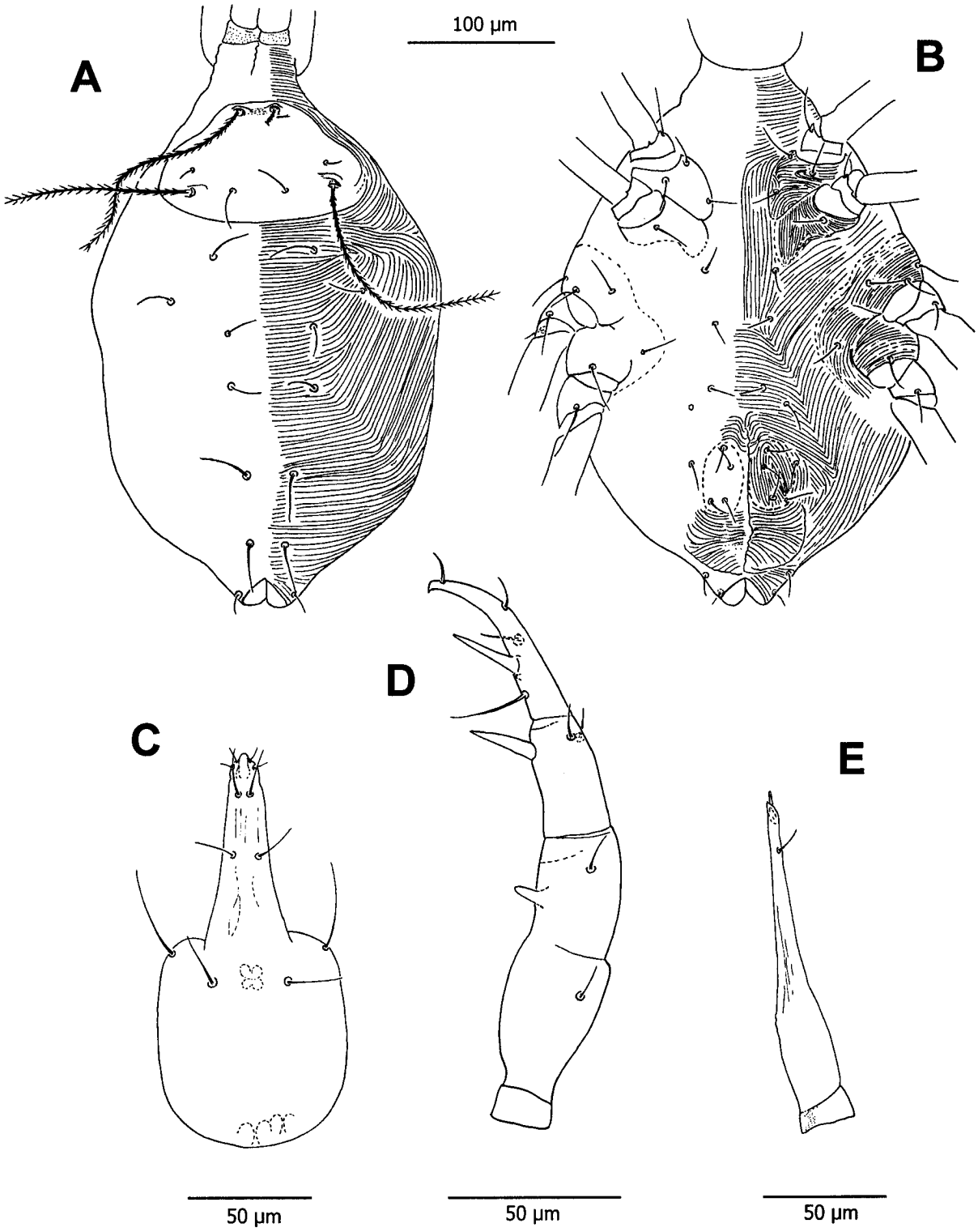

Figure 48. *Cunaxa setirostris*, female – A, dorsum; B, venter; C, ventral hypostome; D, palp; E, chelicera.

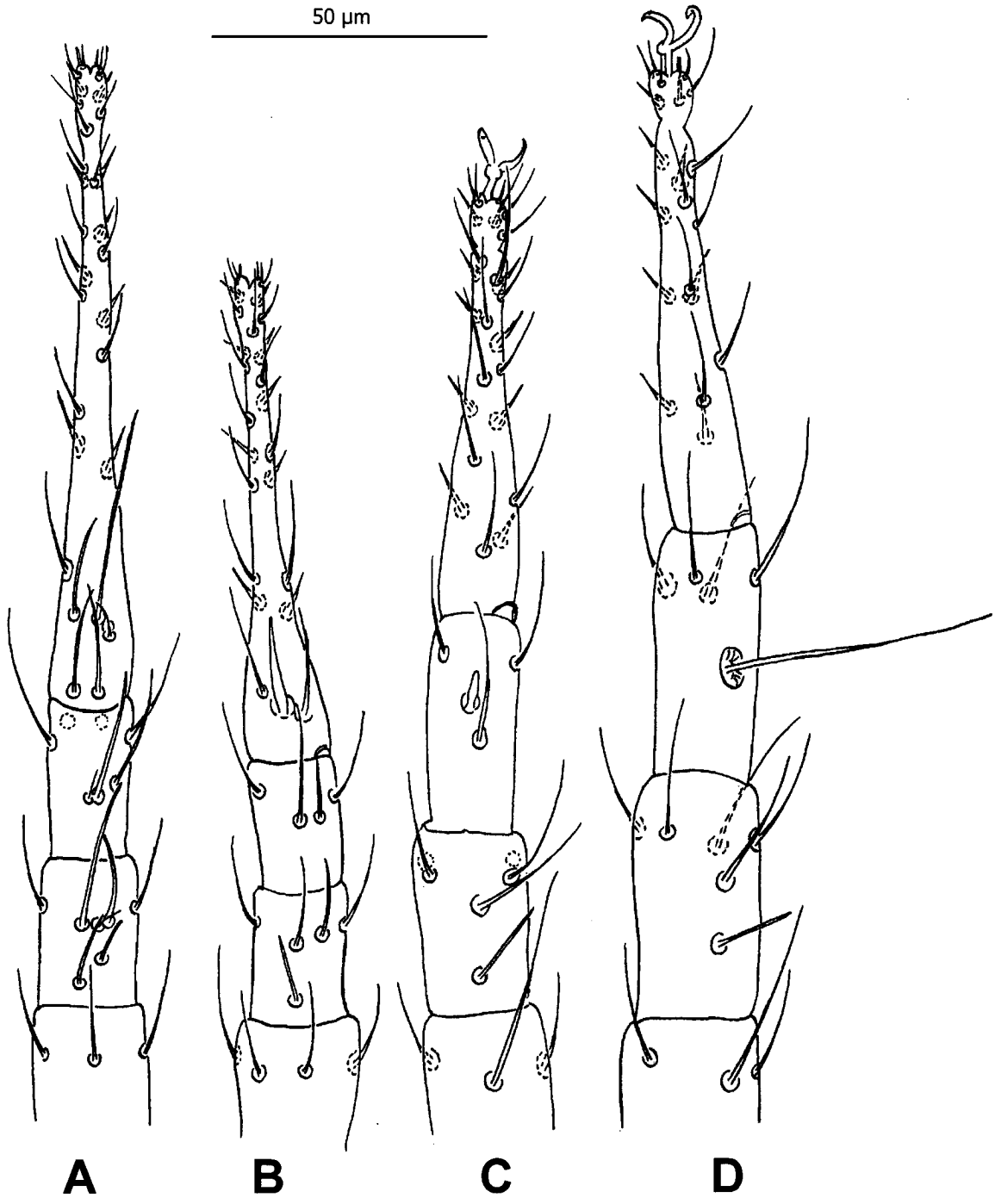

Figure 49. *Cunaxa setirostris*, female – A, leg I; B, leg II; C, leg III; D, leg IV.

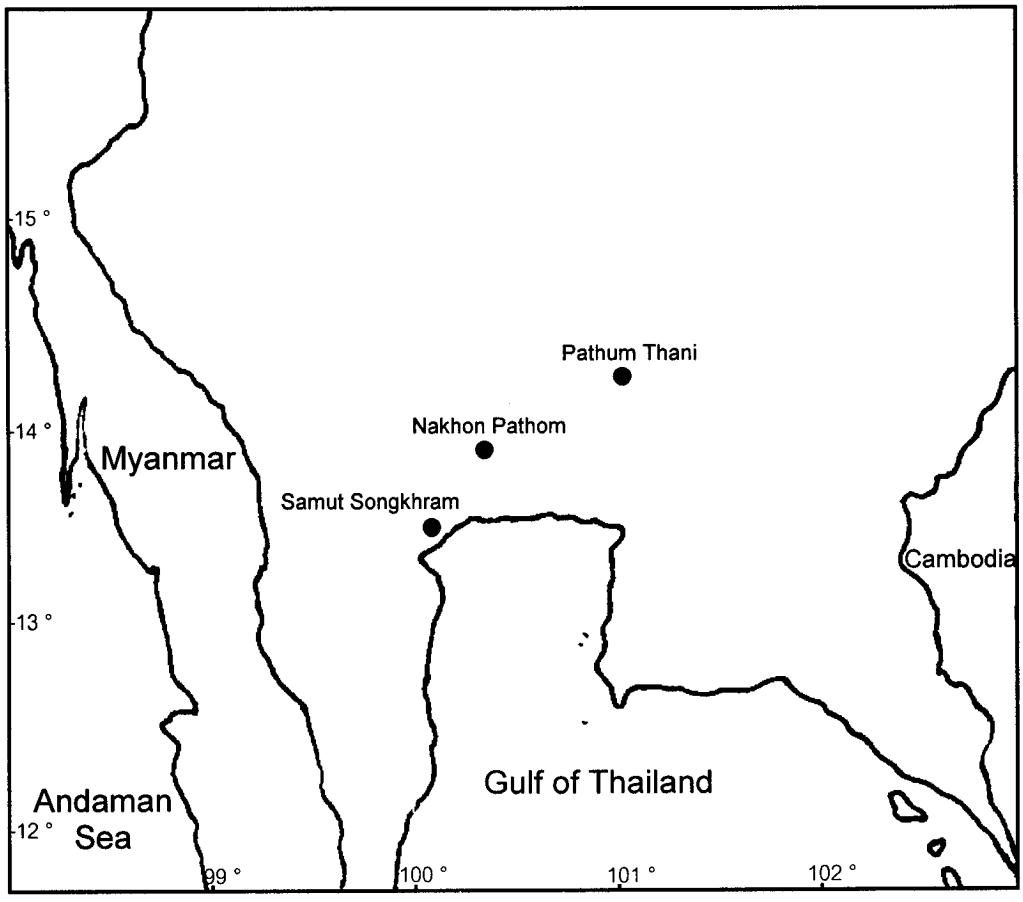

Figure 50. Collecting sites of *Cunaxa setirostris* in central Thailand.

18. *Cunaxa venusae* Corpuz-Raros and Garcia, 1995

(Figs. 51 and 52)

Cunaxa venusae Corpuz-Raros and Garcia, 1995: 615.

Diagnosis - According to Corpuz-Raros and Garcia (1995), this species resembles *C. lukoschusi* Smiley, 1992 in having a reticulate propodosomal shield, no median and lateral hysterosomal shields, and in having a small spur adjacent to median spine on inner margin of palp tibiotarsus. However, all the dorsal hysterosomal setae are spiculate in *C. venusae* while only setae f_1 and h_1 are spiculate in *C. lukoschusi*.

Female – Dimension - Length of idiosoma 350-360 (355), width 235-250 (242.5); length of hypognathum 153-163 (158), width 85-95 (90); length of palp 163-188 (175.5); length of chelicera 133-148 (140.5); length of legs: I 315-325 (320); II 315-330 (322.5); III 335-375 (355); IV 385-415 (400).

Gnathosoma - Hypostome (Fig. 51D) subrectangular, coneshaped distally, with granulated ventrally, four pairs of *hg* setae, hg_4 longest, and two pair of adoral setae. Palp with five segments (Fig. 51C) and palpal chaetotaxy as follows: Trochanter with no setae; basifemur with one dorsomedian simple seta; telofemur with one short apically rounded apophysis on inner surface and one dorsomedian simple seta; genu with one long spinelike seta on inner surface, one simple seta and one slender spinelike seta on outer surface; tibiotarsus with one long dorsal simple seta on inner surface close to posterior edge, medially one long spinelike seta associated with small spurlike process, one simple ventral seta on inner surface, one short dorsolateral seta on external surface, terminating with one short simple seta and a small claw. Chelicera with two segments (Fig. 51E), segment I papillate, segment II dorsobasally papillate and one simple subterminal seta behind chela.

Dorsum (Fig. 51A) – Propodosoma with a reticulate subrectangular shield bearing two pairs of setose sensillae and two pairs of propodosomal setae *ve* and *sce*; setae *ve* short and simple, setae *sce* spiculate. Hysterosoma without neither median nor lateral shields and surface densely striae with dotlike lobes. Setae c_1, c_2, d_1, and e_1 long, all spiculate. Setae f_1 reaching the base of setae h_1. One pair of cupule *ip* present to anteriolaterad of setae f_1.

Venter (Fig. 51B) – Coxae I-II and III-IV contiguous and granulated. Coxae I, II and IV with reticulate pattern. Intercoxal and opisthosomal integument densely striate with dotlike lobes and five pairs of simple setae (except coxal, genital and anal

setae). Genital shields with short broken striae, four pairs of simple subequal setae, arranged as shown in figure 51B. Anal and paraanal setae of Thai specimens not discernible since it is covered by debris.

Legs (Fig. 52) – Legs IV longest and longer than idiosoma. Tarsi tapering without conspicuous terminal lateral lobes. Number of setae on leg segments I-IV as follows: Coxae 3-1-3-2; trochanters 1-1-2-1; basifemora 3-3-3-1; telofemora 4-4-4-4; genu I, 4 attenuate solenidia, 1 micrcroseta + 4; genu II, 2 attenuate solenidia + 5; genu III, 1 attenuate solenidion + 5; genu IV, 1 attenuate solenidion + 5; tibia I, 2 attenuate solenidia, 1 microseta + 4; tibia II, 1 attenuate solenidion + 5; tibia III, 1 short blunt solenidion + 5; tibia IV, 1 trichobothrium + 4; tarsi I, 4 attenuate solenidia, 1 peglike seta, 1 microseta + 21 [including "dt" and "tsl" of Den Heyer (1979a)]; tarsi II, 1 blunt solenidion + 24; tarsi III, 20; tasi IV, 20.

Male – Unknown

Type – Female holotype, on leaves of cogon, *Imperata cylindrica*, Mt. Makiling, Bagong Silang, Los Baños, Laguna, The Philippines, 2. VI. 1993. by R. C. Garcia. Type deposited in the Museum of Natural History of University of The Philippines, Los baños.

Material examined - 1F, Ban Nong Pongnok, Kamphaeng Saen, Nakhon Pathom 14°02′57′′N 99°56′08′′E, alt. 20 m., on litter of unknown tree (Leguminosae), 16. III. 2003; 1F, Sala Loy, Tha Ruea, Ayutthaya, beating from *Streblus asper*, 9. VI. 2002.

Distributions – The Philippines; Thailand, additional localities from this study (Fig. 53): Nakhon Pathom and Ayutthaya.

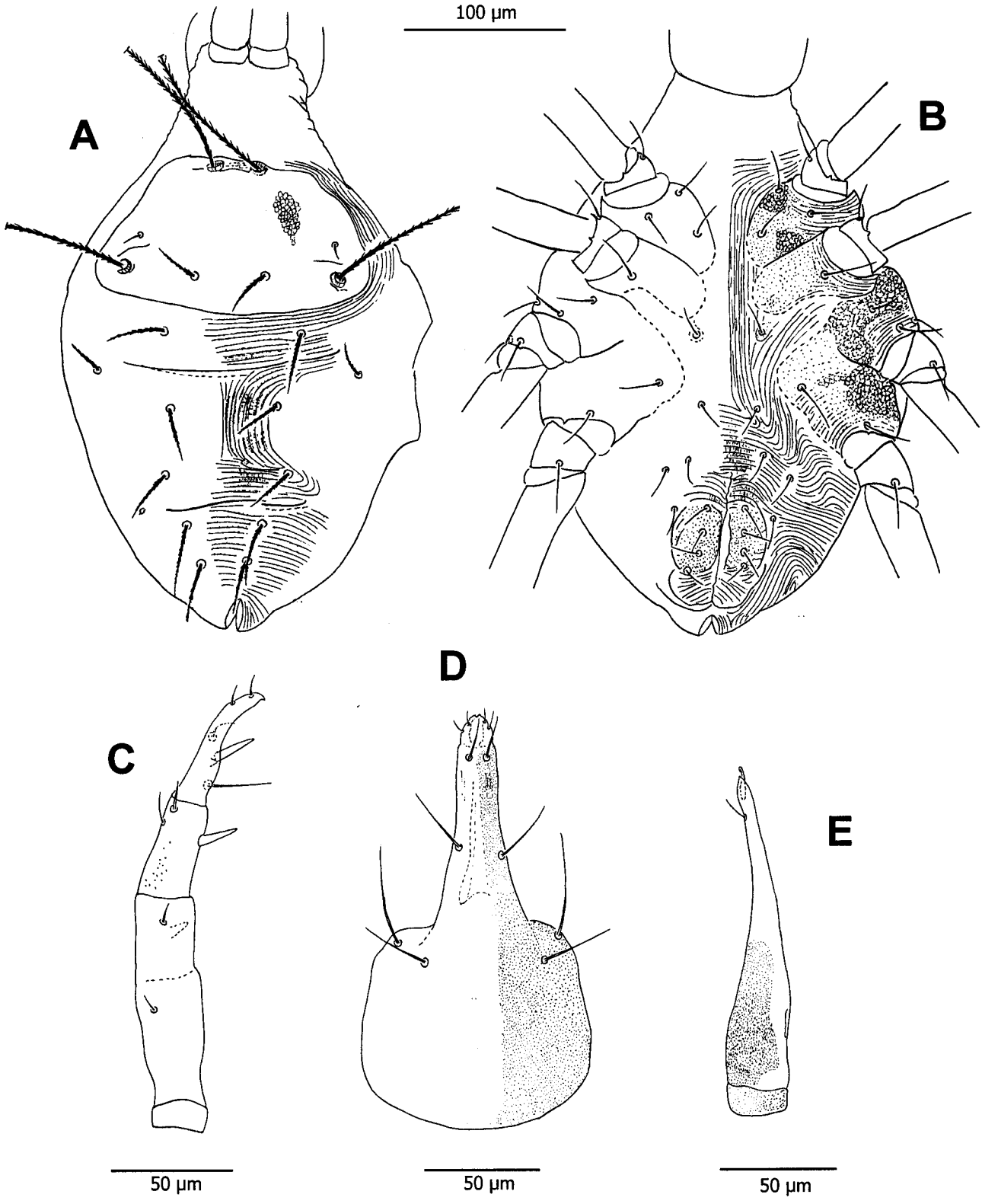

Figure 51. *Cunaxa venusae*, female – A, dorsum; B, venter; C, palp; D, ventral hypostome; E, chelicera.

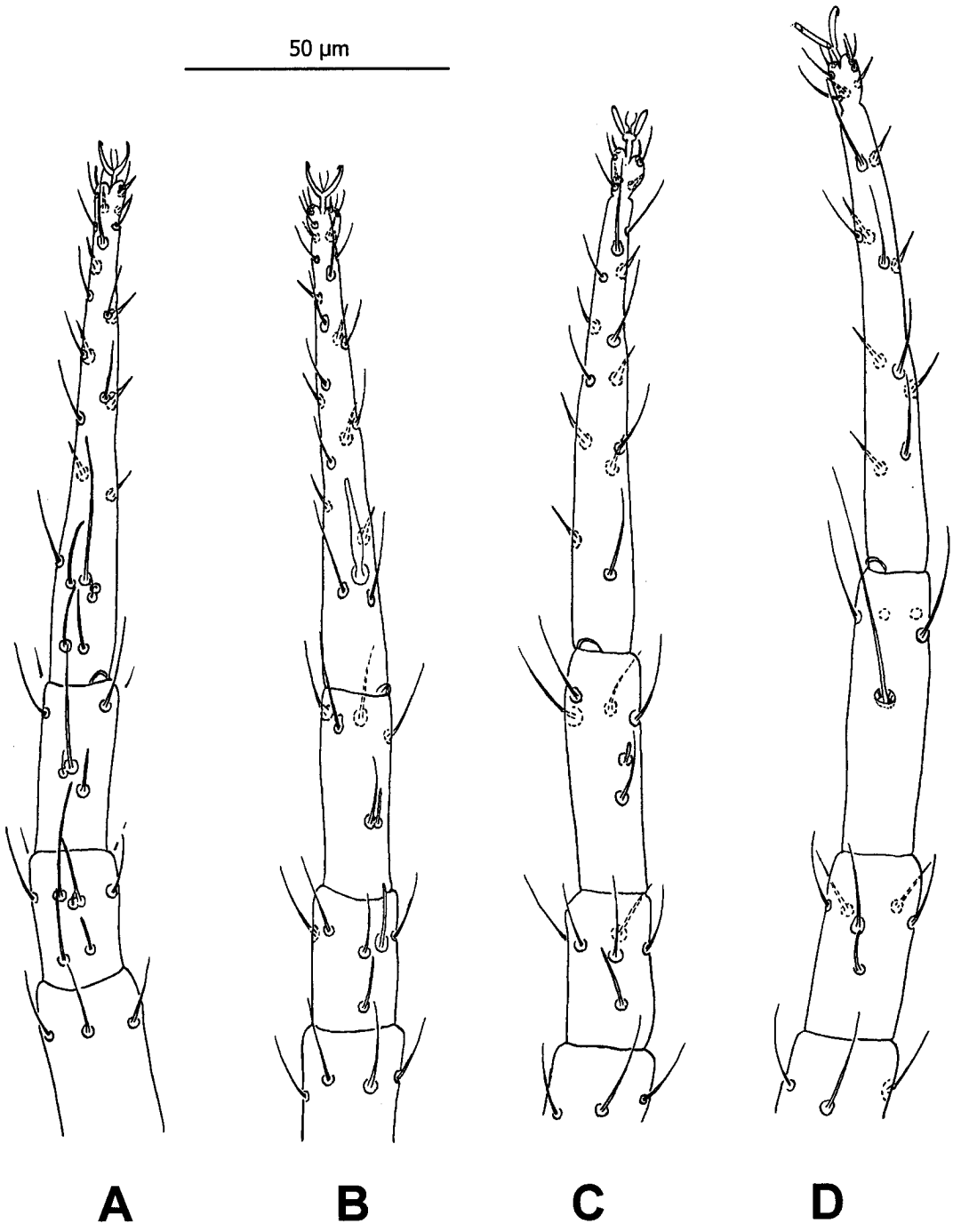

Figure 52. *Cunaxa venusae*, female – A, leg I; B, leg II; C, leg III; D, leg IV.

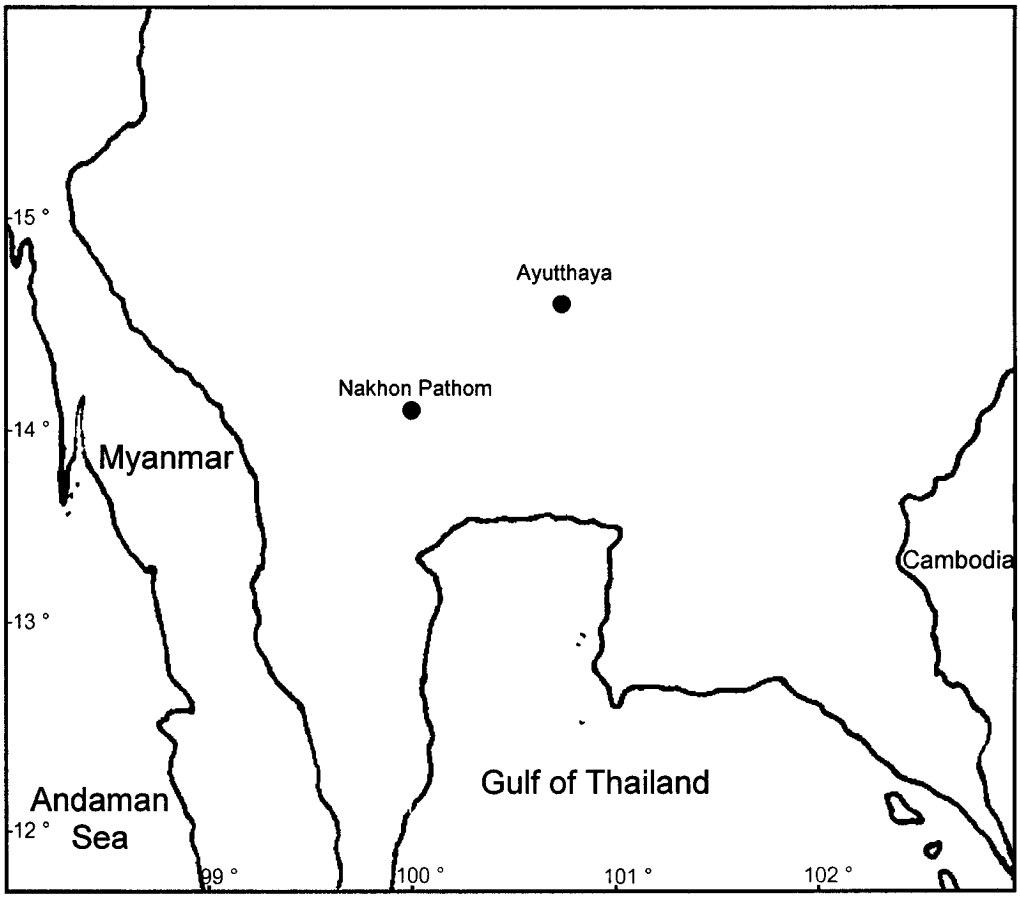

Figure 53. Collecting sites of *Cunaxa venusae* in central Thailand.

19. *Cunaxa vizcayana* Corpuz-Raros and Garcia, 1995

(Figs. 54 and 55)

Cunaxa vizcayana Corpuz-Raros and Garcia, 1995: 615.

Diagnosis - This species is most closely related to *Cunaxa lukoschusi,* Smiley, 1992, in that setae f_1 and h_1 are spiculate, a small spur is adjacent to the median spinelike seta on inner margin of palp tibiotarsus, and a propodosomal shield is reticulated. However, setae f_1 are longer, reaching the base of setae h_1 in *C. lukoschusi* while setae f_1 are shorter, not reaching the base of setae h_1 in *C. vizcayana.*

Female – Dimension - Length of idiosoma 355-443 (407.17), width 230-275 (257.5); length of hypognathum 155-180 (165.75), width 80-85 (82.5); length of palp 138-180 (158.14); length of chelicera 138-163 (148.75); length of legs: I 375-390 (382.5); II 375-390 (382.5); III 415-450 (430); IV 450-470 (460).

Gnathosoma - Hypostome (Fig. 54D) subrectangular, coneshaped distally, and granulated ventrally with four pairs of *hg* setae, hg_4 longest, and two pairs of adoral setae. Palp with five segments (Fig. 54E) and palpal chaetotaxy as follows: Trochanter with no setae; basifemur with one dorsomedian simple seta; telofemur with one small triangular apophysis on inner surface and one dorsomedian simple seta; genu with one long spinelike seta on inner surface, one ventral simple seta and one dorsal spinelike seta on outer surface; tibiotarsus with one long dorsal simple seta on inner surface close to posterior edge, medially one long spinelike seta associated with a small spurlike process, one long simple ventral seta on inner surface, one short dorsolateral seta on external surface, terminating with one short simple seta and small claw. Chelicera with two segments (Fig.54C), segment I with dense papillae, segment II with dorsobasally papillae with a group of reticulation, and one simple subterminal seta behind chela.

Dorsum (Fig. 54A) – Propodosoma with a reticulate subrectangular shield bearing two pairs of simple propodosomal setae, *ve* and *sce*, and two pairs of setose sensillae; reticulations of propodosomal shield composed of small cells, no indication of secondary reticulations. Hysterosoma without median nor lateral shields and surface densely striae with dotlike lobes. Setae c_1, c_2, d_1, and e_1 short, simple, and subequal in length. Setae f_1 and h_1 long and spiculate; setae h_1 longest. Setae f_1 not reaching the base of setae h_1. One pair of cupule *ip* present to anteriolaterad of setae f_1

Venter (Fig. 54B) – Coxae I-II and III-IV contiguous, granulate. Anterior part of coxae III and IV reticulate. Intercoxal and opisthosomal integument striate with dotlike lobes and four pairs of simple setae (except coxal, genital and anal setae). Genital shields granulate with four pair of simple setae arranged as shown in figure 54B. Anal region with one pair of anal and one pair of paraanal setae. One pair of cupule *ih* present.

Legs (Fig. 55) – Legs IV longest and longer than idiosoma. Tarsi tapering without conspicuous terminal lateral lobes. Number of setae on leg segments I-IV as follows: Coxae 3-1-3-2; trochanters 1-1-2-1; basifemora 3-3-3-1; telofemora 4-4-4-4; genu I, 4 attenuate solenidia, 1 micrcroseta + 4; genu II, 2 attenuate solenidia + 5; genu III, 1 attenuate solenidion + 5; genu IV, 2 attenuate solenidia + 5; tibia I, 2 attenuate solenidia, 1 microseta + 4; tibia II, 1 attenuate solenidion + 5; tibia III, 1 short blunt solenidion + 5; tibia IV, 1 trichobothrium + 4; tarsi I, 4 attenuate solenidia, 1 peglike seta, 1 microseta + 22 [including "dt" and "tsl" of Den Heyer (1979a)]; tarsi II, 1 blunt solenidion + 24; tarsi III, 21; tasi IV, 17.

Male – Thai materials unknown.

Type – Female holotype, on *Artocarpus heterophyllus*, Villaverde, Nueva Vizcayana, Luzon Is., The Philippines, 26. X. 1962, by R. S. Raros. Type deposited in the Museum of Natural History of University of The Philippines, Los Baños.

Material examined - 6FF, Sarika, Nakhon Nayok 14°18′05′′N 101°18′ 17′′E, on *Citrus grandis* leaves, 7. IV. 2003; 3FF, Pho Chon Kai, Bang Rachan, Sing Buri, on *Citrus grandis* leaves, 17. X. 2002; 2FF, Sala Loy, Tha Ruea, Ayutthaya, on *Streblus asper*, 9. IV. 2002.

Distributions – The Philippines; Thailand, additional localities from this study (Fig. 56): Nakhon Nayok, Sing Buri and Ayutthaya.

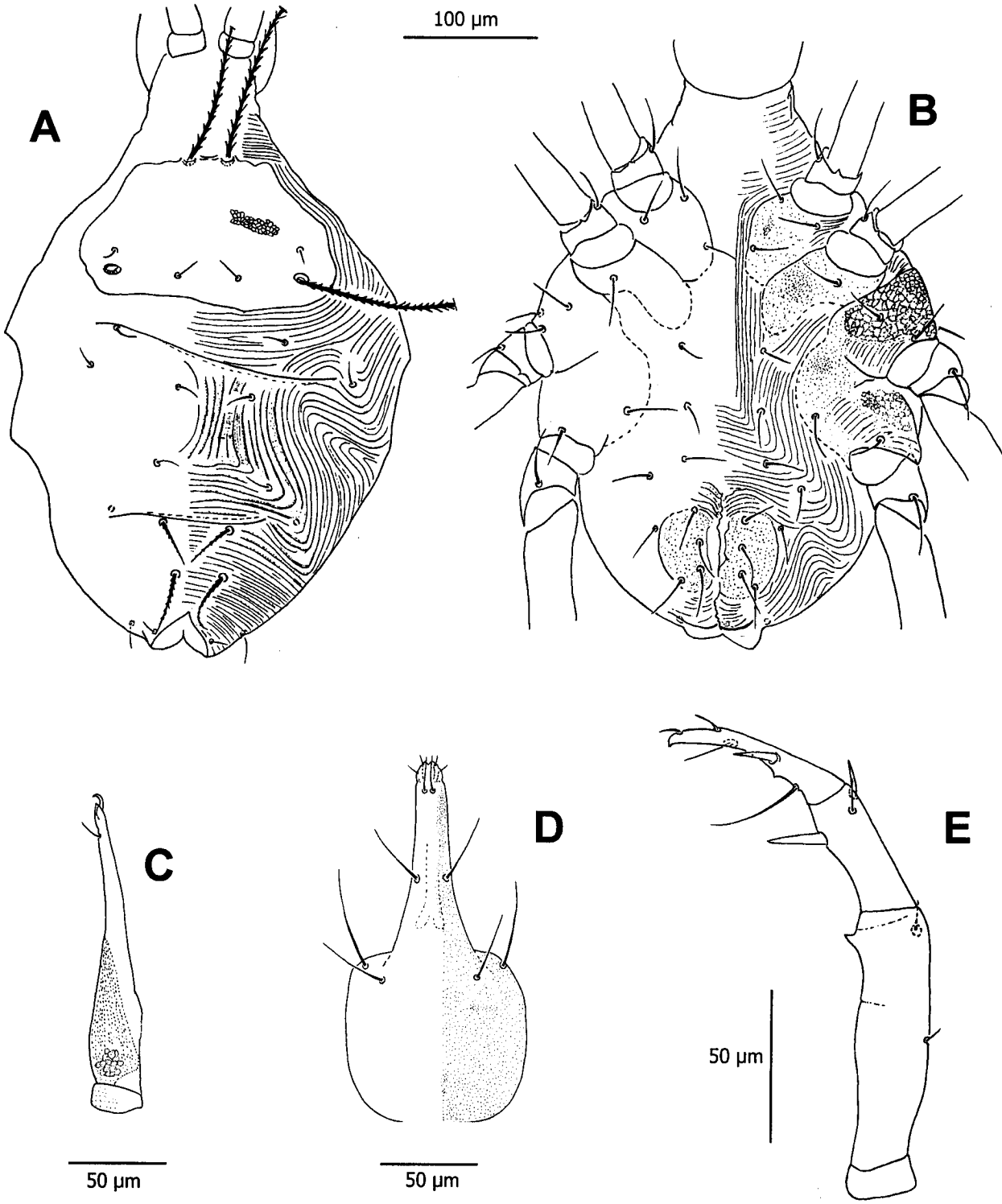

Figure 54. *Cunaxa vizcayana*, female – A, dorsum; B, venter; C, chelicera; D, ventral hypostome; E, palp.

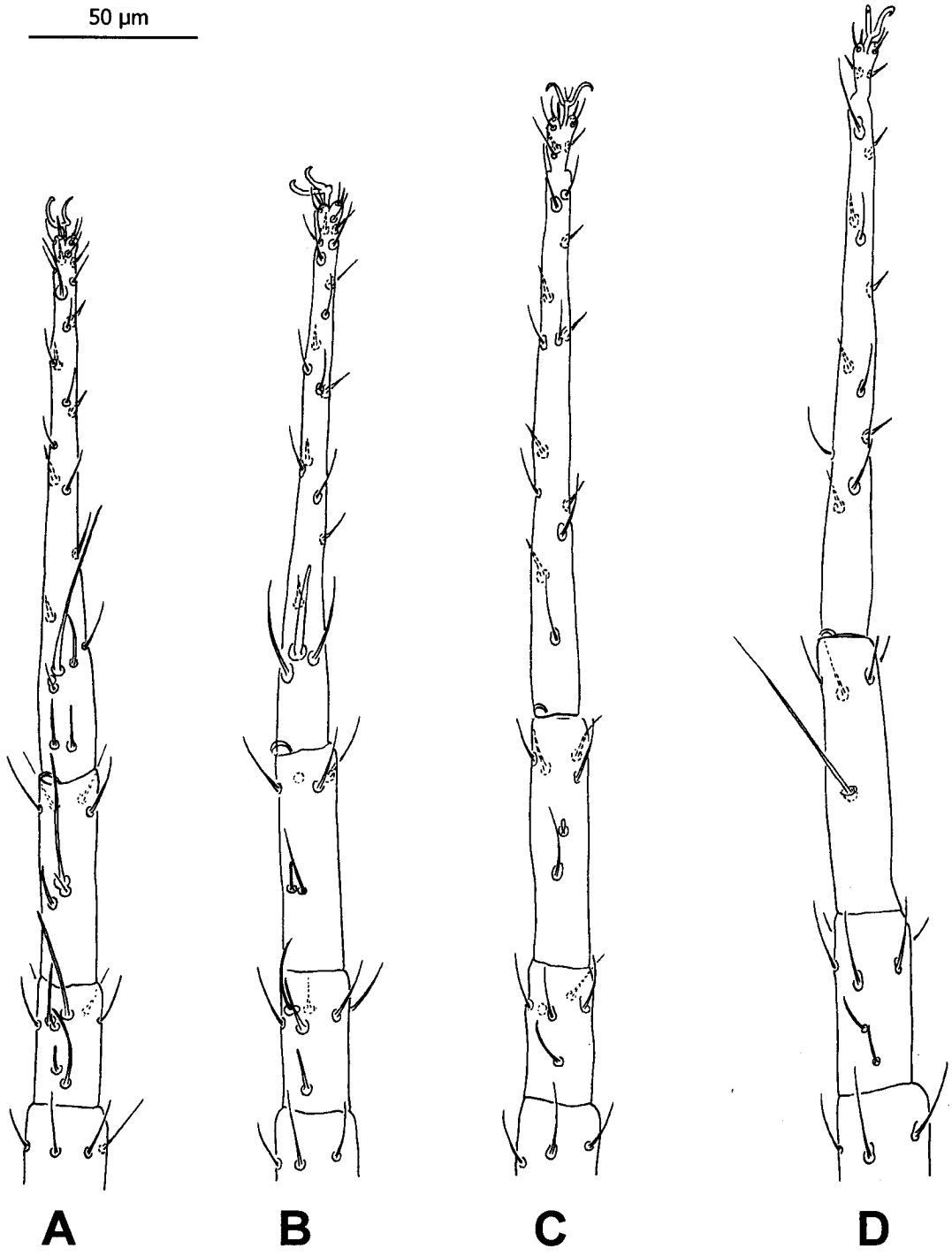

Figure 55. *Cunaxa vizcayana*, female – A, leg I; B, leg II; C, leg III; D, leg IV.

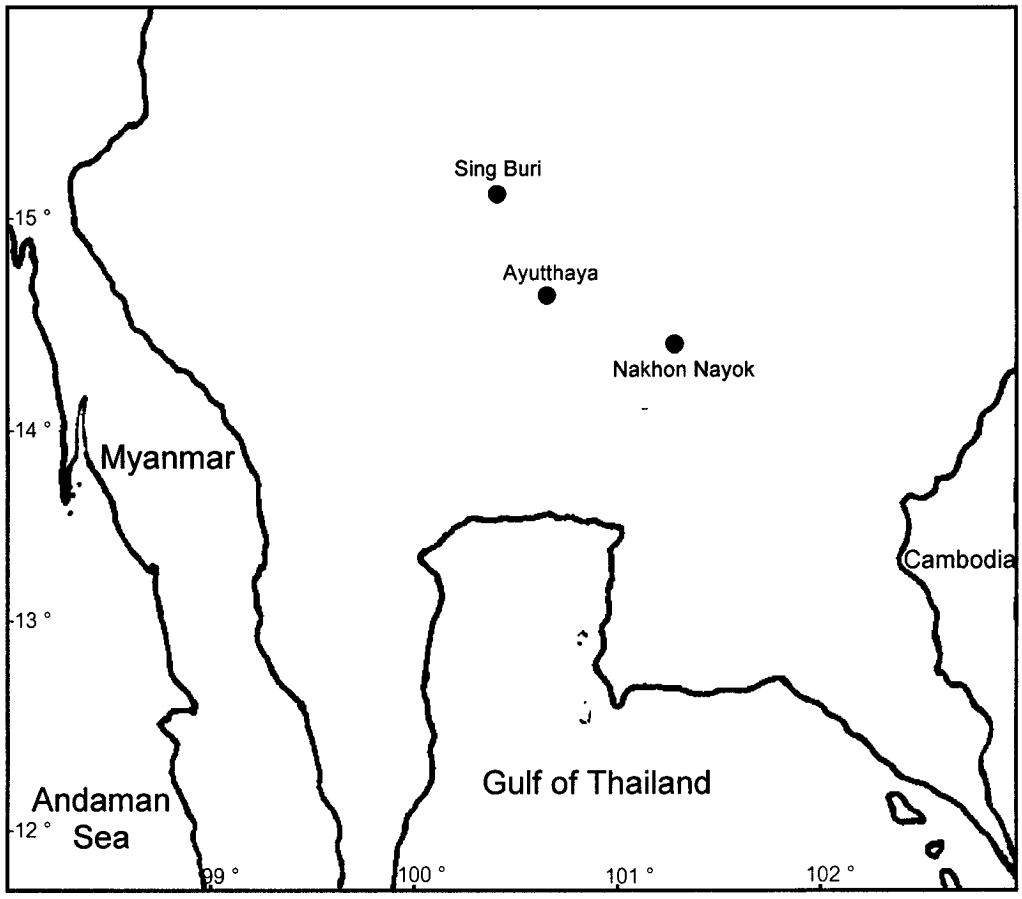

Figure 56. Collecting sites of *Cunaxa vizcayana* in central Thailand.

20. *Cunaxa* sp. 1

(Figs. 57 and 58)

Diagnosis - This species is similar to *C. grobleri* in having the smooth propodosomal and hysterosomal shields, setae c_1 longest, and in having a small spur adjacent to medial spine on inner margin of palp tibiotarsus. They can be separated by the character of genital shields and genu I. The genital shields are weakly striate, and genu I possess a base without solenidion in *C. grobleri* while the genital shields are subcuticular reticulation, and leg genu I lacks of a base without solenidia in *Cunaxa* sp. 1.

Female – Dimension - Length of idiosoma 340-385 (357), width 235-270 (255); length of hypognathum 125-140 (133.2), width 72.5-80 (74.5); length of palp 150-163 (156.2); length of chelicera 113-130 (121.6); length of legs: I 260-290 (278); II 245-275 (261); III 290-310 (300); IV 315-350 (328.33).

Gnathosoma - Hypostome (Fig. 57E) subrectangular, coneshaped distally with four pairs of hg setae, hg_4 longest, and two pairs of adoral setae. Palp with five segments (Fig. 57D) and palpal chaetotaxy as follows: Trochanter with no setae; basifemur with one dorsomedian simple seta; telofemur with one elongate apically rounded apophysis on inner surface and one dorsomedian simple seta; genu with one long spinelike seta on inner surface, one dorsal and one ventral simple seta on outer surface; tibiotarsus with one long dorsal simple seta on inner surface close to posterior edge, medially one long spinelike seta associated with small spurlike process, adjacently one simple ventral seta on inner surface, one short dorsolateral seta on external surface, terminating with one short simple seta and small claw. Chelicera with two segments (Fig. 57C), segment I papillate, segment II with one simple subterminal seta behind chela.

Dorsum (Fig. 57A) – Propodosoma with a smooth subrectangular shield bearing two pairs of propodosomal setae *ve* and *sce*, and two pairs of setose sensillae; setae *ve* minute and simple, setae *sce* longer, not reaching their bases. Hysterosoma with a smooth shield bearing simple setae c_1, c_2, d_1, and e_1, all simple. Setae c_1 longest. Setae e_1 reaching the shield boundary. The cupule *ip* present at the posterior corners of the shield; surface outside the shield with smooth striae.

Venter (Fig. 57B) – Totally covered by smooth striae with dense striation on coxal region. Coxae I-II and III-IV contiguous with subcuticular punctuations. Five pairs of ventral simple setae (except coxal, genital and anal setae) present. Genital

shields with subcuticular reticulations, four pairs of simple setae, arranged as shown in figure 57B. Anal region with one pair of anal setae, one pair of paraanal setae, and one pair of cupule *ih*.

Legs (Fig. 58) – All legs shorter than idiosoma. Tarsi tapering without conspicuous terminal lateral lobes. Number of setae on leg segments I-IV as follows: Coxae 3-1-3-2; trochanters 1-1-2-1; basifemora 4-4-2-1; telofemora 4-4-4-4; genu I, 3 attenuate solenidia, 1 micrcroseta + 4; genu II, 2 attenuate solenidia + 5; genu III, 1 attenuate solenidion + 5; genu IV, 1 attenuate solenidia + 5; tibia I, 2 attenuate solenidia, 1 microseta + 4; tibia II, 1 attenuate solenidion + 5; tibia III, 1 short blunt solenidion + 5; tibia IV, 1 trichobothrium + 4; tarsi I, 4 attenuate solenidia, 1 peglike seta, 1 microseta + 23 [including "dt" and "tsl" of Den Heyer (1979a)]; tarsi II, 1 blunt solenidion + 24; tarsi III, 22; tarsi IV, 19.

Male – Unknown

Material examined - 1F, Ban Nongpongnok, Kampangsan, Nakornpathom 14°02′57′′N 99°56′08′′E, alt. 20 m., on litter of *Tamarindus indicus*, 16. III. 2003; 35 FF, Phumoung, Supanburi, on forest litter, 16. III. 2003.

Distributions – Thailand, additional localities from this study (Fig. 59): Nakorn Pathom and Supan Buri.

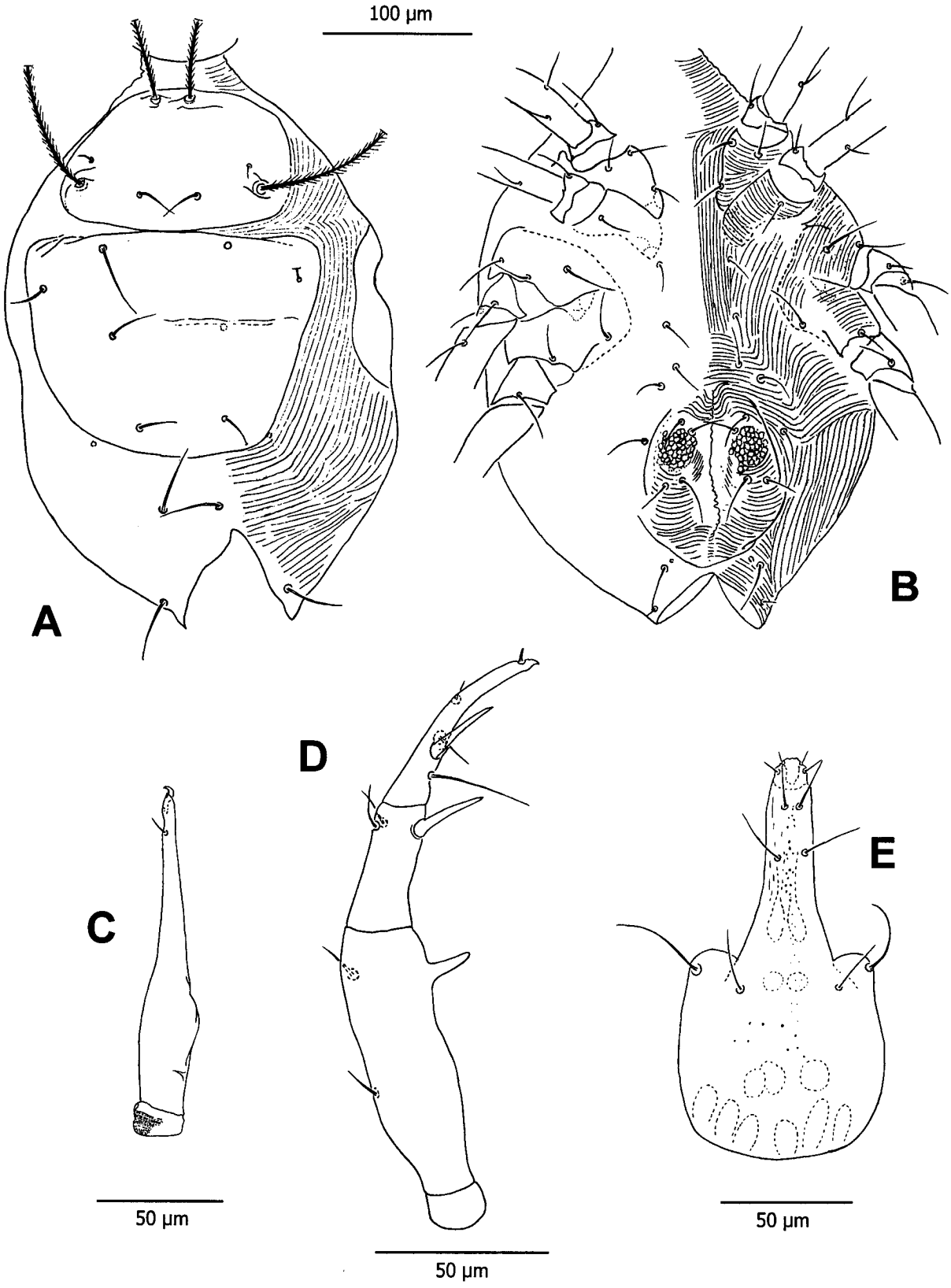

Figure 57. *Cunaxa* sp. 1, female – A, dorsum; B, venter; C, chelicerae; D, palp; E,ventral hypostome.

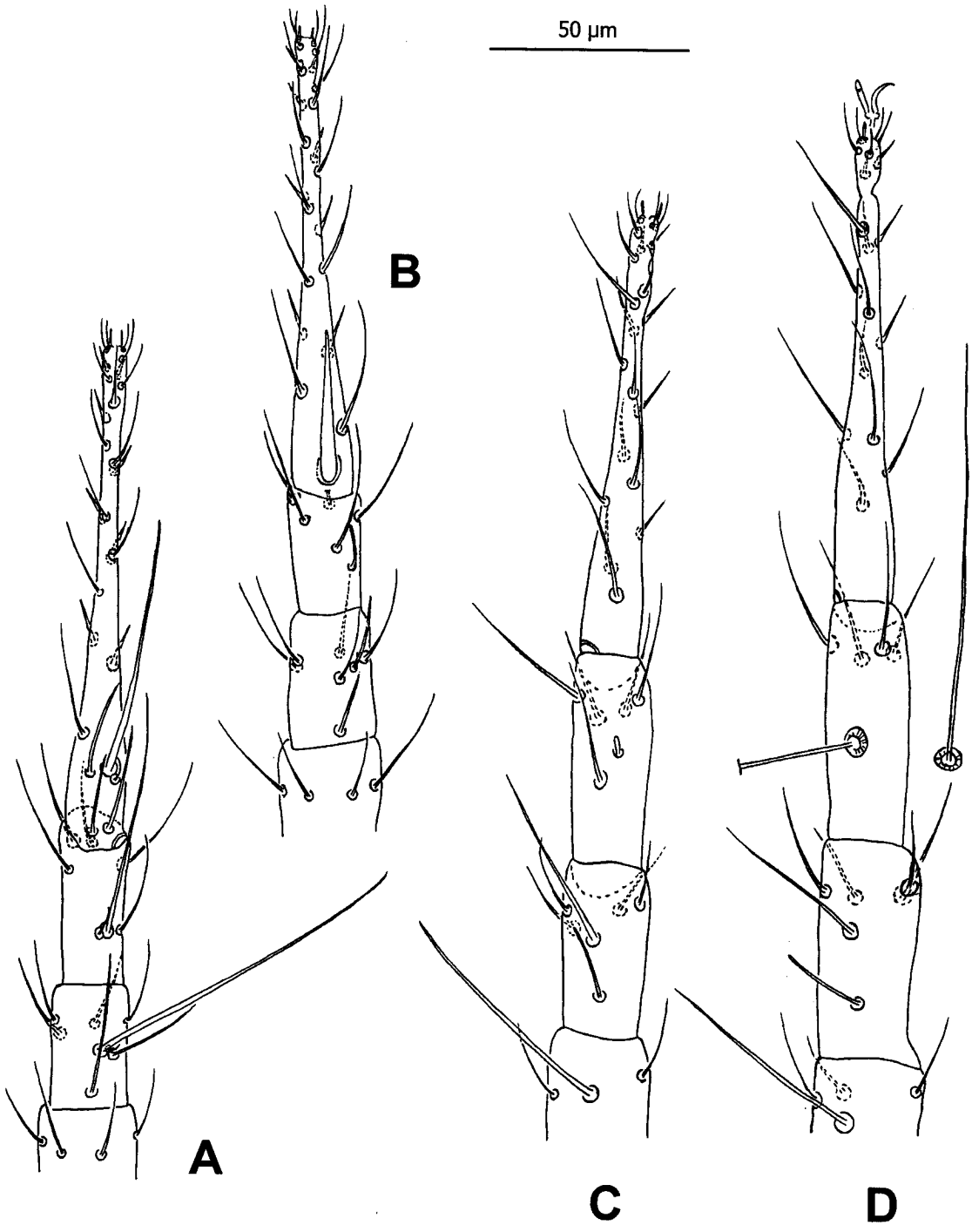

Figure 58. *Cunaxa* sp. 1, female – A, leg I; B, leg II; C, leg III; D, leg IV.

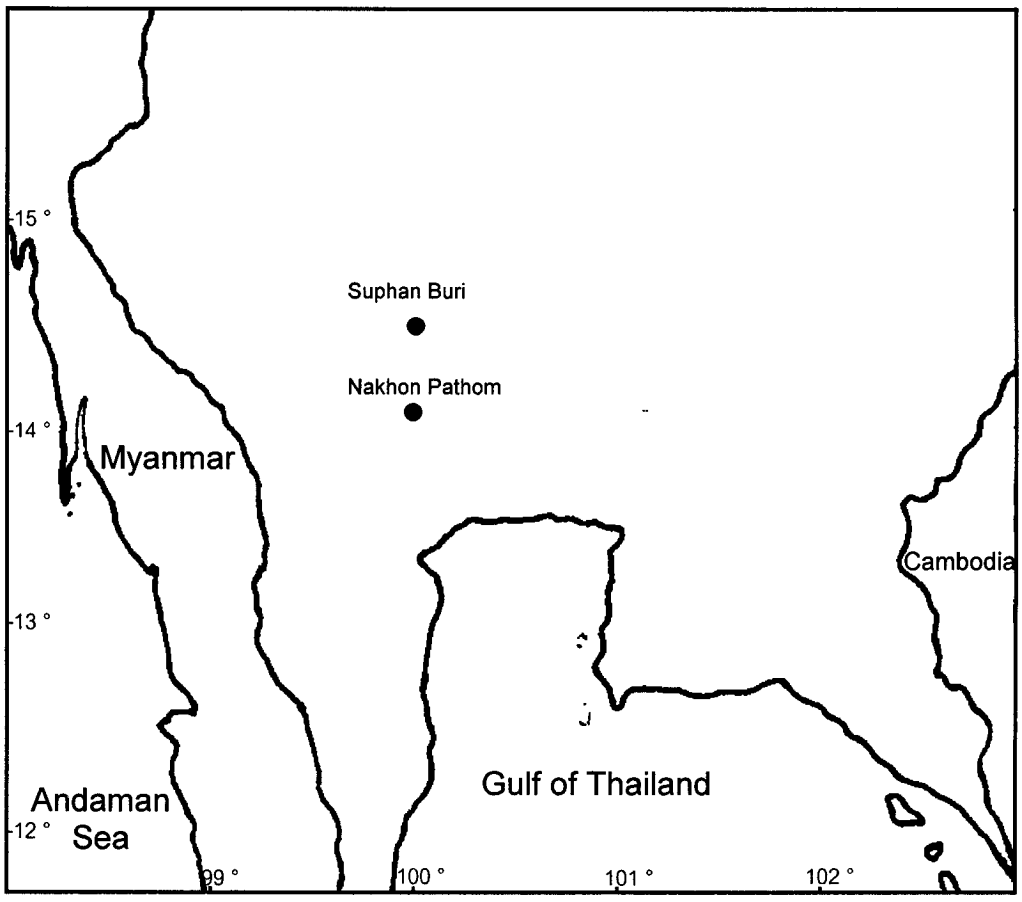

Figure 59. Collecting sites of *Cunaxa* sp. 1 in central Thailand.

21. *Cunaxa* sp. 2

(Figs. 60 and 61)

Diagnosis - This species is most closely related to *C. reevesi* Smiley, 1992, in having a reticulated propodosomal shield, an apohysis on palpal telofemur located on inner anterior portion of segment. However, *Cunaxa* sp. 2 differs from *C. reevesi* in the presence of simple dorsal setae on outer surface of palpal telofemur instead of spinelike setae as in *C. reevesi*.

Female – Dimension - Length of idiosoma 450-587 (512.33), width 290 (290); length of hypognathum 165-175 (171.67), width 90 (90), length of palp 188-200 (194.33); length of chelicera 158-160 (158.67); length of legs: I 415 (415); II 425 (425); III 500-520 (510); IV 555-565 (560).

Gnathosoma - Hypostome (Fig. 60D) subrectangular, coneshaped distally; ventral surface of hypostome granulated with four pairs of *hg* setae, hg_4 longest, and two pairs of adoral setae. Palp with five segments (Fig. 60E) and palpal chaetotaxy as follows: Trochanter with no setae; basifemur with one dorsomedial simple seta; telofemur with one pointed apophysis on inner surface and one dorsomedian simple seta on outer surface; genu with one spinelike seta on inner surface, one dorsal spinelike seta and one ventral simple seta on outer surface; tibiotarsus with one long simple seta on inner surface close to posterior edge, medially one spinelike seta and small spurlike process adjacent to a simple seta on inner surface, one short dorsolateral seta on external surface, terminating with one short simple seta and small claw. Chelicera with two segments (Fig. 60C), segment I papillate, segment II with dorso-basal half papillate, one simple subterminal seta behind chela.

Dorsum (Fig. 60A) – Propodosoma with a reticulated shield, reticulation with large cell contained many small cells insides (secondary reticulation present); propodosomal shield with two pairs of simple propodosomal setae, *ve* and *sce*, and two pairs of setose sensillae; Hysterosoma without hysterosomal shield, surface with smooth striae and dotlike lobes. Dorsal hysterosomal setae simple, h_1 longest; a pair of cupule *ip* located anteriolaterad of f_1.

Venter (Fig. 60B) – Totally covered by smooth striae, with dotlike lobes, and dense striation on coxal region. Coxae I-II and III-IV contiguous. Six pairs of ventral simple setae (except coxal, genital and anal setae) present. Genital shields granulated with four pairs of simple setae, arranged as shown in figure60 B. Two pairs of genital

papillae, anterior one incompletely divided. Anal region with one pair of anal setae, one pair of paraanal setae, and one pair of cupule *ih*.

Legs (Fig. 61) – All legs shorter than idiosoma. Tarsi tapering without conspicuous terminal lateral lobes. Number of setae on leg segments I-IV as follows: Coxae 3-1-3-1; trochanters 1-1-2-1; basifemora 3-3-3-1; telofemora 4-4-4-4; genu I, 3 attenuate solenidia, 1 micrcroseta + 4; genu II, 2 attenuate solenidia + 5; genu III, 1 attenuate solenidion + 5; genu IV, 1 attenuate solenidion + 5; tibia I, 2 attenuate solenidia, 1 microseta + 4; tibia II, 1 attenuate solenidion + 5; tibia III, 1 attenuate solenidion + 5; tibia IV, 1 trichobothrium + 4; tarsi I, 4 attenuate solenidia, 1 peglike seta, 1 microseta + 25 [including "dt" and "tsl" of Den Heyer (1979a)]; tarsi II, 1 attenuate solenidion + 27; tarsi III, 23; tarsi IV, 20.

Male – Unknown

Material examined - 1F, Tha Chai, Muang, Chai Nat, on *Tamarindus indicus* litter 14°02′57′′N 99°56′08′′E, alt. 20 m., 28. III. 2003; 3FF, Pho Chonkai, Bang Rachan, Sing Buri 15°10′16′′N 100°05′33E, alt. 27 m., on *Tamarindus indicus* litter, 28. III. 2003.

Distribution – Thailand, additional localities from this study (Fig. 62): Chai Nat and Sing Buri.

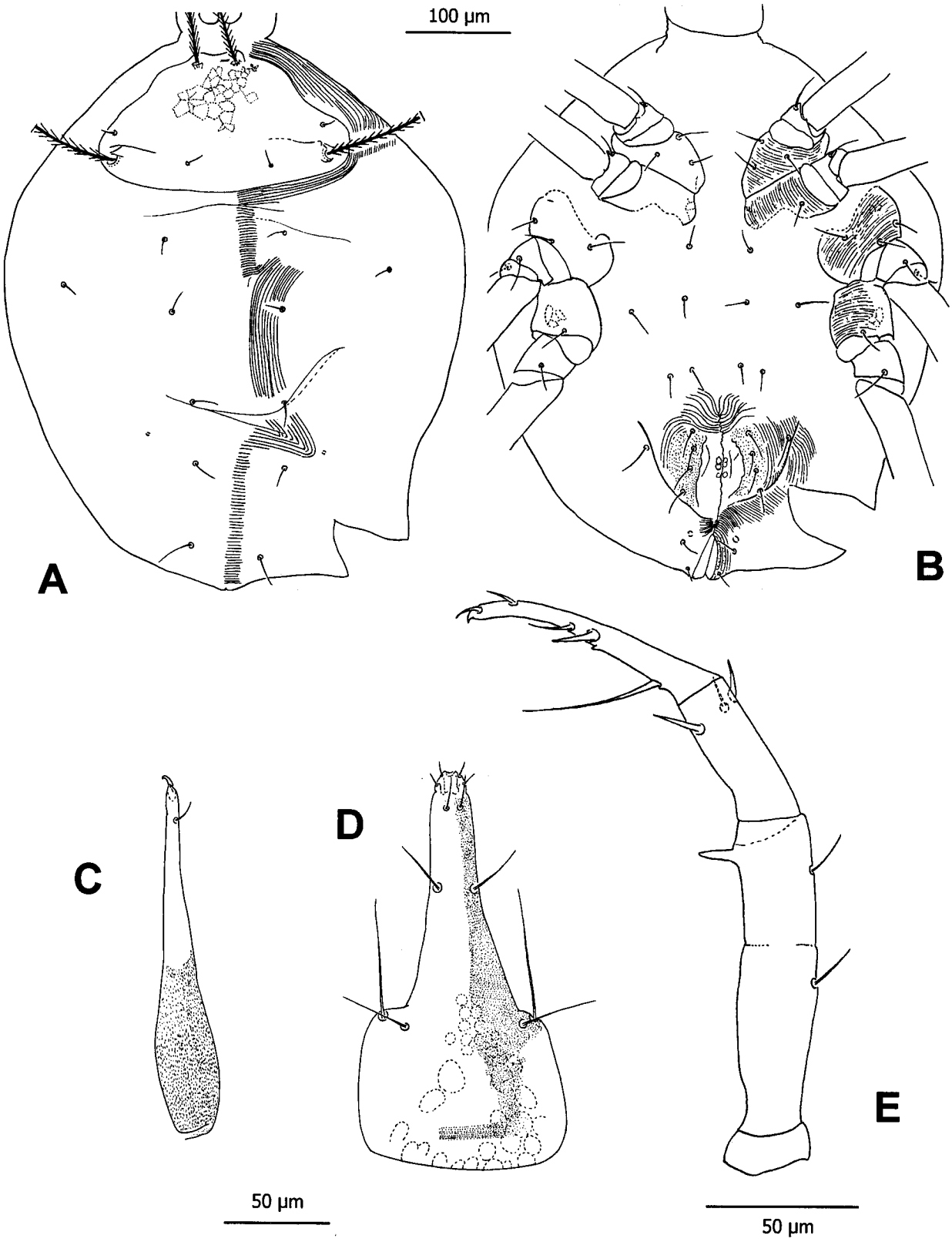

Figure 60. *Cunaxa* sp. 2, female – A, dorsum; B, venter; C, chelicerae; D, ventral hypostome; E, palp.

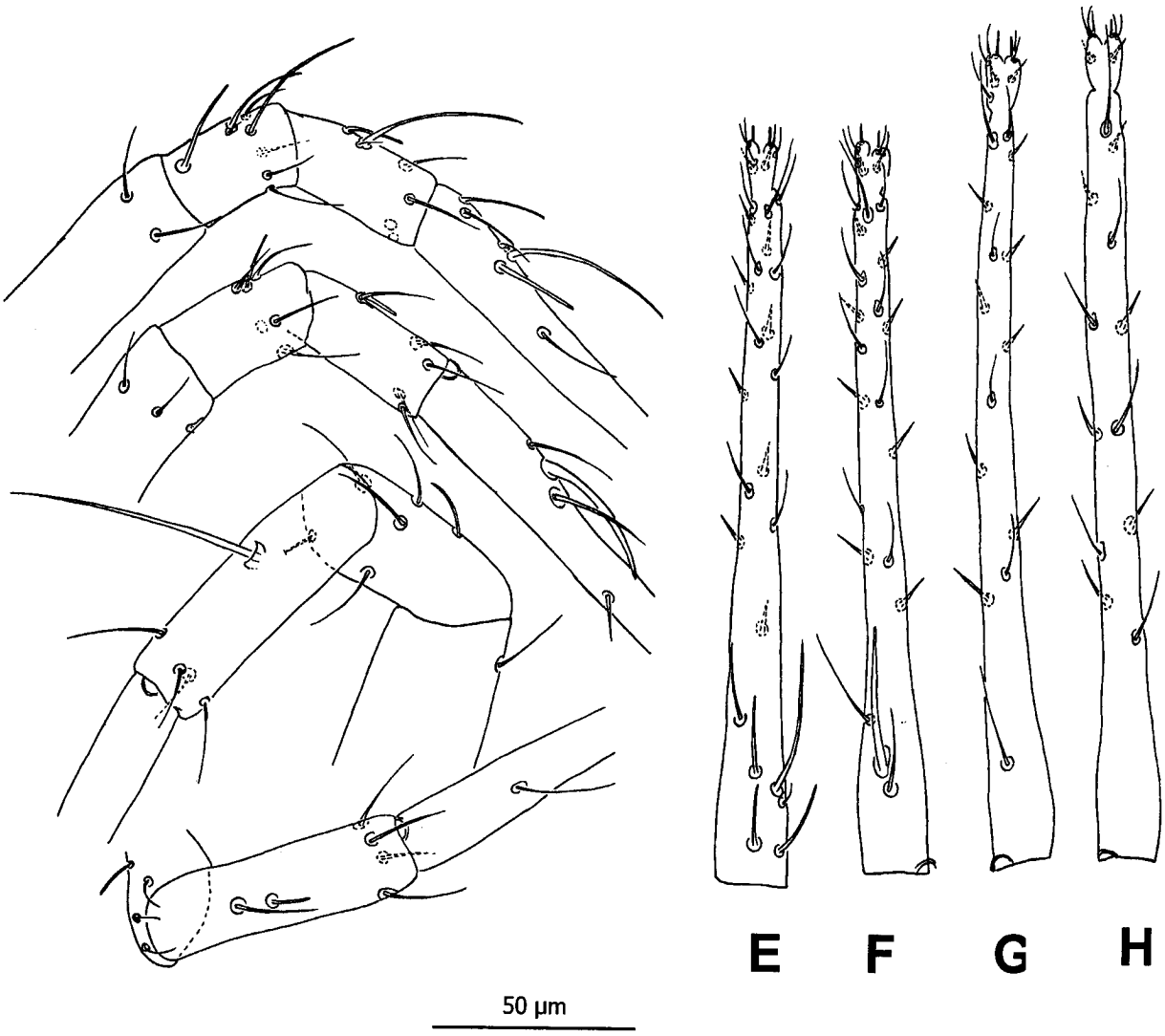

Figure 61. *Cunaxa* sp. 2, female – A, leg I; B, leg II; D leg III; C, leg IV; E, tarsi I; F, tarsi II; G, tarsi III; H, tarsi IV.

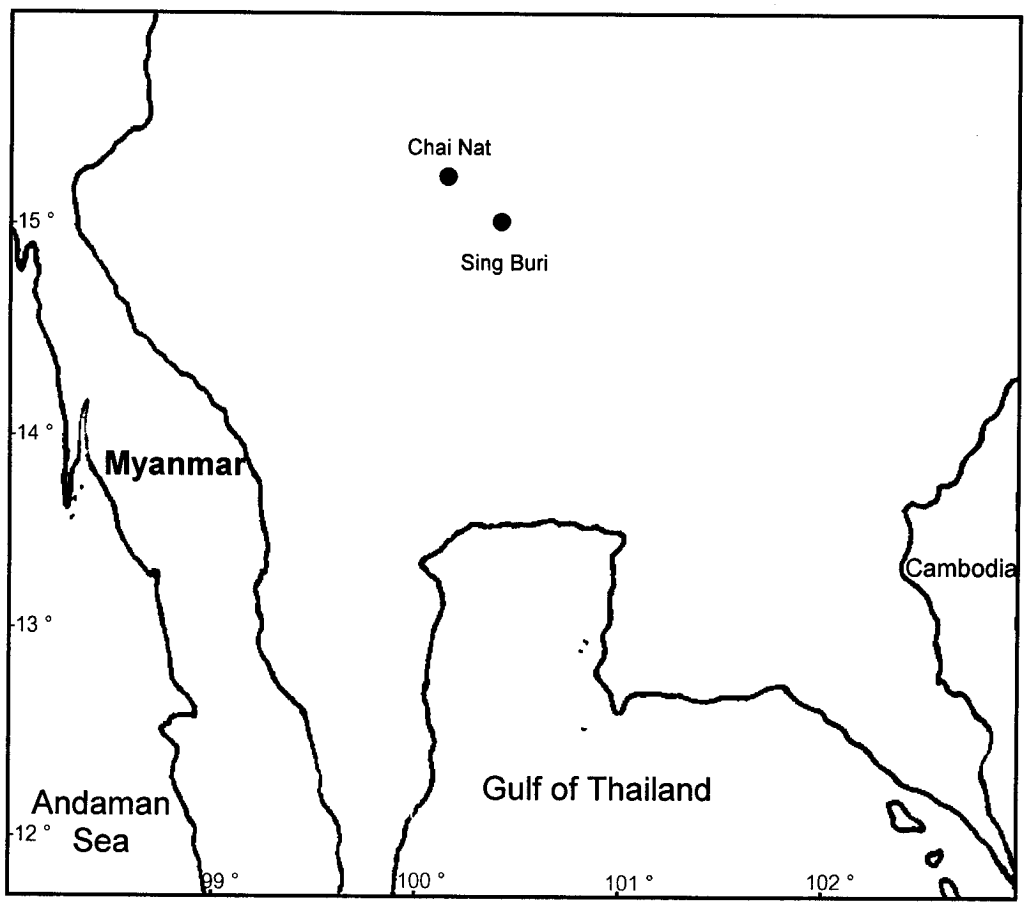

Figure 62. Collecting sites of *Cunaxa* sp. 2 in central Thailand.

22. *Cunaxa* sp. 3

(Figs. 63 and 64)

Diagnosis - This species is most closely related to *C. bambusae* Gupta and Ghosh, 1980, in that the propodosomal shield is reticulated. Palpal telofemur and genu without an apophysis or spinelike seta. They can be separated by the numbers of setae on palpal tibiotarsus and type of setae f_1 and h_1. There are four simple setae on palpal tibiotarsus, and setae f_1 and h_1 are spiculate in *Cunaxa* sp. 3 while five simple setae on palpal tibiotarsus, and setae f_1 and h_1 are simple in *C. bambusae*.

Female – Dimension - Length of idiosoma 425 (425); length of hypognathum 128-133 (130.2), width 70-75 (72.5); length of palp 100-105 (101.8); length of chelicera 123-130 (124.6); length of legs: I 240 (240); II 235-240 (238.75); III 260-275 (268.75); IV 290-300 (297).

Gnathosoma - Hypostome (Fig. 63D) subrectangular, coneshaped distally; ventral surface of hypostome finely granulated but forming longitudinal ridge from the level of hg_3 to the anterior end; four pairs of *hg* setae, hg_2 longest, and two pairs of adoral setae. Palp with five segments (Fig. 63C) and palpal chaetotaxy as follows: Trochanter with no setae; basifemur with one long dorsomedial simple seta; telofemur with one dorsomedian simple seta, apophysis absent on inner surface; genu with one simple seta on inner surface, medially with one simple seta, one dorsal and one ventral simple seta on outer surface; tibiotarsus with one dorsal simple seta on inner surface close to posterior edge, medially one stout spinelike seta and without small spurlike process, one simple ventral seta on inner surface, one short dorsolateral seta on external surface, terminating with one short simple seta and small claw. Chelicera with two segments (Fig. 63E), segment I papillate, segment II dorsobasally papillate with one simple subterminal seta behind chela.

Dorsum (Fig. 63A) – Propodosoma with a reticulated subrectangular shield bearing two pairs of propodosomal setae, *ve* and *sce*, and two pairs of setose sensillae; setae *sce* simple and about two times setae *ve*. Hysterosoma without hysterosomal shields and surface with smooth striae with dotlike lobes. Dorsal hysterosomal setae c_1, c_2, d_1, and e_1 simple and subequal. Setae f_1 and h_1 finely spiculate, h_1 longest, about two times of setae c_1, d_1, and e_1. The cupule *ip* present.

Venter (Fig. 63B) – Totally covered by smooth striae with dense striation on coxal region. Coxae I-II and III-IV contiguous, coxa III with reticulation. Five pairs of ventral simple setae (except coxal, genital and anal setae) present. Genital shields

punctuated with four pairs of simple setae, arranged as shown in figure 63B. Anal region with one pair of anal setae and one pair of paraanal setae.

Legs (Fig. 64) – All legs shorter than idiosoma. Tarsi tapering without conspicuous terminal lateral lobes. Number of setae on leg segments I-IV as follows: Coxae 3-1-3-2; trochanters 1-1-2-1; basifemora 3-3-2-1; telofemora 4-4-4-4; genu I, 4 attenuate solenidia, 1 micrcroseta + 4; genu II, 2 attenuate solenidia + 5; genu III, 1 attenuate solenidion + 5; genu IV, 1 attenuate solenidia + 5; tibia I, 2 attenuate solenidia, 1 microseta + 4; tibia II, 1 attenuate solenidion + 5; tibia III, 1 attenuate solenidion + 5; tibia IV, 1 trichobothrium + 4; tarsi I, 4 attenuate solenidia, 1 peglike seta, 1 microseta + 17 [including "dt" and "tsl" of Den Heyer (1979a)]; tarsi II, 1 attenuate solenidion + 17; tarsi III, 15; tarsi IV, 13.

Male – Unknown

Material examined - 3FF, Ban Sala Loy, Tha Ruae, Ayutthaya, beating from *Streblus asper*, 9. VI. 2002; 8FF, Ban Sala Loy, Tha Ruae, Ayutthaya, on leaves of *Morinda citrifolia* Linn., 10. XI. 2002; 1F, Ban Nong Pongnok, Kamphang Saen, Nakhon Pathom 14°02′57′′N 99°56′ 08′′E, alt. 20 m., on mango leaves, 16. III. 2003.

Distribution – Thailand, additional localities from this study (Fig. 65): Ayutthaya and Nakhon Pathom.

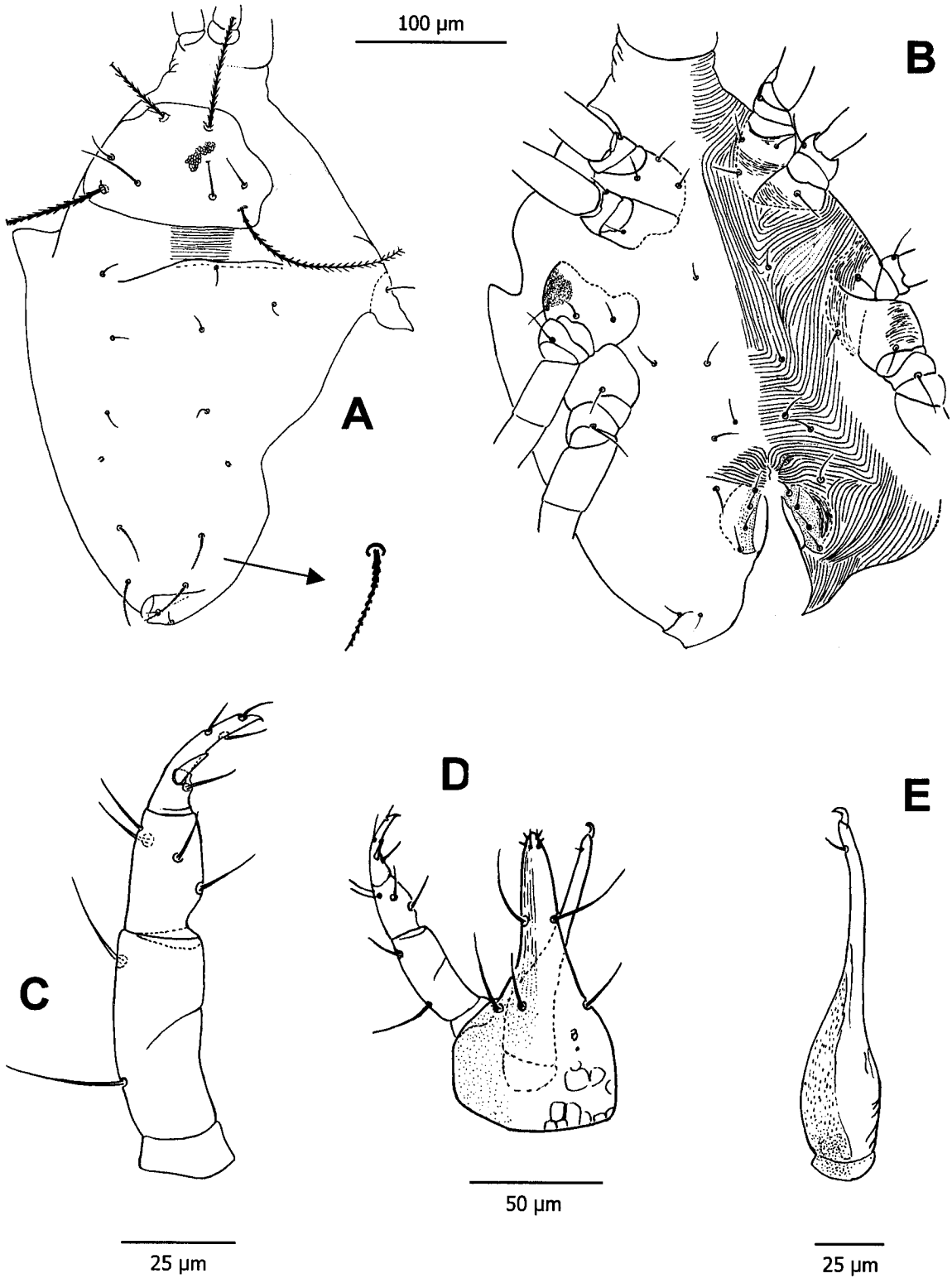

Figure 63. *Cunaxa* sp. 3, female – A, dorsum; B, venter; C, palp; D, ventral gnathosoma; E, chelicerae.

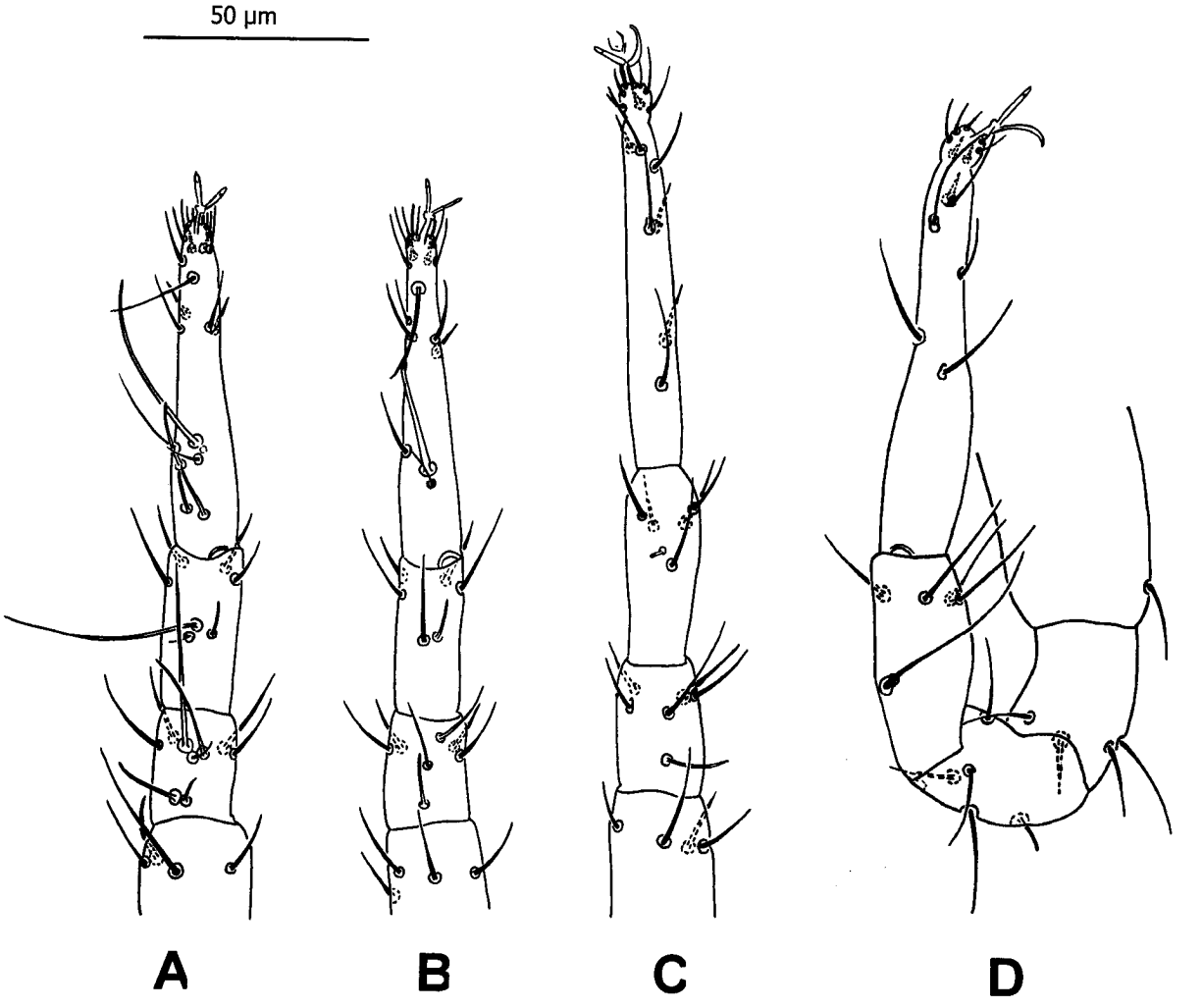

Figure 64. *Cunaxa* sp. 3, female – A leg I; B, leg II; D, leg III; C, leg IV.

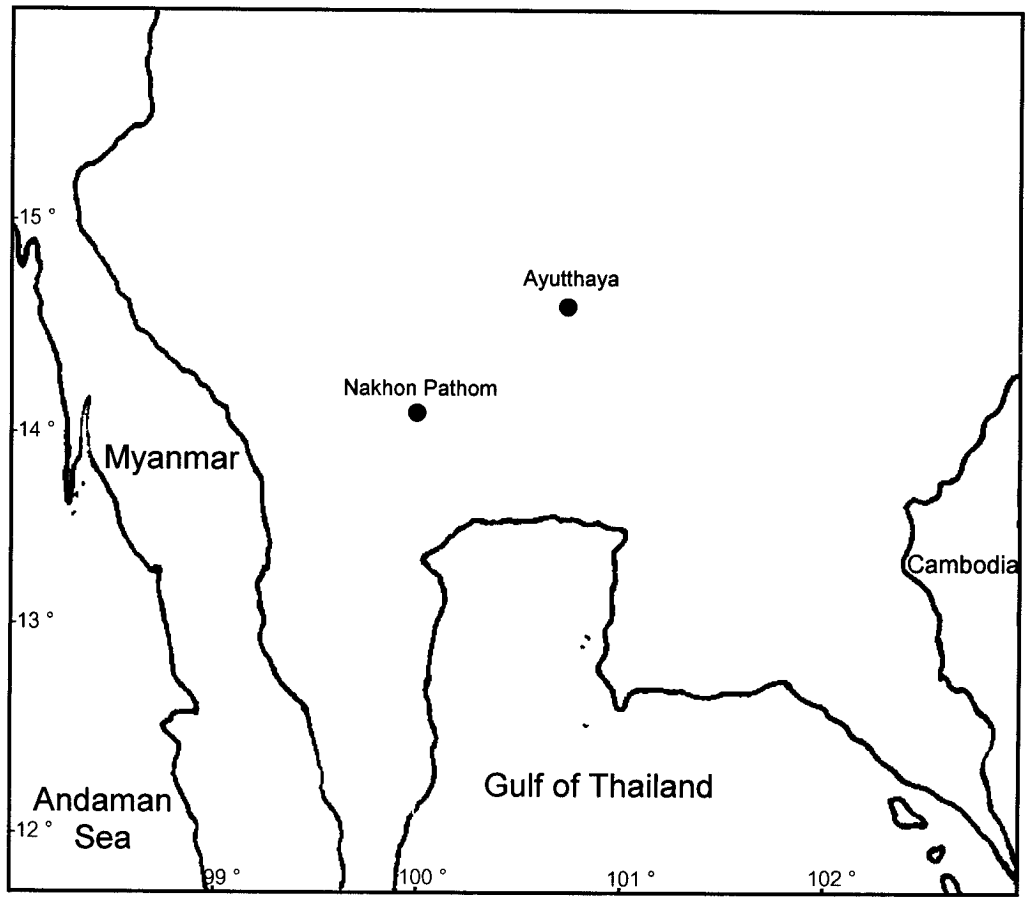

Figure 65. Collecting sites of *Cunaxa* sp. 3 in central Thailand.

Table 4-7. A comparison of main characters between the species belonging to the genus *Cunaxa*.

Characters	*C. grobleri*	*C.* sp. 1	*C. romblonensis*	*C. setirostris*	*C.* sp.2	*C.* sp. 3	*C. lukoschusi*	*C. venusae*	*C. vizcayana*
apophysis on palp telofemur	fingerlike	fingerlike	fingerlike	fingerlike	spinelike	absent	fingerlike	fingerlike	subtriagular process
spinelike seta on palp genu	present	present	present	present	present	absent	present	present	present
small spurlike process	present	present	absent	present	present	present	present	present	present
propodosomal shield	smooth	smooth	smooth	smooth	reticulate	reticulate	reticulate	reticulate	reticulate
hysterosomal shield	present	present	present	absent	absent	present	absent	absent	absent
genital shields	striate	reticulate	striate	granulate	granulate	granulate	striate	granulate	granulate
setae *sce*	simple	simple	simple	simple	simple	simple	simple	spinose	simple
setae c_1	simple	simple	simple	simple	simple	simple	simple	spinose	simple
setae c2	simple	simple	simple	simple	simple	simple	simple	spinose	simple
setae d_1	simple	simple	simple	simple	simple	simple	simple	spinose	simple
setae e_1	simple	simple	simple	simple	simple	simple	simple	spinose	simple
setae f_1	simple	simple	simple	simple	simple	simple	spinose	spinose	spinose
setae h_1	simple	simple	simple	simple	simple	simple	spinose	spinose	spinose
chaetotaxy of basifemora I-II-III-IV	4-4-2-1	4-4-2-1	4-4-3-1	4-4-3-1	3-3-3-1	3-3-2-1	3-3-3-1	3-3-3-1	3-3-3-1
chaetotaxy of telofemora I-II-III-IV	4-4-4-4	4-4-4-4	4-4-4-4	4-4-4-4	4-4-4-4	4-4-4-4	4-4-4-4	4-4-4-4	4-4-4-4
number of solenidia on genu I-II-III-IV	(4)-2-1-1	3-2-1-1	4-2-1-1	4-2-1-1	3-2-1-1	4-2-1-1	4-2-1-2	4-2-1-1	4-2-1-1
number of solenidia on tibia I-II-III-IV	2-1-1-0	2-1-1-0	2-1-1-0	2-1-1-0	2-1-1-0	2-1-1-0	2-1-1-0	2-1-1-0	2-1-1-0

Genus *Dactyloscirus* Berlese, 1916

Scirus (*Dactyloscirusi*) Berlese, 1916: 131; Vizthum, 1931: 146; Thor and Willmann, 1941: 173; Baker and Wharton, 1952: 193.

Rosehofia Oudemans, 1922: 110; Thor and Willmann, 1941; 173; Baker and Wharton, 1952: 193; Den Heyer, 1979c: 87. Type-species: *Rosenhofia machiarodus* Oudemans, by original designation.

Dactyloscirus Thor and Willmann, 1941: 173; Smiley, 1975: 230; Den Heyer, 1979c: 85; Sepasgosarian, 1984: 139; Michoka, 1982: 328; 1987: 92; Liang, 1986: 159; Gupta, 1992: 140; Smiley, 1992: 214; Swift, 1996: 225; Inayatullah and Shahid, 1996: 547.Type-species: *Scirus* (*Dactyloscirus*) *eupaloides* Berlese, by original designation.

Diagnosis – Propodosoma with a reticulated shield. Hysterosoma with two small lateral shields. Palpal five segments, extending beyond the apex of the hypostome, and with strong lateral elongated or spinelike apophyses on the basifemur, telofemur, and genu; tarsi I-IV short and stout, terminating with large, conspicuous lateral bilobed flanges; tarsi I proximally with an elongate-base solenidion.

Two unidentified species of *Dactyloscirus* were recognized in this study. A comparison of main characters between these two species is present in Table. 4-8.

Table 4-8. A comparison of main characters between species belonging to the genus *Dactyloscirus*

Characters	*Dactyloscirus* sp. 1	*Dactyloscirus* sp. 2
propodosomal shield	reticulate	reticulate
median shield on hysterosoma	absent	absent
ratio of length of lateral shield/ c_1-c_1	1	2
setae f_1 and h_1	thick	simple
tip of apohysis on palp telofemur	not expanded	expanded
median seta on palp tibiotarsus	spinelike	rodlike
genital shields	reticulate	granulated
chaetotaxy of basifemora I-II-III-IV	5-5-3-2	5-5-3-2
chaetotaxy of telofemora I-II-III-IV	5-5-4-4	5-5-4-4
number of solenidia on genu I-II-III-IV	4-2-1-2	4-2-1-2
number of solenidia on tibia I-II-III-IV	2-1-1-0	2-1-1-0

23. *Dactyloscirus* sp. 1

(Figs. 66 and 67)

Diagnosis – This species is mostly resembles *D. dolichosetosus*, Den Heyer 1979 in having elongate lateral hysterosomal shields, about the nearest distance between setae c_1 and c_2. They can be separated by the elongate base solenidion is shorter than adjacent solenidion on tarsi I in *Dactyloscirus* sp. 1 while the elongate base solenidion is longer than the adjacent solenidion on tarsi I in *D. dolichosetosus* (Den Heyer, 1979c)

Female – Dimension - Length of idiosoma 475 (475), width 325-350 (333); length of hypognathum 250-275 (268.75), width 125-140 (133.33); length of palp 225-250 (237.5.8); length of chelicera 125-225 (173.75); length of legs: I 375-425 (402.5); II 315-350 (341.25); III 350-410 (378.33); IV 405-460 (438.33).

Gnathosoma - Dorsolateral and ventrolateral surface of hypostome (Fig 65D) reticulated with four pairs of *hg* setae, hg_4 longest, and two pairs of adoral setae. Palp with five segments (Fig. 66C) and palpal chaetotaxy as follows: Trochanter with no setae; basifemur with one dorsal spinelike seta; telofemur with one short bulbous apophysis on inner surface and one dorsomedian spinelike seta; genu with one longer bulbous apophysis on inner surface, three simple setae on apical half, one medially ventral simple seta; tibiotarsus with one long simple seta on inner surface close to posterior edge, medially one small spinelike seta, two short simple setae on external surface, terminating with one long thick seta and small claw. Chelicera slender with two segments (Fig. 66E), segment I granulated, segment II dorsobasally reticulate, one long simple subterminal seta behind chela.

Dorsum (Fig. 66A) – Propodosoma with a reticulated shield, bearing two pairs of simple propodosomal setae, *ve* and *sce*, and two pairs of setose sensillae; setae *ve* and *sce* about equal in length. Hysterosoma with elongate lateral hysterosomal shields about the distance between c_1 and c_2; median hysterosomal shields absence; integument striate and densely granulated. Dorsal hysterosomal simple; f_1 and h_1 long and thicker, about three times of c_1, c_2, d_1, e_1, and h_2; the cupule *ip* present, located anteriolaterad of f_1.

Venter (Fig. 66B) – Coxae I-II and III-IV contiguous. Coxa I and coxa II mainly granulate with reticulation,coxae III-IV totally reticulate. Five pairs of ventral simple setae: ag_1, ag_2 and three setae (except coxal, genital and anal setae). Genital shields totally reticulate with four pairs of unequal simple setae, g_3 longest, arranged

as shown in figure 66B. Two pairs of genital papillae present. Anal region with two pairs of setae, ps_1 and ps_2, and one pair of cupule, *ih*.

Legs (Fig. 67) – All legs shorter than idiosoma. Tarsi with conspicuous terminal lateral lobes. Number of setae on leg segments I-IV as follows: Coxae 3-3-3-3; trochanters 1-1-2-1; basifemora 5-5-3-2; telofemora 5-5-4-4; genu I, 4 attenuate solenidia, 1 micrcroseta + 4; genu II, 2 attenuate solenidia + 5; genu III, 1 attenuate solenidion + 5; genu IV, 2 attenuate solenidia + 5; tibia I, 2 attenuate solenidia, 1 microseta + 4; tibia II, 1 attenuate solenidion + 5; tibia III, 1 attenuate solenidion + 5; tibia IV, 1 trichobothrium + 4; tarsi I, 5 solenidia of which one is multibranches and elongate base, 1 microseta + 21 [including "dt" and "tsl" of Den Heyer (1979a)]; tarsi II, 1 attenuate solenidion + 23; tarsi III, 23; tarsi IV, 20.

Male – Unknown.

Material examined - 3FF, Chulalongkorn University Campus, Bangkok, on litter of *Tabebuia rosae*, 9. VII. 2002; 5FF, Chulalongkorn University Campus, Bangkok 13°44′40′′N 100°31′69′′E, on litter of *Sananea saman*, 9. II. 2003.

Distributions – Thailand, additional localities from this study (Fig. 70): Bangkok.

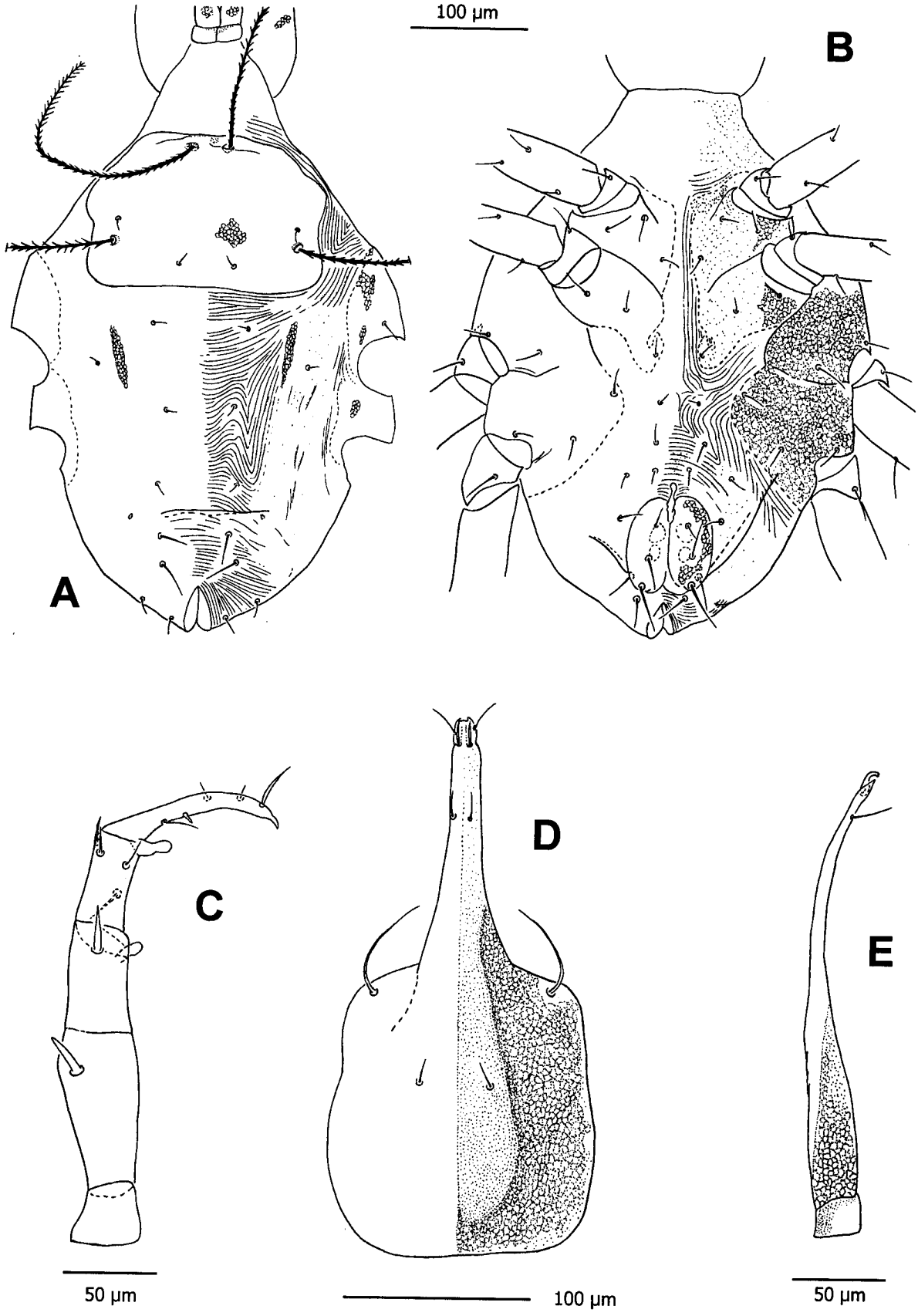

Figure 66. *Dactyloscirus* sp. 1, female – A, dorsum; B, venter; C, palp; D, ventral hypostome; E, chelicera.

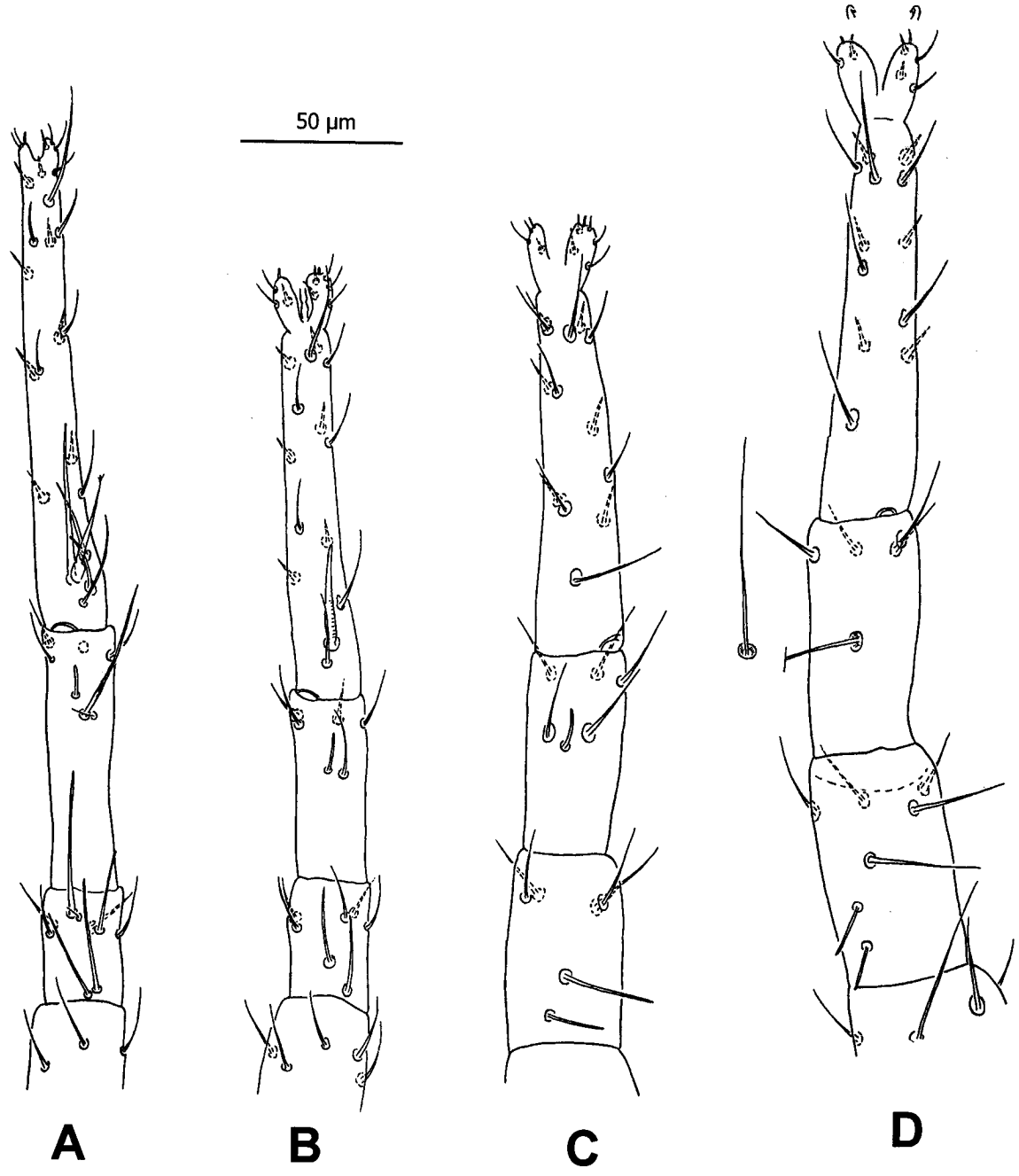

Figure 67. *Dactyloscirus* sp. 1, female – A, leg I; B, leg II; C, leg III; D, leg IV.

24. *Dactyloscirus* sp. 2

(Figs. 68 and 69)

Diagnosis – This species resembles *D. inermis* (Tragardh, 1905) in having the elongate, bulbous apophysis on palp telofemur and genu. However, they can be distinguished by the lateral hyterosomal shield are elongate in *Dactyloscirus* sp. 2 while the lateral hysterosomal shields are short and inconspicuous in *D. inermis*.

Female – Dimension - Length of idiosoma 450-540 (490), width 390 (390); length of hypognathum 183-205 (194), width 87-105 (96); length of palp 174-213 (194); length of chelicera 168-183 (175.5); length of legs: I 310-340 (325); II 275-290 (282.5); III 310-350 (330); IV 340-395 (367.5).

Gnathosoma - Dorsolateral and ventrolateral surface of hypostome (Fig. 68D) reticulated with four pairs of *hg* setae, hg_4 longest, and two pairs of adoral setae. Palp with five segments (Fig. 68C) and palpal chaetotaxy as follows: Trochanter with no setae; basifemur with one dorsal spinelike seta; telofemur with one bulbous apophysis on inner surface and one apical dorsomedian spinelike seta; genu apically with one long bulbous apophysis on apical inner surface, one dorsal spinelike seta, one short simple seta on outer surface, one long simple seta on inner surface, medially one long ventral simple seta; tibiotarsus with one long simple seta on inner surface, medially one small rodlike seta on inner surface, two short simple setae on external surface, terminating with one long thick seta and small claw. Chelicera with two segments (Fig. 68E), segment I granulated, segment II dorsobasally reticulate, one long simple subterminal seta behind chela.

Dorsum (Fig. 68A) – Propodosoma with a reticulated shield, bearing two pairs of simple propodosomal setae, *ve* and *sce*, and two pairs of setose sensillae; setae *sce* about two times of *ve*; Hysterosoma with a pair of narrow, elongated, inconspicuously reticulated lateral shields, the shields about a half of the distance between the base of c_1 and c_2; medial hysterosomal shields absent; integument striate with granulate; dorsal hysterosomal setae simple, f_1 and h_1 long, about two times of c_1, c_2, d_1, e_1 and h_1.

Venter (Fig. 68B) – Coxae I-II and III-IV contiguous. Coxa I and coxa II mainly granulate, and reticulate; coxae III-IV totally reticulate. Five pairs of ventral simple setae (except coxal, genital and anal setae). Genital shields granulated with a group of reticulation, four pairs of unequal simple setae, g_3 longest, arranged as

shown in figure 68B. Two pairs of genital papillae present. Anal region with setae ps_1, ps_2, and one pair of cupule *ih*.

Legs (Fig. 69) – All legs shorter than idiosoma. Tarsi with conspicuous terminal lateral lobes. Number of setae on leg segments I-IV as follows: Coxae 3-3-3-3; trochanters 1-1-2-1; basifemora 5-5-3-2; telofemora 5-5-4-4; genu I, 4 attenuate solenidia, 1 micrcroseta + 4; genu II, 2 attenuate solenidia + 5; genu III, 1 attenuate solenidion + 5; genu IV, 2 attenuate solenidia + 5; tibia I, 2 attenuate solenidia, 1 microseta + 4; tibia II, 1 attenuate solenidion + 5; tibia III, 1 attenuate solenidion + 5; tibia IV, 1 trichobothrium + 4; tarsi I, 5 solenidia of which one with elongate base, 1 microseta + 21 [including "dt" and "tsl" of Den Heyer (1979a)]; tarsi II, 1 attenuate solenidion + 23; tarsi III, 22; tarsi IV, excluding setae on pretarsi, 12.

Male – Unknown.

Material examined - 3FF, Bang Khan Taek, Samut Songkhram, on coconut litter, 25. VI. 2002; 5FF, Khlong Sip Song, Pathum Thani, 14°06′42′′N 100°52′37′′E, on *Acacia* sp. litter, 16. IX. 2003; 1F, as previous data but on leaf litter under Leguminosae; 2FF, as previous data but on decomposing grasses; 1F, Kaeng Sam Chan, Sarika, Nakhon Nayok, 14°18′05′′N 101°18′17′′E, on litter under *Citrus grandis*, 2. IX. 2003.

Distributions – Thailand, additional localities from this study (Fig. 70): Nakhon Nayok, Samut Songkhram and Pathum Thani.

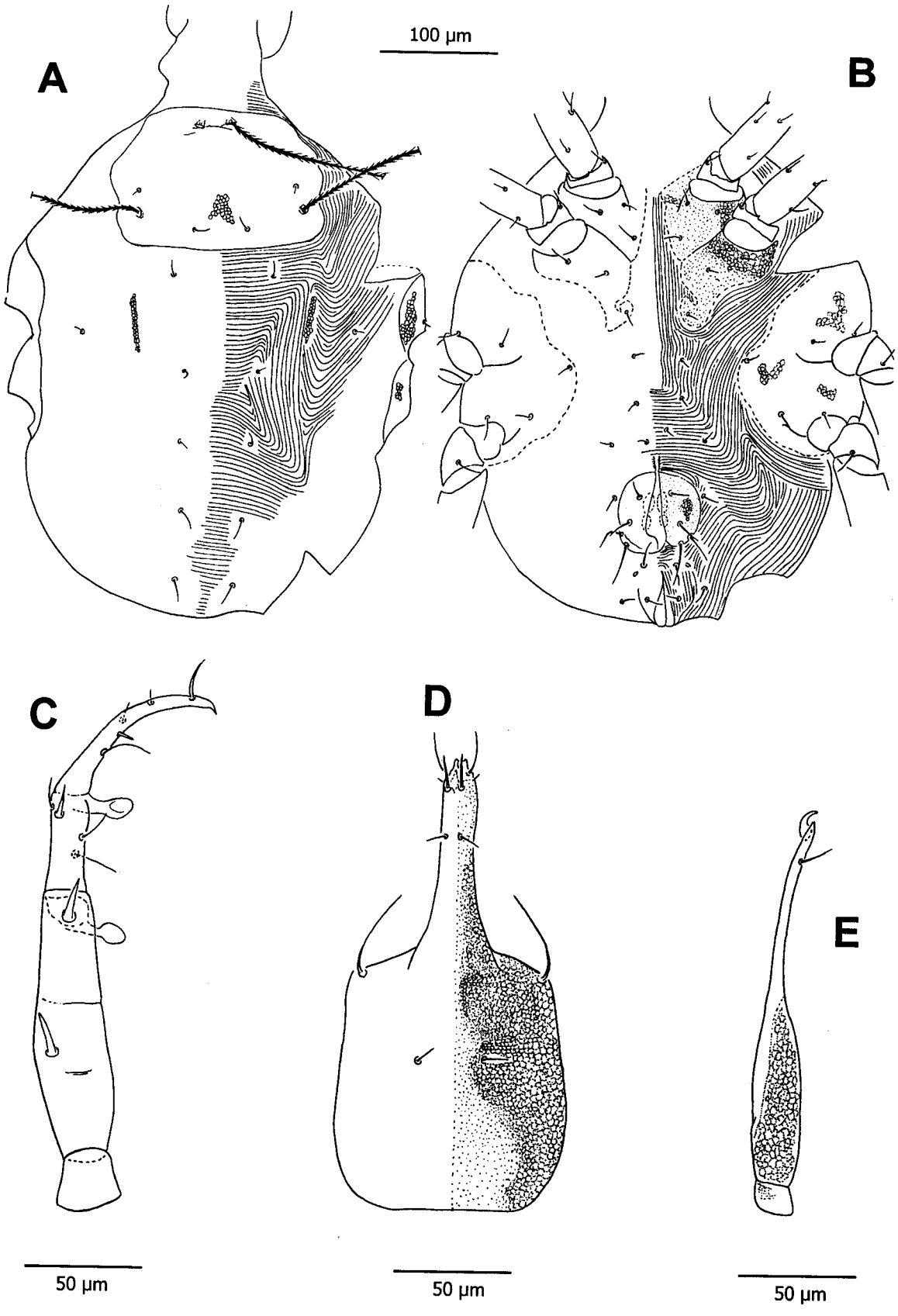

Figure 68. *Dactyloscirus* sp. 2, female – A, dorsum; B, venter; C, palp; D, ventral hypostome; E, chelicera.

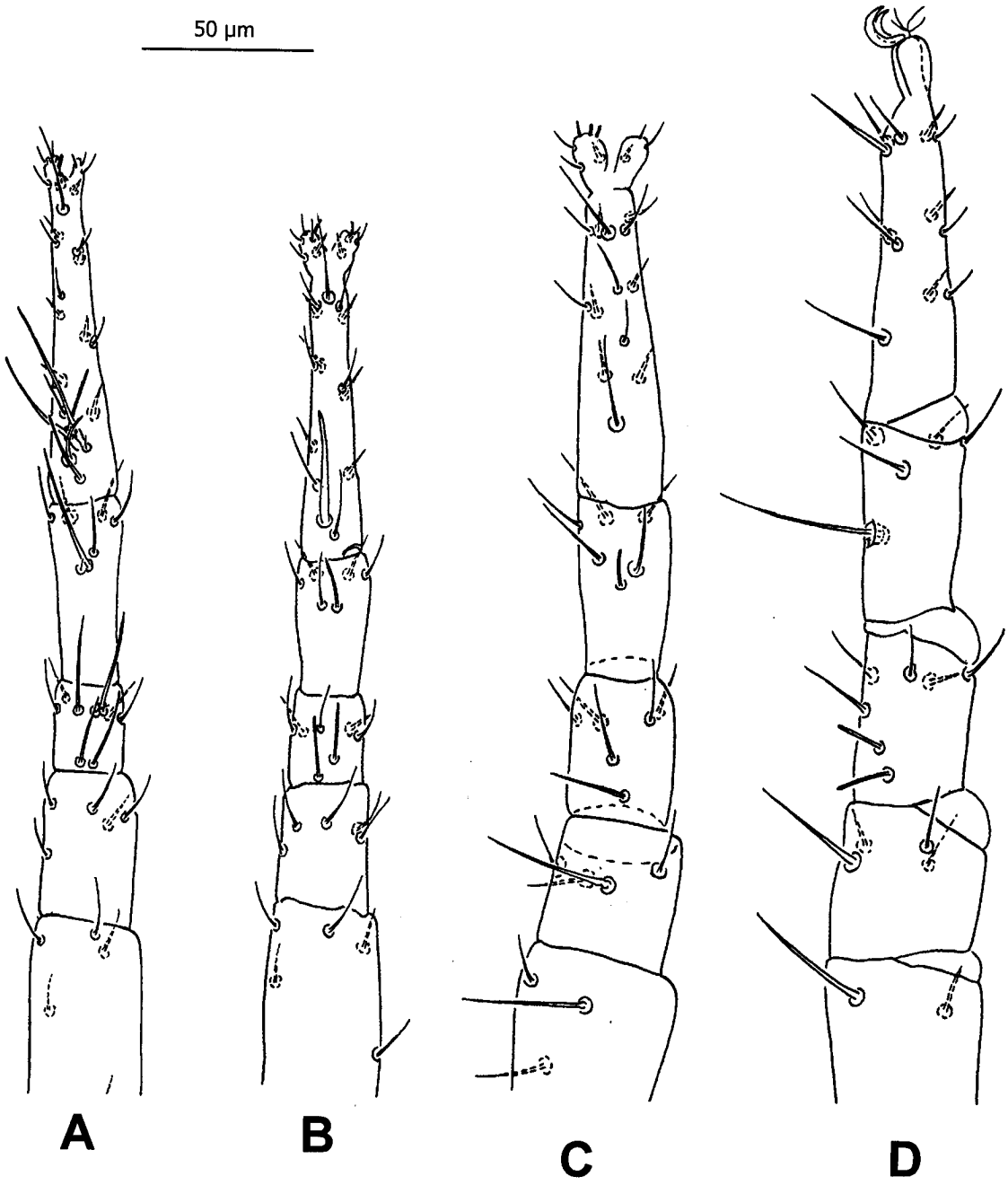

Figure 69. *Dactyloscirus* sp. 2, female – A, leg I; B, leg II; C, leg III; D, leg IV.

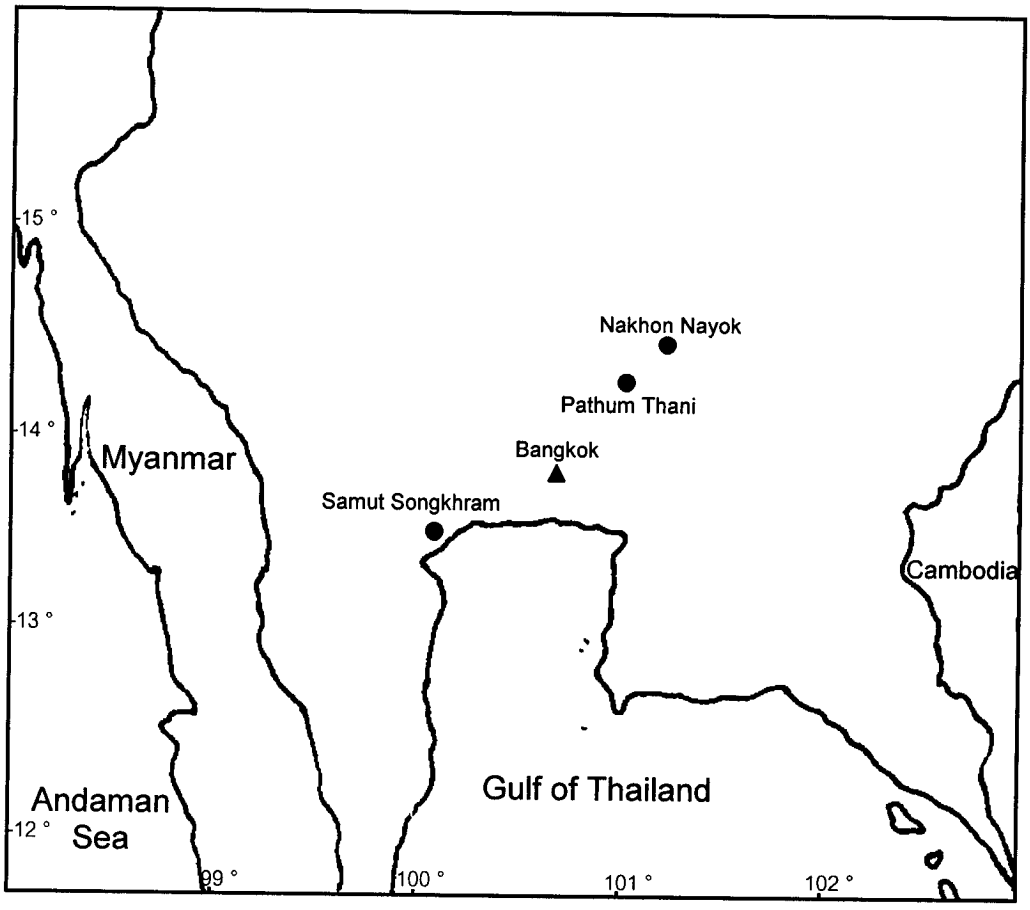

Figure 70. Collecting sites of *Dactyloscirus* sp.1 (triangle), and *Dacyloscirus* sp.2 (circle) in central Thailand.

Subfamily Cunaxoidinae Den Heyer, 1979

Cunaxoidinae Den Heyer, 1979d: 338.

Diagnosis: Palpus with three segments, palp tibiotarsus terminating with a claw, inner medial surface usually with processing two knoblike apophyses. Femur and genu fused, elongate, and longer than wide. Setae hg_{1-4} simple. Dorsum of propodosoma with a shield extending into the hysterosomal region. The shield usaually bears setae *vi*, *ve*, *sci*, *sce*, c_1, c_2, d_1, and e_1.

Key to the Genera of Cunaxoidinae in Central Thailand

Hysterosomal setae f_2 absent.....*Neocunaxoides*

Hysterosomal setae f_2 present..... *Pulaeus*

Genus *Neocunaxoides* Smiley, 1975

Neocunaxoides Smiley, 1975: 237; Den Heyer, 1979d: 338; 1980e: 129; Kuznetzov and Livshitz, 1979a: 51; 1979b: 1233; Gupta and Ghosh, 1980: 190; Tseng, 1980: 265; Michoka, 1982: 324; Sepasgosarian, 1984: 139; Inayatullah and Sahid, 1989: 221; Gupta, 1991: 225; 1992: 140; Smiley, 1992: 274; Corpuz-Raros, 1996c: 126; Lin *et al.*, 2001: 145; 2003: 101; Sionti and Papadoulis, 2003a: 225; 2003b: 319; Type species: *Cunaxoides andrei* Baker and Hoffmann, by original designation.

Scutopalus Den Heyer, 1980a: 187. Type species: *Scutopalus latisetosus* Den Heyer, by original designation.

Diagnosis: Palpus with three segments. Dorsal idiosoma mostly covered by a large shield, extending from propodosoma to hysterosoma; hysterosoma setae f_2 absent.

Two described species and 2 unidentified species were recognized in this study. Key to species of describd species is given below, and a comparison of main characters between these four species are present in Table 4-9.

Key to the Species of *Neocunaxoides* in Central Thailand

Palp tiobiotarsus with one bifurcated seta; dorsal setae simple.....*N. neopectinatus*

Palp tibiotarsus without bifurcate setae; dorsal setae barbed ..... *N. philippinensis*

25. *Neocunaxoides neopectinatus* (Shiba, 1976)

(Figs. 71 and 72)

Cunaxoides neopectinatus Shiba, 1976: 123.

Neocunaxoides neopectinatus Smiley, 1992: 288; Corpuz-Raros, 1996c: 133.

Diagnosis – This species is separated from all other known species of the genus by the presence of bifurcate basal setae on inner surface of the palp tibiotarsus, and the divided lateral coxal plate III+IV.

Female – Dimension (n=1) – Length of idiosoma 375, width 270; length of hypognathum 108, width 88; length of palp 63; length of chelicera 108; length of legs: I 230; II 215; III 225; IV 250.

Gnathosoma – Hypostome (Fig. 71D) subrectangular, coneshaped distally; ventral surface of hypostome granulated with a numbers of subcuticular cells and four pairs of *hg* setae, hg_4 longest. Palp with three segments (Fig. 71C) and palpal chaetotaxy as follows: Trochanter with no setae; femurogenua with five simple setae; tibiotarsus with two outer lateral simple setae, basally with one bifurcate seta and one simple seta on inner surface, above these setae with one elongate apophysis, terminating with a claw and one parallel simple seta.

Dorsum (Fig. 71A) – Idiosoma with a large shields extending from propodosoma into hyseterosomal region, surface finely punctuated, bearing two pairs of sensillae *vi* and *sci*, and six pairs of simple setae *ve*, *sce*, c_1, c_2, d_1 and e_1 located on the shield; setae *ve* longest; setae e_1 thickest. Setae f_1, h_1 and h_2 on striated integument; the cupules *ip* anteriolaterad of f_1.

Venter (Fig. 71B) – Coxae I and II fused as a sternal shield, punctuated with six pairs of simple setae; coxae III and IV fused as a lateral shields, divided into two shields, of each side, inner shield punctuate with two pairs of simple setae, outer shield surface broken striae with two pairs of simple setae; genital shields punctuate with subcuticular cells and four simple setae, arranged as shown in figure 71B; a small circular shield bearing one simple seta anterior to genital shields; one pair of setae on membrane adjacent to genital; anal region with two pairs of anal setae ps_1 and ps_2, and one pair of cupule *ih*.

Legs (Fig. 72) – All legs shorter than idiosoma, legs IV longest; tarsi I-IV stout and without terminal lateral lobes. Number of setae on leg segments I-IV as follows: Coxae 3-3-2-2; trochanters 1-1-2-1; basifemora 3-5-3-2; telofemora 5-5-4-3; genu I, 4 attenuate solenidia, 1 micrcroseta + 4; genu II, 2 attenuate solenidia + 5;

genu III, 1 attenuate solenidion + 5; genu IV, 2 attenuate solenidion 5; tibia I, 2 attenuate solenidia + 5; tibia II, 1 attenuate solenidion + 5; tibia III, 1 attenuate solenidion + 5; tibia IV, 1 trichobothrium + 4; tarsi I, 3 attenuate solenidia, 1 peglike seta, + 24 [including "dt" and "tsl" of Den Heyer (1979a)]; tarsi II, 1 blunt solenidion + 24; tarsi III, 20; tarsi IV, 17.

Male – Thai material unknown.

Type – Female Holotype, Pasoh Forest, north of Plot 1, Malaysia, on litter, 26. III. 1971, by M. Shiba. Type deposited in Biological Laboratory, Matsuyama Shinome Junior College, Matsuyama, Japan.

Material examined - 1F, Phu Kae Botanical Garden, Saraburi, 14°40′30′′N 100°53′10′′E, on litter, 7. IV. 2003.

Distribution – Malaysia; The Philippines; Thailand, additional localities from this study (Fig. 73): Saraburi.

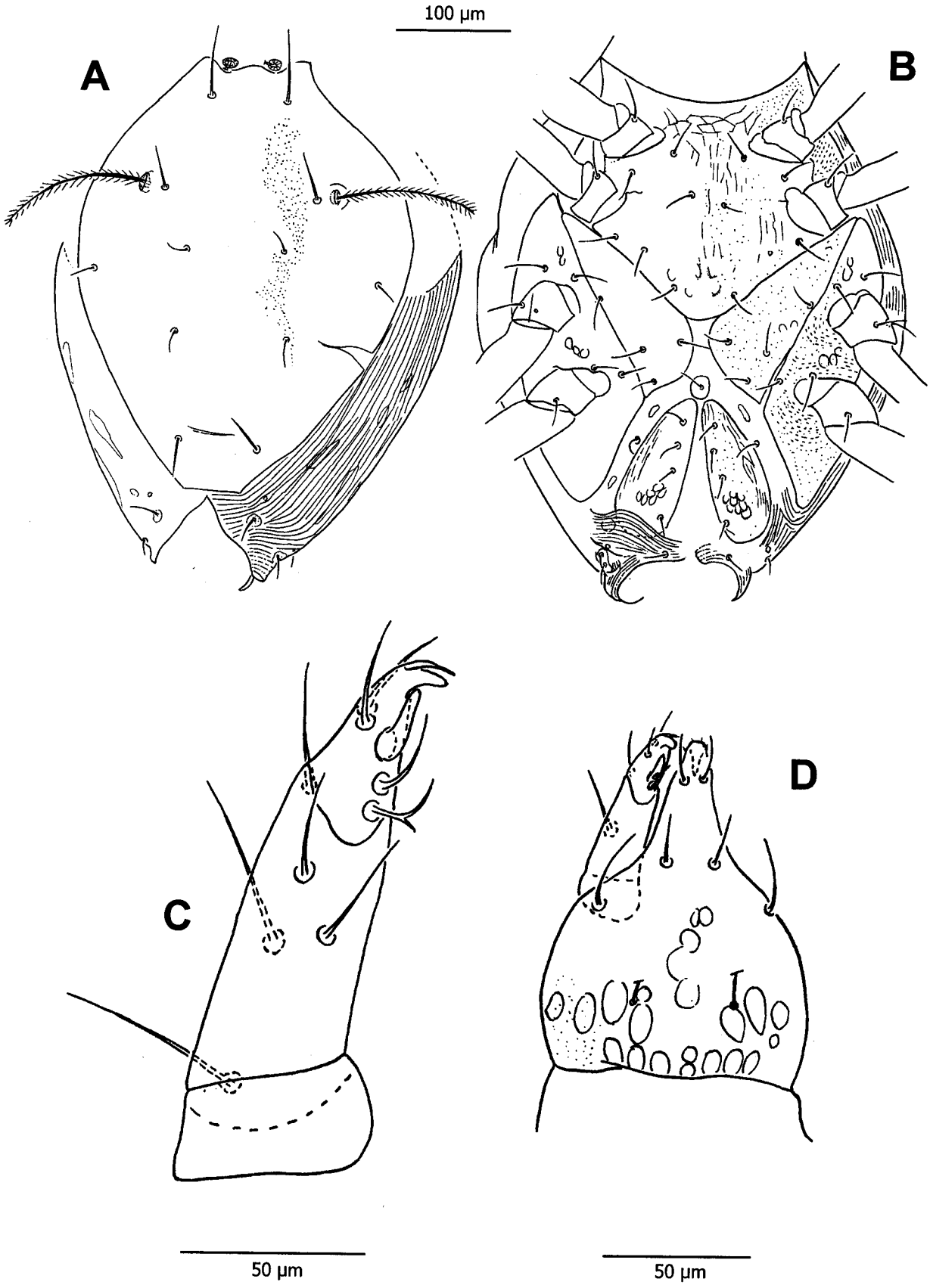

Figure 71. *Neocunaxoides neopectinatus*, female – A, dorsum; B, venter; C, palp; D, ventral hypostome.

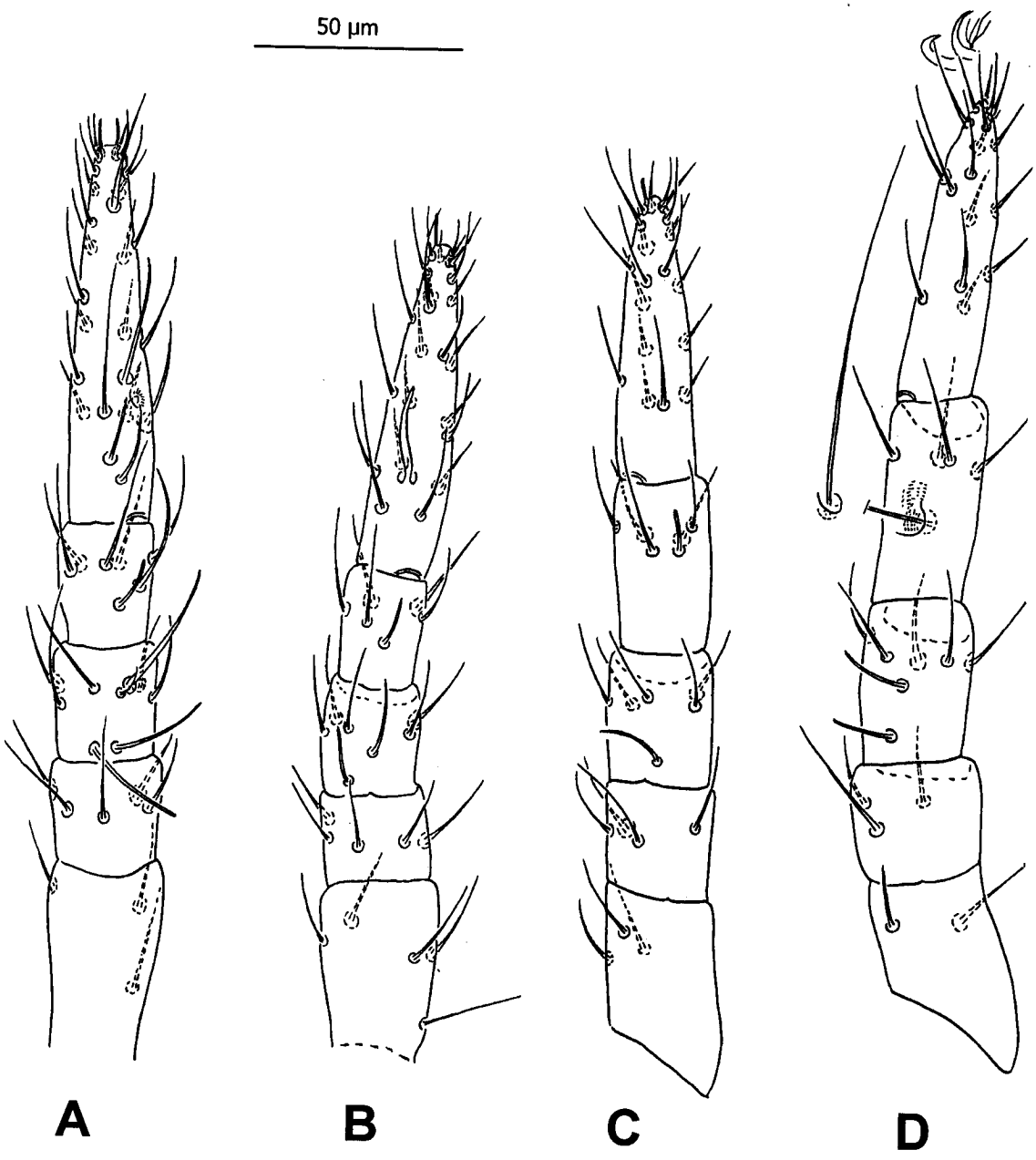

Figure 72. *Neocunaxoides neopectinatus*, female – A, leg I; B, leg II; C, leg III; D, leg IV.

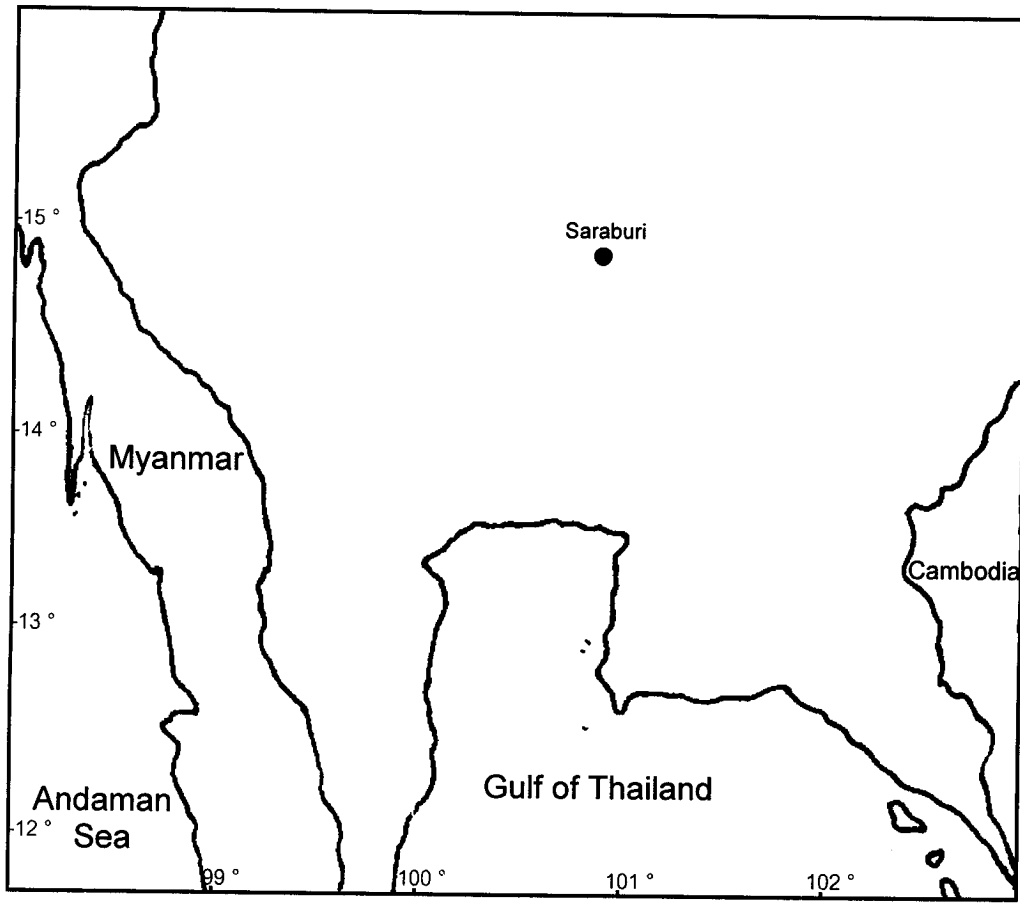

Figure 73. Collecting sites of *Neocunaxoides neopectinatus* in central Thailand.

26. *Neocunaxoides philippinensis* Corpuz-Raros, 1996

(Figs. 74 and 75)

Neocunaxoides philippinensis Corpuz-Raros, 1996c: 135.

Diagnosis – According to Corpuz-Raros, 1996c, this species resembles *N. latisetosus* (Den Heyer, 1980) and *N. pradhani* Gupta & Ghosh, 1980 in having rod-shaped or slightly flattened and lightly barbed dorsal setae as well as the presence of four pairs of ventral hysterosomal setae on membrane between ventral shields. However, seta h_1 is very short and not thicken in *N. philippinensis* while seta h_1 is thickened and subequal to other dorsal setae in *N. latisetosus* and *N. pradhani*.

Female – Dimension – Length of idiosoma 300-350 (335.71), width 230-250 (243.57); length of hypognathum 110-113 (112.57), width 73-80 (76.86); length of palp 75-80 (78.29); length of chelicera 105-115 (113.43); length of legs: I 210-235 (222.86); II 200-225 (211.67); III 210-245 (224); IV 225-255 (240).

Gnathosoma – Hypostome (Fig. 74D) subrectangular, coneshaped distally; ventral surface of hypostome punctuate with a numbers of subcuticular cells and four pairs of *hg* setae, hg_4 longest. Palp with three segments (Fig. 74C) and palpal chaetotaxy as follows: Trochanter with no setae; femurogenua with five simple setae; tibiotarsus with two outer lateral simple setae, basally with three simple setae and two triangular tubercles on inner surface, terminating with a claw.

Dorsum (Fig. 74A) – Idiosoma with a large shields extending from propodosoma into hysterosoma and one small elongate shield, surface sparsely foveolated; the large shield bearing two pairs of setose sensillae, *vi* and *sci*, and six pairs of setae *ve*, *sce*, c_1, c_2, d_1 and e_1; setae f_1 and h_1 born on small platelet; all tactile setae except c_2 and h_1 thick, pointed and spiculate; the cupules *ip* on posteior to the corners of the large dorsal shield.

Venter (Fig. 74B) – Coxae I and II fused as a sternal shield, surface striate, subcuticular cells present, six pairs of simple setae; coxae III and IV fused as a lateral shields of each side, surface striate on inner lateral half and granulate in outer lateral half, six pairs of simple setae; genital shields elongate, surface mostly punctuate but striate laterally, four pairs of simple setae, arranged as shown in figure 74B, a group of subcuticular cells each; four pairs of setae on membrane between ventral shields; anal region with two pairs of anal setae ps_1 and ps_2, one pair dorsal hysterosomal seta h_2, and one pair of cupule *ih*.

Legs (Fig. 75) – All legs shorter than idiosoma, legs IV longest; tarsi stout and without terminal lateral lobes. Number of setae on leg segments I-IV as follows: Coxae 3-3-3-3; trochanters 1-1-2-1; basifemora 4-5-3-1; telofemora 4-4-3-2; genu I, 4 attenuate solenidia, 1 micrcroseta + 4; genu II, 2 attenuate solenidia + 5; genu III, 1 attenuate solenidion + 5; genu IV, 2 attenuate solenidion 5; tibia I, 1 attenuate solenidion, 1 peg-like solenidion + 5; tibia II, 1 short blunt solenidion + 5; tibia III, 1 short blunt solenidion + 5; tibia IV, 1 trichobothrium + 4; tarsi I, 4 attenuate solenidia, 1 peglike seta, + 22 [including "dt" and "tsl" of Den Heyer (1979a)]; tarsi II, 1 blunt solenidion + 18; tarsi III, 14; tarsi IV, 11.

Male – Thai material unknown.

Type – Female Holotype (LACR 4415), UPLB Foresty Campus, Los Banos, Laguna, on *Strombosia philippinensis*, by R. C. Garcia. Type deposited in the Museum of Natural History, University of the Philippines, Los Banos.

Material examined - 6F, Kaeng Sam Chan, Sarika, Nakhon Nayok 14°18′ 05′′N 101°18′17′′E, on litter under *Tamarindus indicus*, Linn., 7. VI. 2003; 1F,Tha Chai, Muang, Chai Nat 14°02′57′′N 99°56′08′′E, alt. 20 m., litter under*Tamarindus indicus,* 28. III. 2003; 2FF, as previous data but under lotten log; 7FF, near Sarika waterfall, Nakhon Nayok 14°18′17′′N 101°15′33′′E, on forest litter, 7. IV. 2003; 17FF, near Sam Lan waterfall, Saraburi 14°25′56′′N 100°57′51′′E, on forest litter, 7. IV. 2003; 1F, Phu Kae Botanical Garden 14°40′30′′N 100°53′10′′E, alt. 92 m., on litter, 7. IV. 2003.

Distributions – The Philippines; Thailand, additional localities from this study (Fig. 76): Saraburi, Nakhon Nayok and Chai Nat.

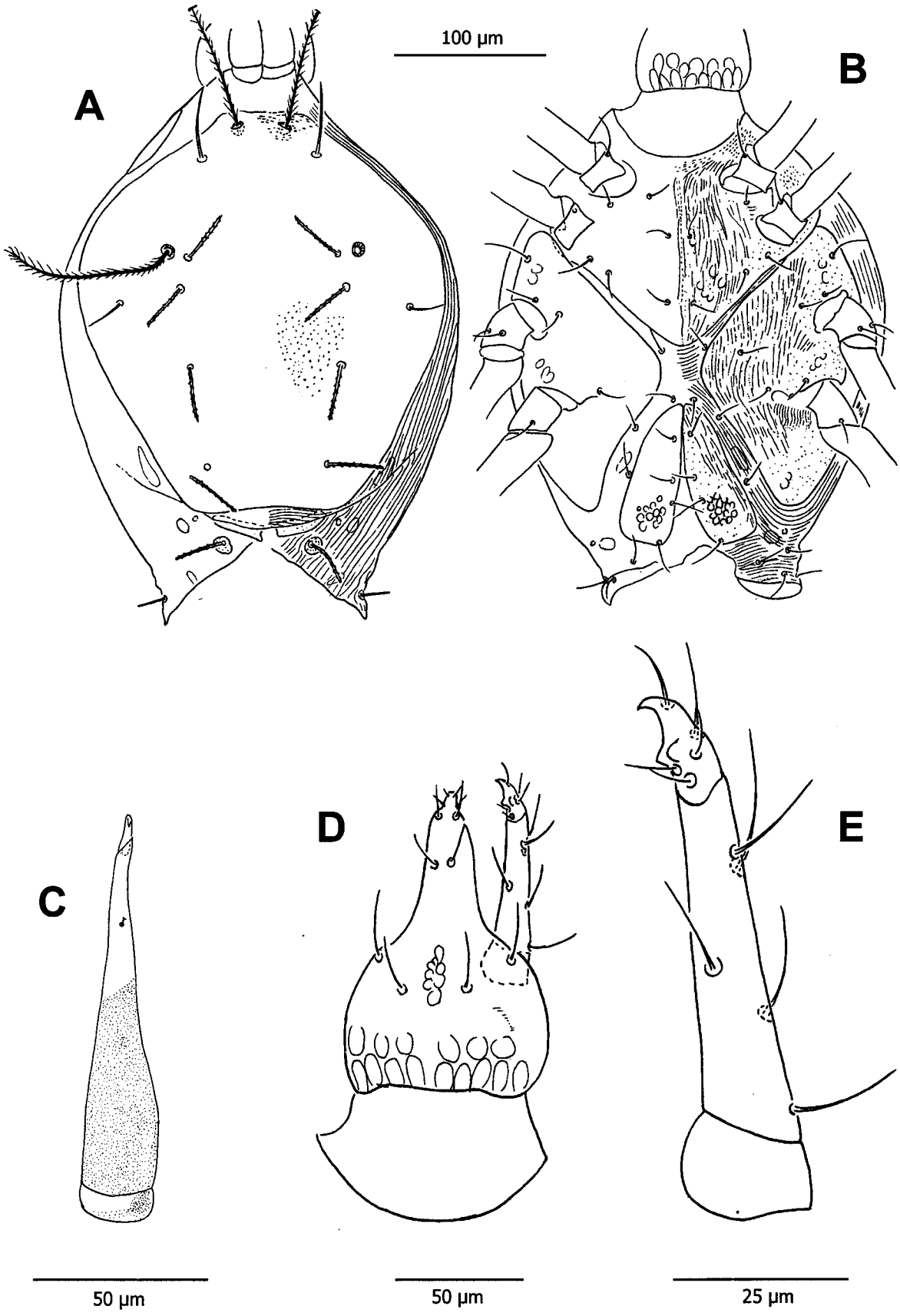

Figure 74. *Neocunaxoides philippinensis*, female – A, dorsum; B, venter; C, palp; D, ventral hypostome.

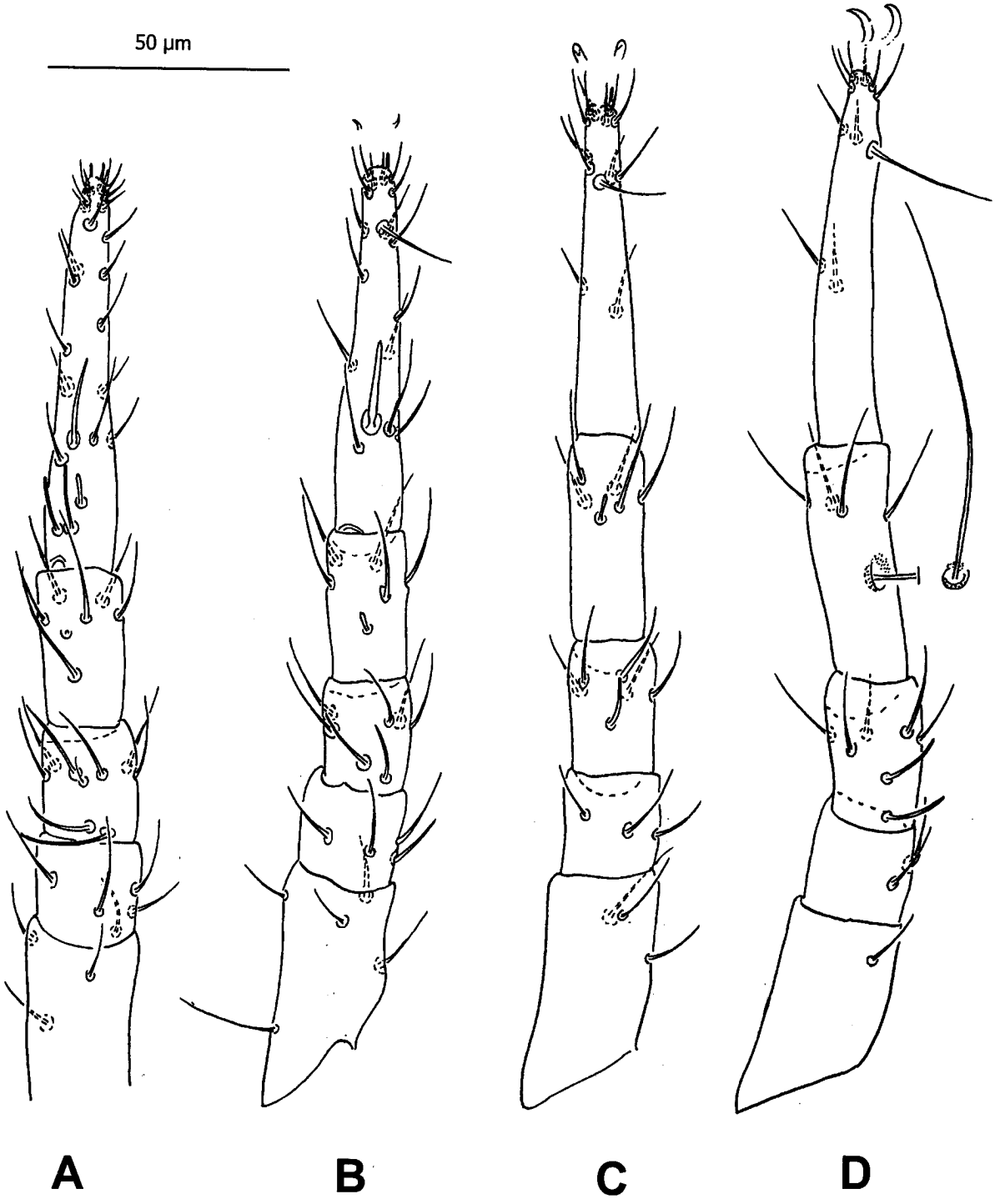

Figure 75. *Neocunaxoides philippinensis*, female – A, leg I; B, leg II; C, leg III; D, leg IV.

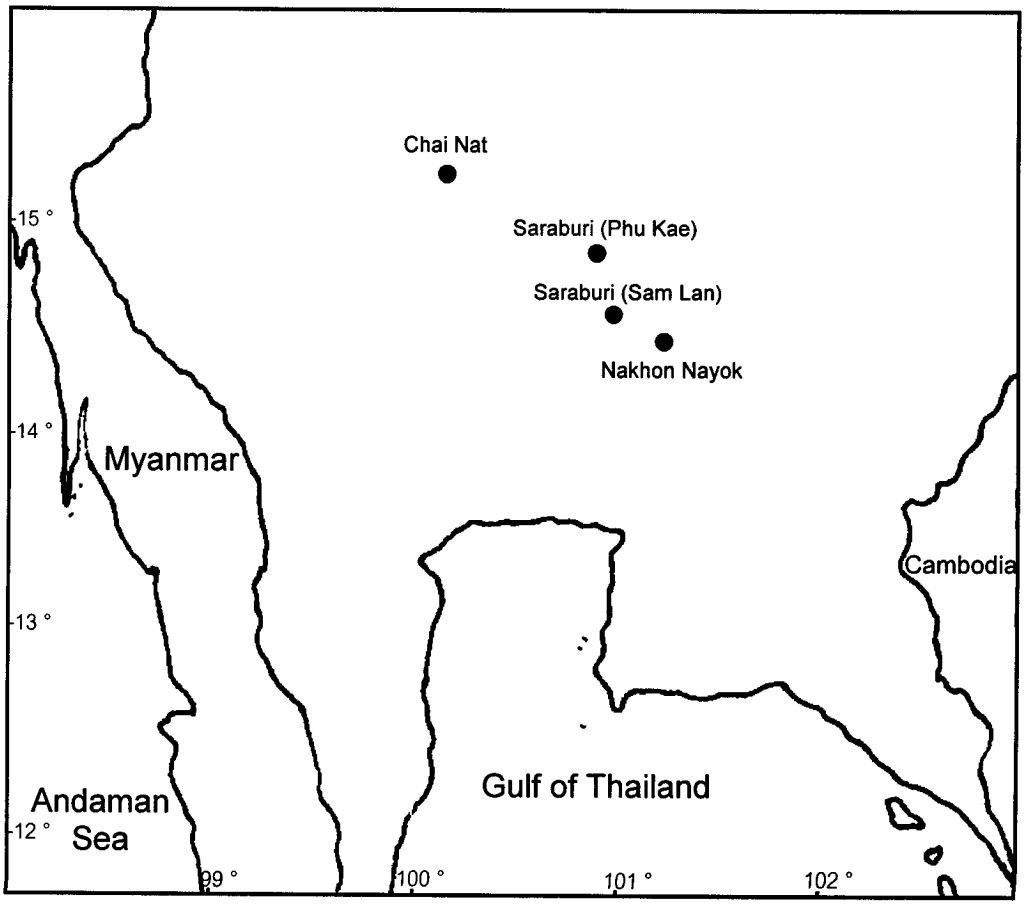

Figure 76. Collecting sites of *Neocunaxoides philippinensis* in central Thailand.

27. *Neocunaxoides* sp. 1

(Figs. 77 and 78)

Diagnosis – This species can be separated from other known species of the genus by the presence of two bifurcate setae on inner surface of palp tibiotarsus.

Female – Dimension (n=1) - Length of idiosoma 365, width 245; length of hypognathum 110, width 88; length of palp 68; length of chelicera 100; length of legs: I 220; II 205; III 230; IV 250.

Gnathosoma - Hypostome (Fig. 77D) subrectangular, coneshaped distally; ventral surface of hypostome sparsely granulated with four pairs of *hg* setae. Palp with three segments (Fig. 77E) and palpal chaetotaxy as follows: Trochanter with no setae; femurogenua with five simple setae; tibiotarsus with two outer lateral simple setae, basally with two bifurcate setae on inner surface, above these setae with one elongate apophysis, terminating with a claw and one pararell simple seta.

Dorsum (Fig. 77A) – Idiosoma with a large shields extending from propodosoma into hysterosoma, surface sparsely punctuated, bearing two pairs of sensillae *vi* and *sci*, and six pairs of simple setae *ve*, *sce*, c_1, c_2, d_1 and e_1; setae *ve* longest; setae e_1 noticeably thicker than other hysterosomal setae. Setae f_1, h_1 and h_2 simple and on striated membrane; the cupules *ip* behind posterior corners of the shield.

Venter (Fig. 77B) – Coxae I and II fused as a sternal shield, punctuated with six pairs of simple setae; coxae III and IV fused as a lateral shields of each side with four pairs of simple setae; genital shields elongate and punctuate with four pairs of simple setae, arranged as shown in figure 77B; a small circular shield bearing one simple seta anterior to genital shields; one pair of setae on membrane adjacent to genital; anal region with one pairs of anal setae ps_1, and one pair of cupule *ih* anteriorlaterad of h_2.

Legs (Fig. 78) – All legs shorter than idiosoma, legs IV longest; tarsi I-IV stout and without terminal lateral lobes. Number of setae on leg segments I-IV as follows: Coxae 3-3-2-2; trochanters 1-1-2-1; basifemora 3-5-3-2; telofemora 5-5-4-3; genu I, 4 attenuate solenidia, 1 micrcroseta + 4; genu II, 2 attenuate solenidia + 5; genu III, 1 attenuate solenidion + 5; genu IV, 2 attenuate solenidion + 5; tibia I, 2 attenuate solenidia + 5; tibia II, 1 attenuate solenidion + 5; tibia III, 1 attenuate solenidion + 5; tibia IV, 1 trichobothrium + 4; tarsi I, 3 attenuate solenidia, 1 peglike

seta, + 24 [including "dt" and "tsl" of Den Heyer (1979a)]; tarsi II, 1 blunt solenidion + 24; tarsi III, 19; tarsi IV, 17.

Male – Unknown

Material examined - 1F, near Sarika waterfall, Nakhon Nayok 14°18′17′′N 101°15′33′′E, on forest litter, 7. IV. 2003.

Distriution - Thailand, additional localities from this study (Fig. 81): Nakhon Nayok.

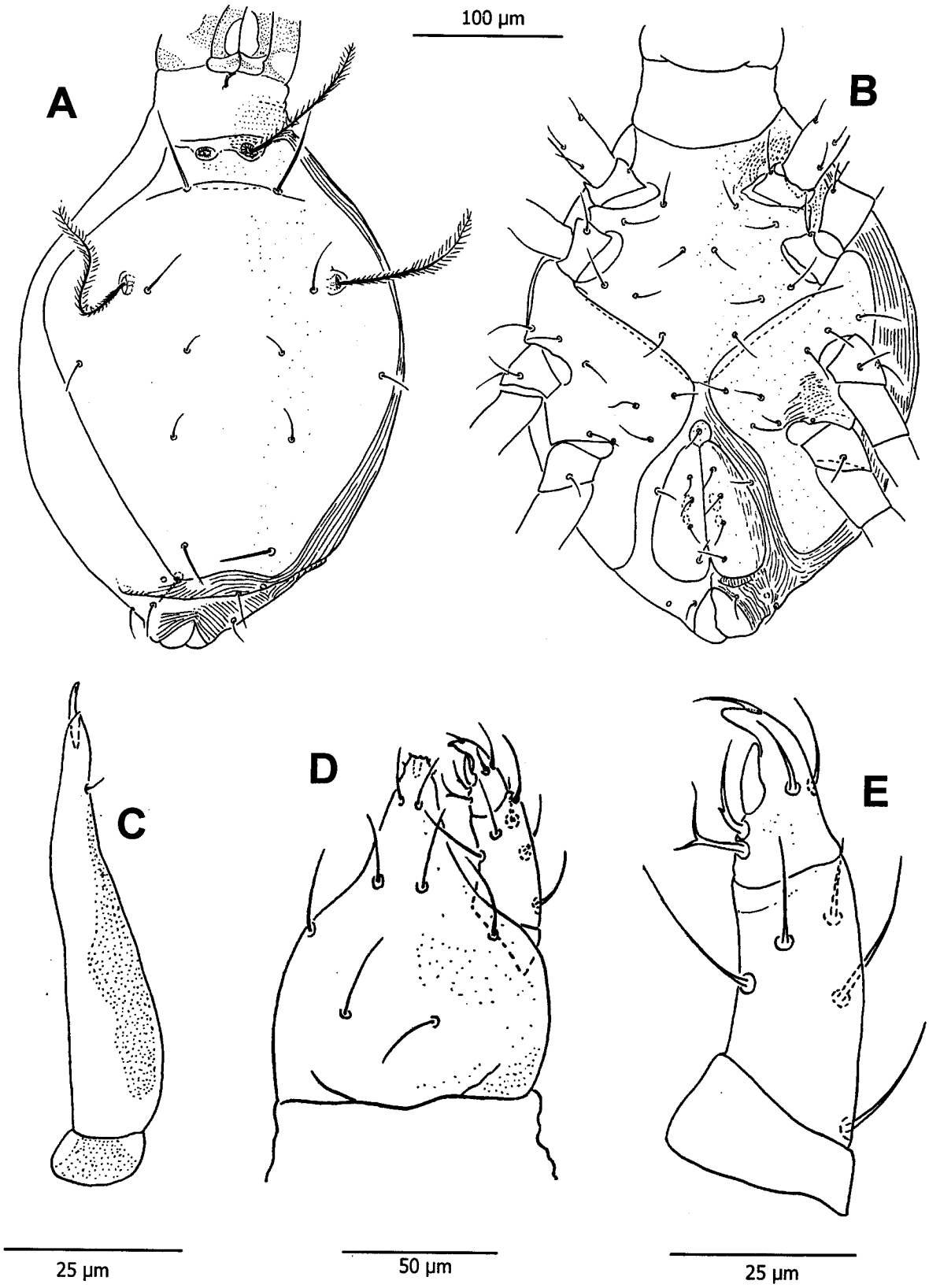

Figure 77. *Neocunaxoides* sp. 1, female – A, dorsum; B, venter; C, chericera; D, ventral hypostome; E, palp.

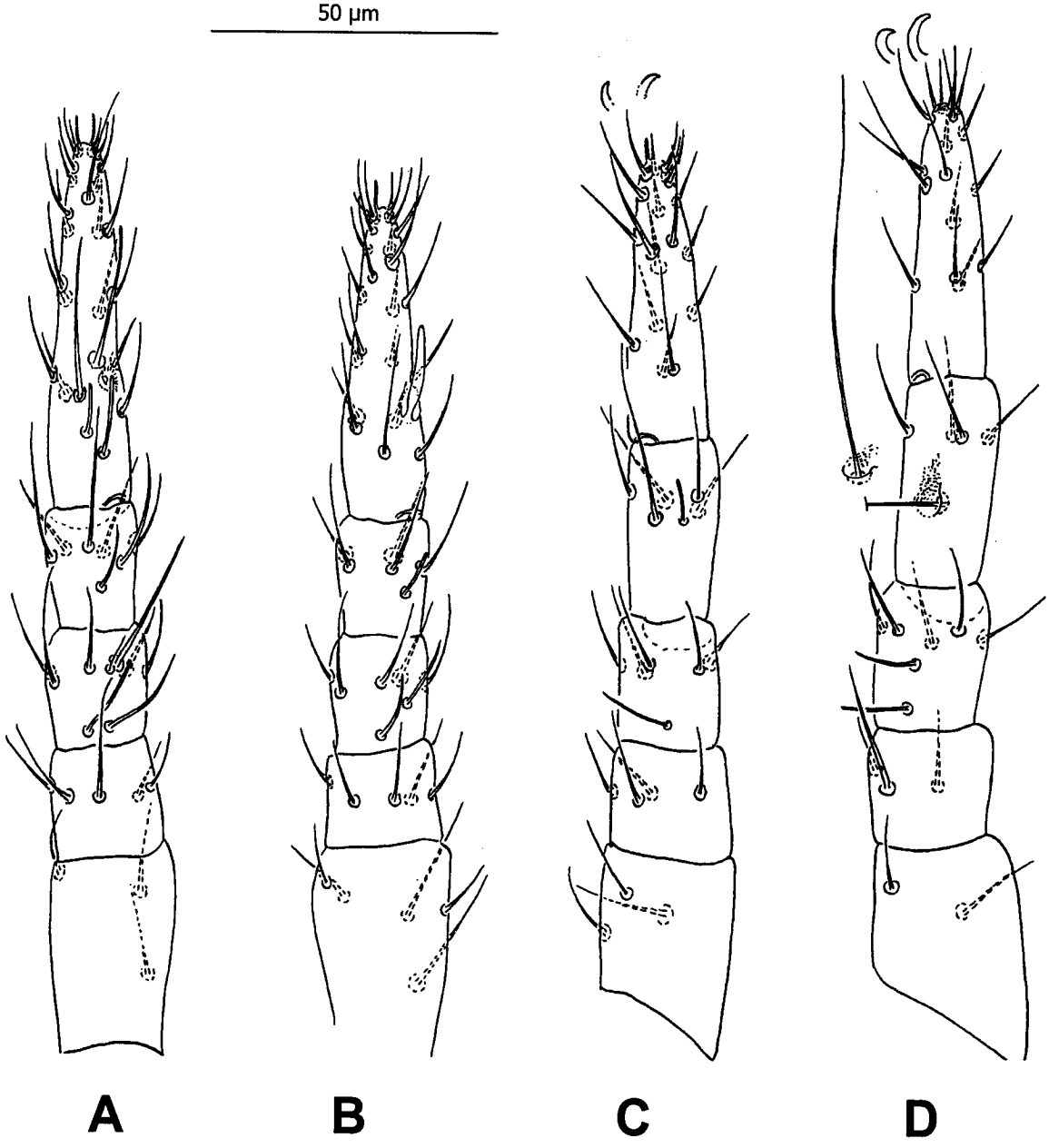

Figure 78. *Neocunaxoides* sp. 1, female – A, leg I; B, leg II; C, leg III; D, leg IV.

28. *Neocunaxoides* sp. 2

(Figs. 79 and 80)

Diagnosis – This species is similar to *N. zuluensis* Den Heyer, 1980 (Den Heyer, 1980e) in having an undivided sternal shield and bladder-like apophysis on basal inner surface of palp tibiotarsus. It may be separated from the latter by the absence of transverse band of papillae on ventral hypostome, and the presence of three setae on membrane between ventral sheids (rather than 7-9).

Female – Dimension - Length of idiosoma 350-400 (375), width 240-285 (262.7); length of hypognathum 103-115 (109), width 130-155 (142.5); length of palp 88-100 (94); length of chelicera 138-159 (144); length of legs: I 245 (245); II 230-235 (232.5); III 250-255 (252.5); IV 270-290 (280).

Gnathosoma - Hypostome (Fig. 79D) subrectangular, coneshaped distally, ventral hypostome with a numbers of subcuticular ridges, and the bands of papillae not reaching hg_3; setae hg_4 longest. Palp with three segments (Fig. 79E) and palpal chaetotaxy as follows: Trochanter with no setae; femurogenua with six simple setae; tibiotarsus with two outer lateral simple setae, basally with one bladder-like apohysis, one triangular apophysis, and three simple setae, terminating with a strong claw.

Dorsum (Fig. 79A) – Idiosoma with a large shields extending from propodosoma into hysterosoma, surface smooth with sparsely punctuated, bearing two pairs of sensillae *vi* and *sci*, and six pairs of setae *ve*, *sce*, c_1, c_2, d_1 and e_1; setae *ve* and *sce* subequal, setae e_1 and f_1 inconspicuously barbed, and thicker than hysterosomal setae; the cupules *ip* behind posterior corners of the dorsal shield.

Venter (Fig. 79B) – Coxae I and II fused as a sternal shield, surface punctuated, six pairs of simple setae; coxae III and IV fused as a lateral shields of each side, anterior surface punctuated but posterior with broken striae, seven simple setae each. Genital shields elongate, surface mostly striate with groups of cells posteriorly and four pairs of simple setae, arranged as shown in figure 79B; three simple setae on membrane between ventral shields. Anal region with two pairs of anal setae ps_1 and ps_2, two pairs dorsal hysterosomal setae, h_1 and h_2, and one pair of cupule *ih* (Fig. 79F).

Legs (Fig. 80) – All legs shorter than idiosoma, legs IV longest; tarsi stout and without terminal lateral lobes. Number of setae on leg segments I-IV as follows: Coxae 3-3-3-?; trochanters 1-1-2-1; basifemora 3-5-2-0; telofemora 5-4/5-3/4-3; genu I, 4 attenuate solenidia, 1 micrcroseta + 4; genu II, 2 attenuate solenidia + 5; genu III,

1 attenuate solenidion + 5; genu IV, 1 attenuate solenidion 5; tibia I, 2 attenuate solenidia + 5; tibia II, 1 short blunt solenidion + 5; tibia III, 1 attenuate solenidion + 5; tibia IV, 1 trichobothrium + 4; tarsi I, 4 attenuate solenidia + 22 [including "dt" and "tsl" of Den Heyer (1979a)]; tarsi II, 1 blunt solenidion + 23; tarsi III, 19; tarsi IV, 17.

Male – Unknown.

Material examined - 1F, Kaeng Sam Chan, Sarika, Nakhon Nayok 14°18′ 05′′N 101°18′17′′E, on litter under *Sandoricum koetjape*, 7. VI. 2003; 1F, as previous data but on litter under *Tamarindus indicus* Linn.

Distribution – Thailand, additional localities from this study (Fig. 81): Nakhon Nayok.

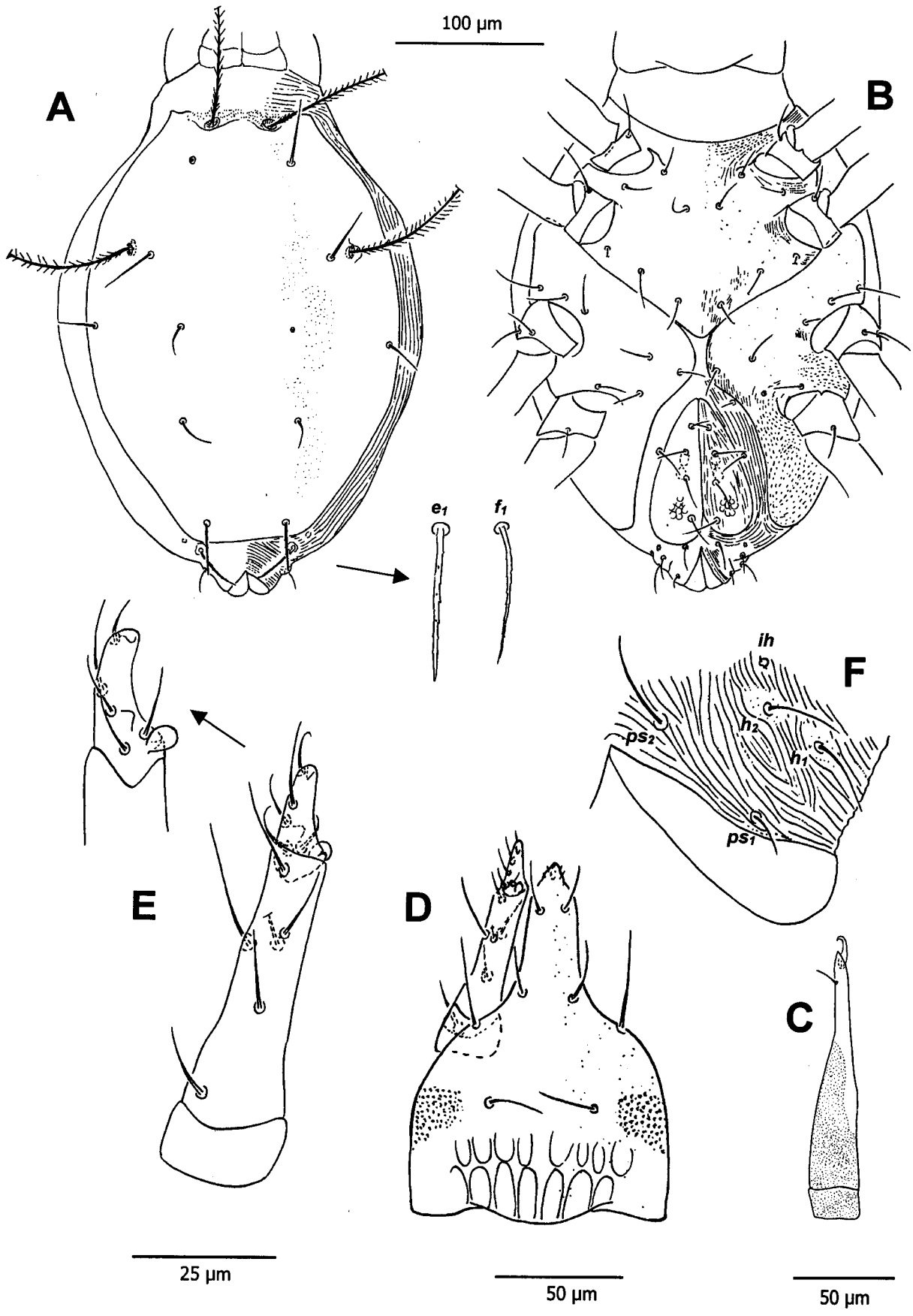

Figure 79. *Neocunaxoides* sp. 2, female – A, dorsum; B, venter; C, chelicera; D, ventral hypostome; E, palp; F, anal region.

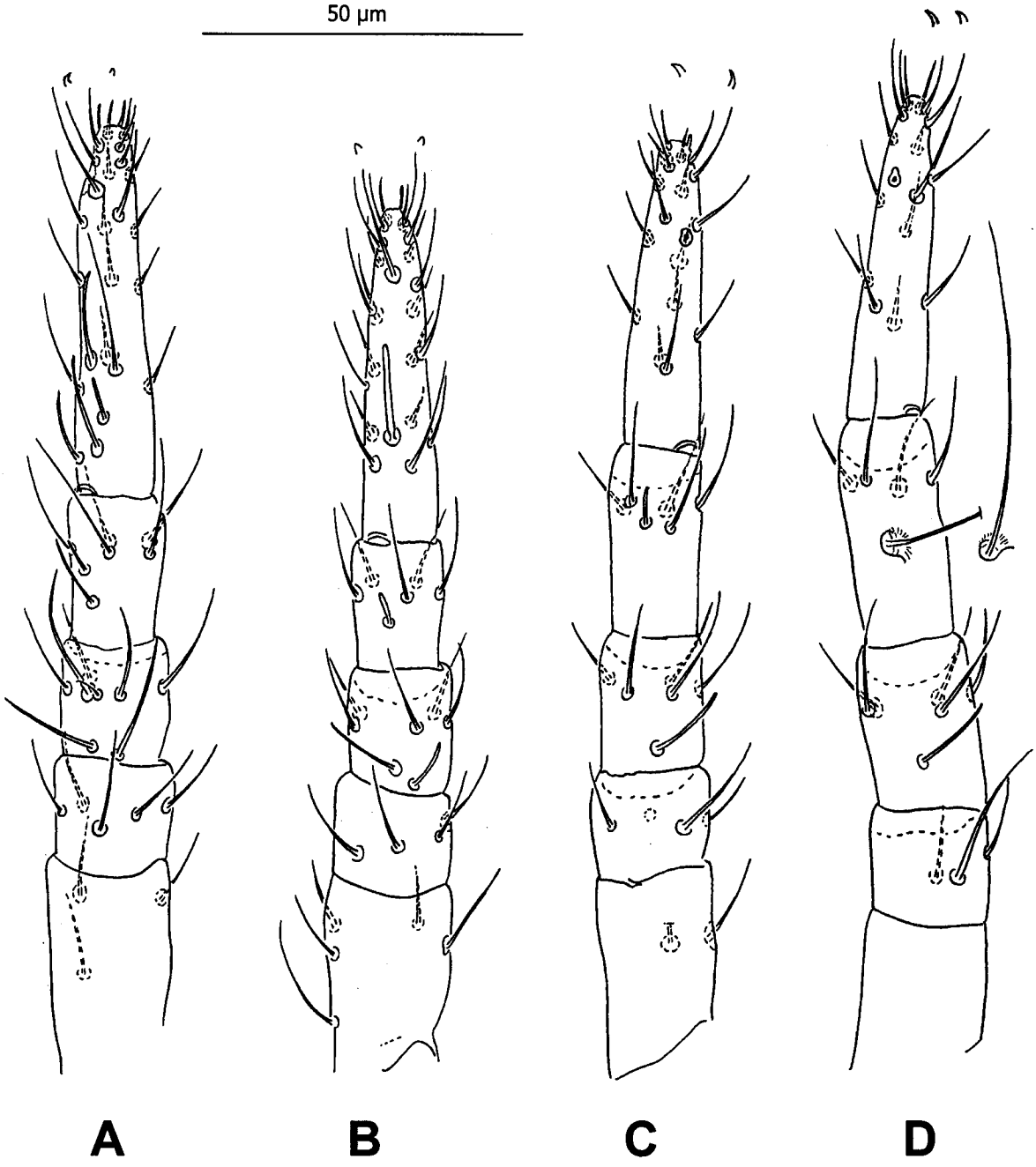

Figure 80. *Neocunaxoides* sp. 2, female – A, leg I; B, leg II; C, leg III; D, leg IV.

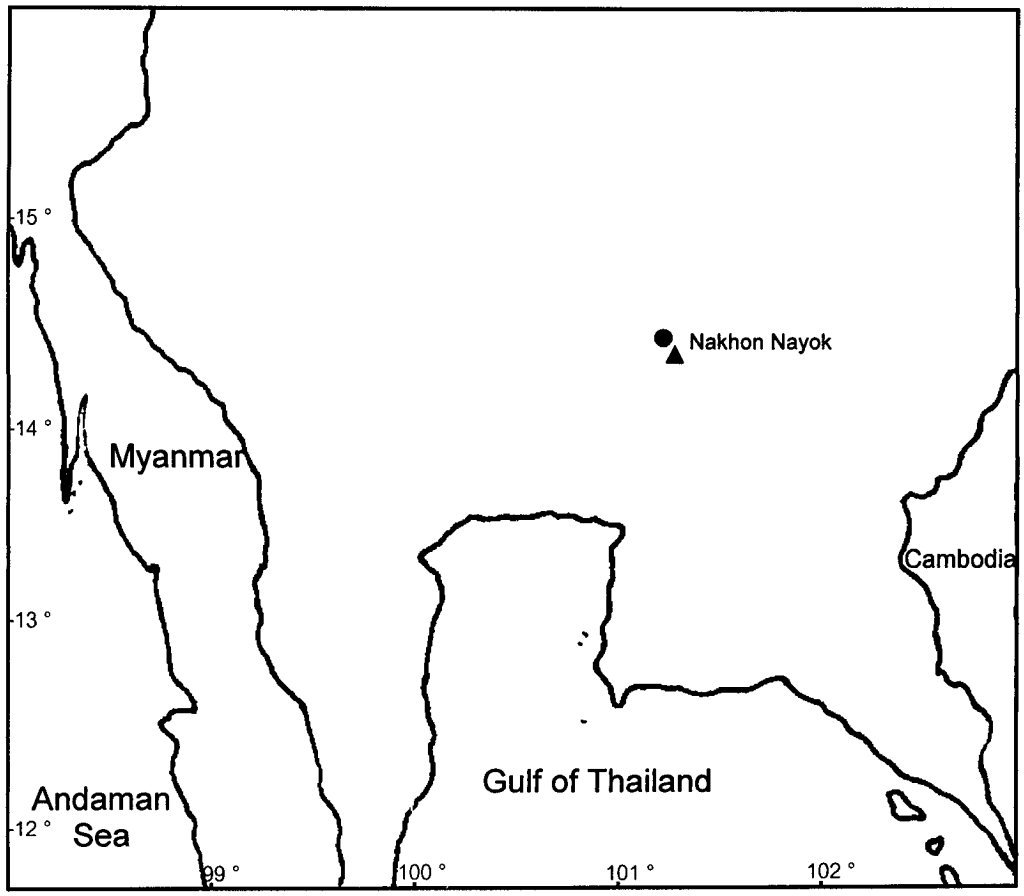

Figure 81. Collecting sites of *Neocunaxoides* sp. 1 (circle), and *Neocunaxoides* sp. 2 (triangle) in central Thailand.

Table. 4-9. A comparison of main characters between species belonging to *Neocunaxoides*.

Characters	*N. neopectinatus*	*N. philippinensis*	*N.* sp. 1	*N.* sp.2
numbers of setae on palp femurogenua	5	5	5	6
number of bifurcate setae on palp tibiotarsus	1	0	1	0
apophyses on tibiotarsus	1 spinelike	2 subtriangular	1 spinelike	1 bladder-like and 1 subtriagular
setae *ve*	spimple	spinose	simple	simple
setae *sce*	spimple	spinose	simple	simple
ratio *ve*, *sce*	*ve>sce*	*ve>sce*	*ve>sce*	*ve=sce*
setae c_1	spimple	spinose	simple	simple
setae c_2	spimple	spinose	simple	simple
setae d_1	spimple	spinose	simple	simple
setae e_1	spimple	spinose	simple	simple
setae f_1	spimple	spinose	simple	spinose
setae h_1	spimple	spinose	simple	spinose
coxal III-IV	divided	undivided	undivided	undivided
chaetotaxy of basifemora I-II-III-IV	3-5-3-2	4-5-3-1	5-5-3-2	3-5-2-0
chaetotaxy of telofemora I-II-III-IV	5-5-4-3	4-4-3-2	5-5-4-3	5-4-4-3
number of solenidia on genu I-II-III-IV	4-2-1-2	4-2-1-2	4-2-1-2	4-2-1-2
number of solenidia on tibia I-II-III-IV	2-1-1-0	2-1-1-0	2-1-1-0	2-1-1-0

Genus *Pulaeus* Den Heyer, 1980

Pulaeus Den Heyer, 1980a: 187; 1980b: 18; 1981b: 87; El-Bishlawy and Rakha, 1983: 373; Sepasgosarian, 1984: 143; Liang, 1985: 79; Bu and Li, 1987a: 22; 1991: 70; Barilo, 1991:131; Smiley, 1992: 300; Corpuz-Raros, 1996d: Type species: *Eupaleus pectinatus* Ewing, 1909, by original designation.

Diagnosis : Palpus with three segments, body covered by dorsal shield extending from propodosoma into hysterosoma region, setae f_2 present.

Two described species and 3 unidentified species of *Pulaeus* were recognized in this study. Key to described species is given below, and a comparison of main characters between these five species is present in Table 4-10.

Key to the Species of *Pulaeus* in Central Thailand

Setae f_2 minute, very shorter than f_1; four pairs of setae on integument between ventral shields.....*P. lenis*

Setae f_2 about half as long as f_1; five pairs of setae on integument between ventral shields.....*P. villacarlosae*

29. *Pulaeus lenis* Corpuz-Raros, 1996

(Figs. 82 and 83)

Pulaeus lenis Corpuz-Raros 1996d: 126.

Diagnosis – This species is recognized from other known species of the genus by the smooth dorsal shield, a very short f_2 seta, four pairs of ventral setae between ventral shields, and a transverse band of papillae on ventral hypostome.

Female – Dimension - Length of idiosoma 335-360 (348.57), width 190-245 (219.29); length of hypognathum 115-138 (126.43), width 85-103 (94.43) length of palp 68-83 (75.57); length of chelicera 105-125 (114.57); length of legs: I 175-200 (192.86); II 170-195 (178.57); III 200-220 (206.67); IV 220-245 (226.43).

Gnathosoma - Hypostome (Fig. 82D) subrectangular, coneshaped distally. Ventral hypostome with a numbers of subcuticular cells, surface mainly punctuated but the transverse band of papillae present with four pairs of *hg* setae, hg_4 longest. Palp with three segments (Fig. 82C) and palpal chaetotaxy as follows: Trochanter with no setae; femurogenua with six simple setae; tibiotarsus with two outer lateral simple setae, basally on inner surface with one bladder-like apohysis, one

subtriangular tubercle, and two simple setae, and medially with one simple seta, terminating with a claw, chelicerae (Fig. 82E) with two segments, segment I granulated, segment II dorsobasally papiliated, with one simple seta behind chela.

Dorsum (Fig. 82A) – Idiosoma with a large smooth shields extending from propodosoma into hysterosoma region, bearing two pairs of sensillae *vi* and *sci*, and six pairs of simple setae *ve*, *sce*, c_1, c_2, d_1 and e_1. Integument outside the shield striated, setae f_1 and f_2 simple and born on a small plate, setae f_2 shorter than f_1, setae h_1 and h_2 also simple but not arising from a small plate; the cupules *ip* behind the posterior corners of the dorsal shield.

Venter (Fig. 82B) – Coxae I+II divided, not fused medially, surface striate, and with six pairs of simple setae; coxae III and IV fused as a lateral shield of each side, with six simple setae each, shield surface striate on inner side but granulated or broken striae on outer side; genital shields with striated surface and four pairs of simple setae, two pairs of genital papillae present; integument between ventral shields with the small oval sclerotized area, and four pairs of setae; anal region with two pairs of anal setae ps_1 and ps_2, and one pair of cupule *ih*.

Legs (Fig. 83) – All legs shorter than idiosoma; tarsi I-IV stout and without terminal lateral lobes. Number of setae on leg segments I-IV as follows: Coxae 3-3-3-3; trochanters 1-1-2-1; basifemora 4-6-3-2; telofemora 5-5-4-3; genu I, 3 attenuate solenidia, 1 micrcroseta + 4; genu II, 2 attenuate solenidia + 5; genu III, 1 attenuate solenidion + 5; genu IV, 1 attenuate solenidion + 5; tibia I, 2 attenuate solenidia + 5; tibia II, 1 short blunt solenidion + 5; tibia III, 1 short blunt solenidion + 5; tibia IV, 1 trichobothrium + 4; tarsi I, 3 blunt solenidia, + 21 [including "dt" and "tsl" of Den Heyer (1979a)]; tarsi II, 1 blunt solenidion + 21; tarsi III, 17; tarsi IV, 15.

Male – Thai material unknown.

Type – Female Holotype, Mt. Makiling, Los Banos, Laguna, on debris, 20. VI. 1962, by P. M. Ramirez. Type deposited in The Natural History Museum of University of the Philippines, Los Banos.

Material examined - 6FF, Kaeng Sam Chan, Sarika, Nakhon Nayok 14°18′ 05′′N 101°18′17′′E, on litter under *Citrus grandis*, 7. VI. 2003; 5FF, as previous data but on litter under *Sandoricum koetjape*; 4FF, as previous data but on litter under *Tamarindus indicus*, Linn.; 7FF, Phatthana Nikhom, Lop Buri 14°51′ 18′′N 101°00′11′′E, alt. 64 m., on coconut litter, 7. IV. 2003; 2FF, as previous data but on litter under *Tamarindus indicus*; 4FF, Phu Kae Botanical Garden 14°40′30′′N

100°53′10′′E, alt. 92 m., on litter, 7. IV. 2003; 11FF, Sala Loy, Tha Ruae, Ayutthaya 14°31′75′′N 100′42′26′′E, alt. 27 m., on litter *Cassia* sp., 23. III. 2003; 5FF, as previous data but on litter under *Tamarindus indicus*; 1F, as previous data but on litter under *Poyalthai longifolia*, 13FF, as previous data but on litter under *Streblus asper*; 1F, Ban Rom, Tha Ruae, Ayutthaya 14°33′03′′N 100°41′91′′E, alt. 18 m., on litter *Sananea saman*, 23. III. 2003; 3FF, near Sam Lan waterfall, Saraburi 14°25′56′′N 100°57′51′′E, on forest litter, 7. IV. 2003; 4FF, Bueng Chawak, Suphan Buri 14°55′49′′N 100°02′49′′E, alt. 17 m., on litter under *Delonix* sp., 28. III. 2003; 4FF, Ban Nong Pongnok, Kamphaeng Saen, Nakhon Pathom 14°02′57′′N 99°56′08′′E, alt. 20 m., on litter under *Azadirachta indica,* and *Leucaena leucocephala*, 16. III. 2003; 2FF, Bang Khan Taek, Samut Songkhram 13°23′16′′N 99°52′45′′E, on soil-litter, 13. II. 2003; 3FF, Bang Khan Taek, Samut Songkhram 13°22′61′′N 99°57′43′′E, alt. 1 m., on litter under *Zizyphys mauritiana* , 25. III. 2003; 2FF, Bang Khan Taek, Smut Songkhram 13°22′46′′N 99°57′24′′E, on coconut litter, 25. III. 2003; 4FF, Sala Loy. Tha Ruae, Ayutthaya 14°37′73′′N 100°42′14′′E, alt. 12 m., on litter under *Tamarindus indicus*, 31. XII. 2002; 9FF, Sala Loy, Tha Ruae, Ayutthaya, on grasses, 25. VII. 2002; 1F, Chulalongkorn University Campus, on litter under *Delonix* sp., 9. VII. 2002; 2FF, Chulalongkorn University Campus 13°44′40′′N 100°31′69′′E, on litter under *Tamarindus indicus*, 9. II. 2003.

Distribution: The Philippines; Thailand, additional localities from this study (Fig. 84): Ayutthaya, Bangkok, Nakhon Nayok, Nakhon Pathom, Lop Buri, Samut Songkhram, Saraburi and Suphan Buri.

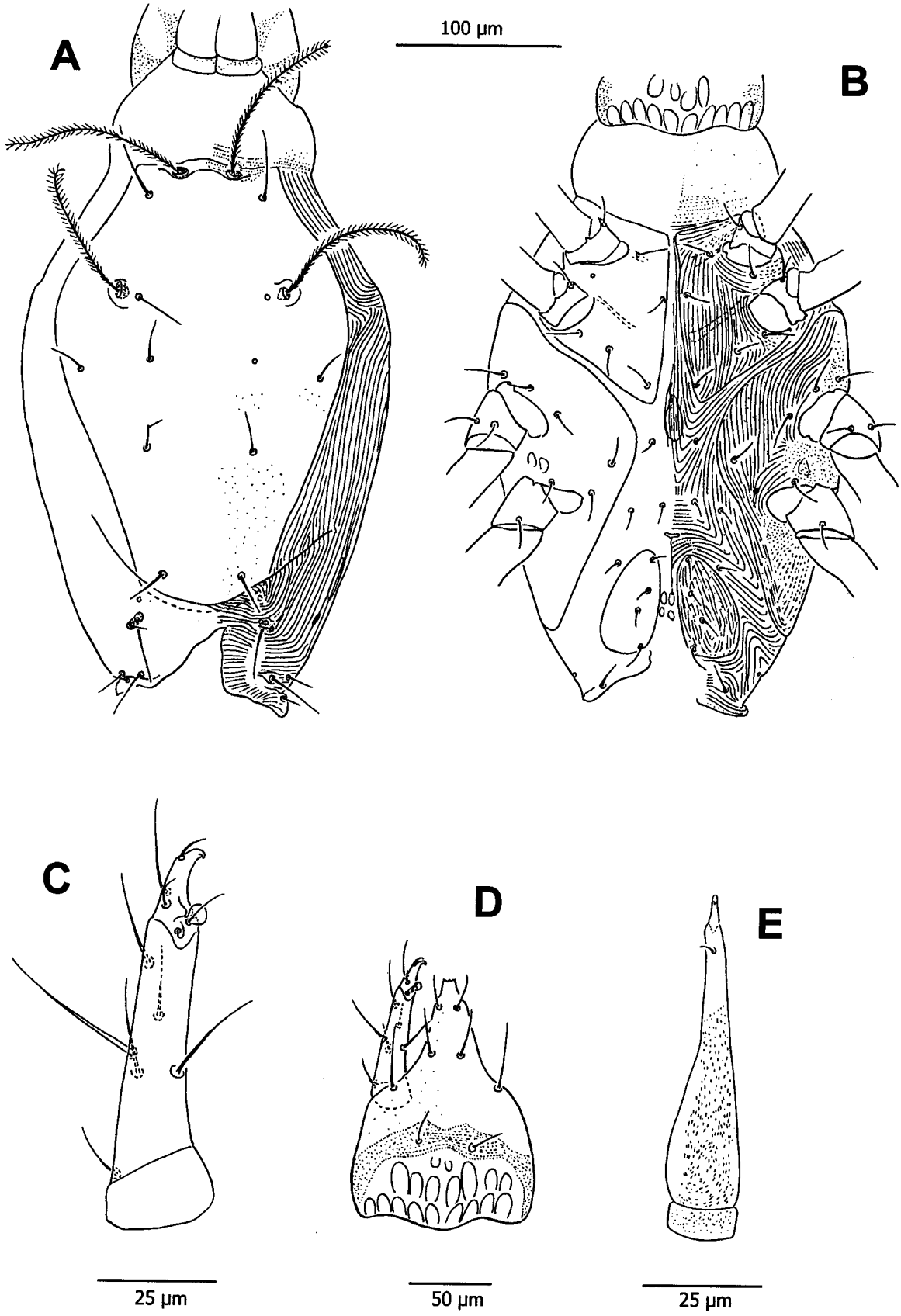

Figure 82. *Pulaeus lenis,* female – A, dorsum; B, venter; C, palp; D, ventral hypostome; E, chelicera.

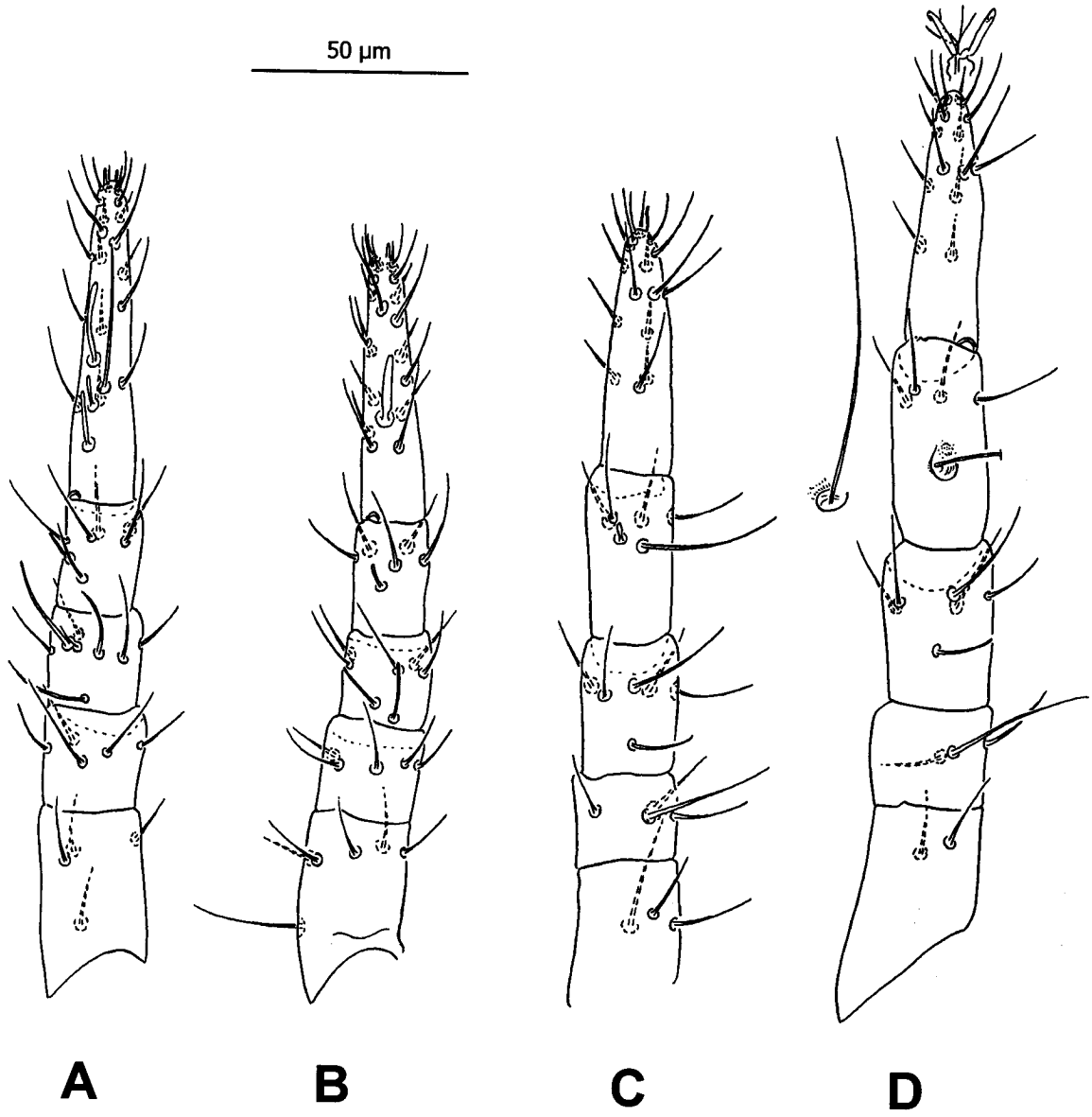

Figure 83. *Pulaeus lenis,* female – A, leg I; B, leg II; C, leg III; D, leg IV.

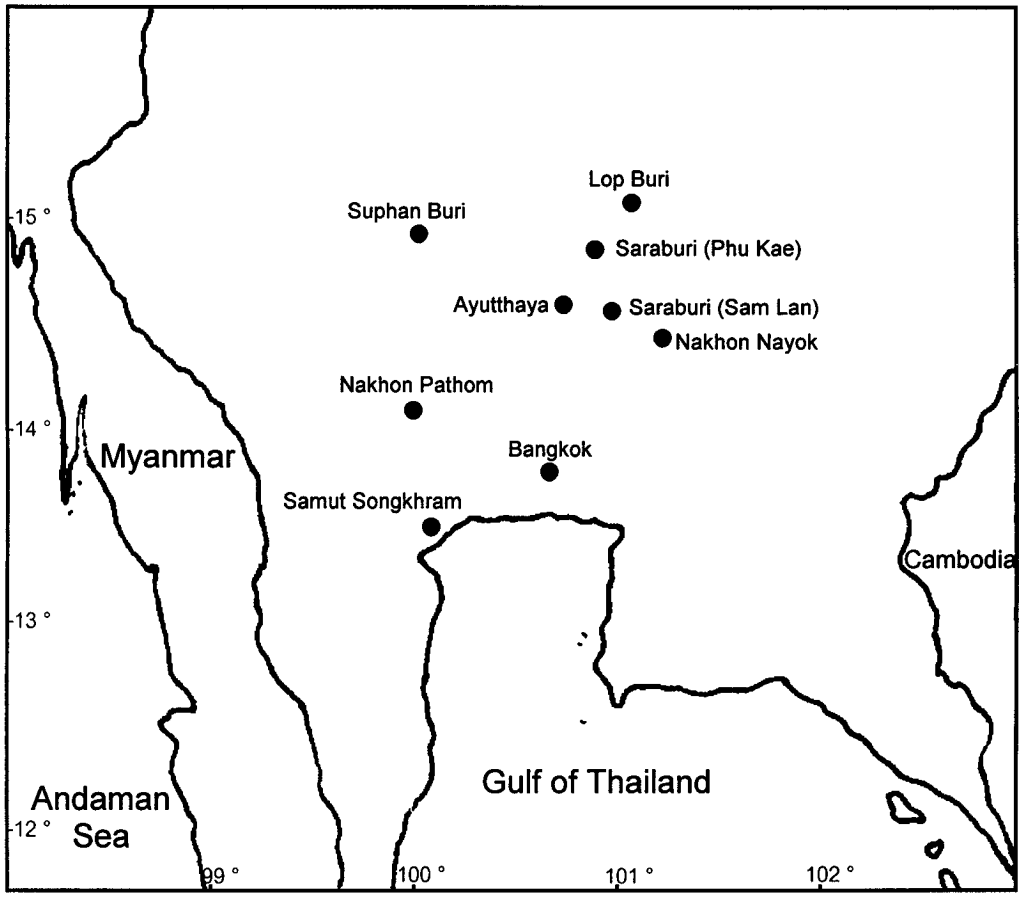

Figure 84. Collecting sites of *Pulaeus lenis* in central Thailand.

30. *Pulaeus villacarlosae* Corpuz-Raros, 1996

(Figs. 85 and 86)

Pulaeus villacarlosae Corpuz-Raros 1996d: 136.

Diagnosis – According to Corpuz-Raros (1996d), this species is recognized from its congeners by a smooth dorsal shield, setae f_1 and f_2 born on small platelet, seta f_2 about half as long as f_1, short and thick palps, coxal plates I+II not medially fused, and five pairs of setae on membrane between ventral shields.

Female – Dimension - Length of idiosoma 250-325 (279.17), width 155-180 (162.5); length of hypognathum 98-105 (99.83), width 65-82 (75.17); length of palp 53-60 (56.83); length of chelicera 80-100 (91.33); length of legs: I 145-160 (151.67); II 130-145 (135.83); III 140-165 (156.67); IV 190-165 (174.17).

Gnathosoma - Hypostome (Fig. 85D) subrectangular, coneshaped distally. Ventral hypostome with a numbers of subcuticular cells, surface striated on central region and punctuated, with four pairs of *hg* setae, hg_4 longest. Palp short and thick with three segments (Fig. 85C) and palpal chaetotaxy as follows: Trochanter with no setae; femurogenua with six simple setae; tibiotarsus with two outer lateral simple setae, basally on inner surface with one bladder-like apophysis, one subtriangular tubercle, and two simple setae, and medially with one simple seta, terminating with a claw, chelicerae (Fig. 85E) with two segments, segment I granulated, segment II coarsely papiliated, with one simple seta behind chela.

Dorsum (Fig. 85A) – Idiosoma with a large smooth shields extending from propodosoma into hysterosomal region, bearing two pairs of setose sensillae and six pairs of simple setae *ve*, *sce*, c_1, c_2, d_1 and e_1, and integument outside the shield striated, setae f_1 and f_2 simple and born on a small plate, setae f_2 about half as long as seta f_1, setae h_1 and h_2 also simple but not arising from a small plate; the cupules *ip* behind the posterior corners of the dorsal shield.

Venter (Fig. 85B) – Coxae I+II divided, surface striate, and with six pairs of simple setae; coxae III and IV fused as a lateral shield of each side, with six simple setae each, shield surface mainly with broken striae and granulated. Genital shields with striate surface and four pairs of simple setae, arranged as shown in figure 85B., two pairs of genital papillae present; integument between ventral shields without the sclerotized area, and with five pairs of simple setae; anal region with two pairs of anal setae ps_1 and ps_2, and one pair of cupule *ih*.

Legs (Fig. 86) – All legs shorter than idiosoma; tarsi I-IV stout and without terminal lateral lobes. Number of setae on leg segments I-IV as follows: Coxae 3-3-3-3; trochanters 1-1-2-1; basifemora 4-6-3-1; telofemora 5-5-4-3; genu I, 3 attenuate solenidia, 1 micrcroseta + 5; genu II, 2 attenuate solenidia + 5; genu III, 1 attenuate solenidion + 5; genu IV, 2 attenuate solenidion + 5; tibia I, 2 attenuate solenidia + 5; tibia II, 1 short blunt solenidion + 5; tibia III, 1 short blunt solenidion + 5; tibia IV, 1 trichobothrium + 4; tarsi I, 4 attenuate solenidia, + 21 [including "dt" and "tsl" of Den Heyer (1979a)]; tarsi II, 1 blunt solenidion + 20; tarsi III, 16; tarsi IV, 15.

Male – Thai materials unknown.

Type – Female Holotype, Villaverda, Neuva Vizcayana, on *Leucaena leucocephala* debris, 26. X. 1962, by R. S. Raros. Type deposited in the Museum of Natural History of University of The Philippines, Los Banos.

Material examined - 1F, Pho Chon Kai, Bang Rachan, Sing Buri 15°10′16′′ N 100°05′33′′E, alt. 27 m., on mixed litter, 20. X. 2002; 13FF, as previous data but on litter under *Tamarindus indicus* Linn., 4FF, as previous data but on litter under *Sandoricum koetjape*, 2FF, as previous data but on bamboo litter; 1F, Pho Chon Kai, Bang Rachan, Sing Buri, on litter under *Citrus grandis*, 17. X. 2002, 2FF, as previous data but litter under *Streblus asper* Lour., 2FF, Pho Chon Kai, Bang Rachan, Sing Buri, on mango litter, 18. X. 2002; 1FF, as previous data but on decomposing banana leaves, 20. X. 2002; 8FF, Pho Chon Kai, Bang Rachan, Sing Buri 15°10′16′′N 100°05′33′′E, alt. 27 m., on litter under *Tamarindus indicus*, 28. III. 2003; 1F, Chulalongkorn University Campus, Bangkok 13°44′40′′N 100°31′69′′E, on litter under *Tamarindus indicus*, 9. II. 2003; 3FF, Chulalongkorn University Campus, Bangkok, on litter under *Delonix* sp., 6. IX. 2002; 24FF, Bang Khan Taek, Samut Songkhram, on litter under *Leucaena leucocephala*, 6. IX. 2002; 1F, as previous data but on debris under bee nest, *Apis cerana*, in coconut tree-hole; 24FF, Bang Khan Taek, Samut Songkhram 13°22′39′′N 99°57′18′′E, on soil-litter under *Citrus grandis*, 6. IX. 2002; 7FF, as previous data but 25. III. 2003; 6FF, as previous data but on decomposing grasses, 23. VI. 2002; 1F, Bang Khan Taek, Samut Songkhram, on litter under *Tamarindus indicus*, 23. VI. 2002; 1F, as previous data but on coconut litter; 1F, Bang Khan Taek, Samut Songkhram 13°22′16′′N 99°52′45′′E, on soil-litter, 13. II. 2003; 1F, Bang Khan Taek, Samut Songkhram 13°22′55′′N 99°57′40′′E, on litter under *Tamarindus indicus,* 25. III. 2003; 6FF, Bang Khan Taek, Samut Songkhram 13°22′46′′N 99°57′24′′E, on coconut litter, 25. III. 2003; 4FF,

Bang Khan Taek, Samut Songkhram 13°22′61′′N 99°57′43′′E, alt. 1 m., on litter under *Zizyphus mauritiana*, 25. III. 2003; 2F, Sala Loy, Tha Ruae, Ayutthaya 14°37′73′′N 100°42′14′′E, alt. 12 m., in soil-litter, 31. XII. 2002; 4FF, Tha Ruea, Ayutthaya 14°33′03′′N 100°41′91′′E, alt. 18 m., on mixed litter. 30. XII. 2002; 1F, Sala Loy, Tha Ruae, Ayutthaya 14°31′75′′N 100°42′26′′E, alt. 27 m., on litter *Cassia* sp., 23. III. 2003; 1F, as previous data but on litter under *Tamarindus indicus*; 2FF, Tha Chai, Muang, Chai Nat, on *Tamarindus indicus* litter 14°02′57′′N 99°56′08′′E, alt. 20 m., 28. III. 2003; 13FF, as previous data but on litter under *Streblus asper* Lour., 8FF, Sala Ya, Phuthamonthon, Nakhon Pathom 13°48′45′′N 100°17′29′′E, alt. 5 m., on litter under *Citrus grandis*, 16. III. 2003; 77FF, near Sam Lan waterfall, Saraburi 14°25′56′′N 100°57′51′′E, on forest litter, 7. IV. 2003; 58FF, near Sarika waterfall, Nakhon Nayok 14°18′17′′N 101°15′33′′E, on forest litter, 7. IV. 2003; 9FF, Phatthana Nikhom, Lop Buri 14°51′18′′N 101°00′11′′E, alt. 64 m., on coconut litter, 7. IV. 2003; 4FF, as previous data but on litter under *Tamarindus indicus*; 11FF, Kaeng Sam Chan, Sarika, Nakhon Nayok 14°18′05′′N 101°18′17′′E, on litter of *Citrus grandis*, 7. VI. 2003; 5FF, as previous data but on litter under *Tamarindus indicus*; 3FF, Phu Kae Botanical Garden 14°40′30′′N 100°53′10′′E, alt. 92 m., litter, 7. IV. 2003; 5FF, Khlong Sip Song, Pathum Thani, 14°06′42′′N 100°52′37′′E, on *Acacia* sp. litter, 16. IX. 2003.

Remark: Thai speciemens differ from original description in having sculpturing on dorsal shields.

Distribution – The Philippines; Thailand, additional localities from this study (Fig. 87): Ayutthaya, Bangkok, Chai Nat, , Lop Buri, Nakhon Nayok, Nakhon Pathom, Samut Songkhram, Sing Buri.

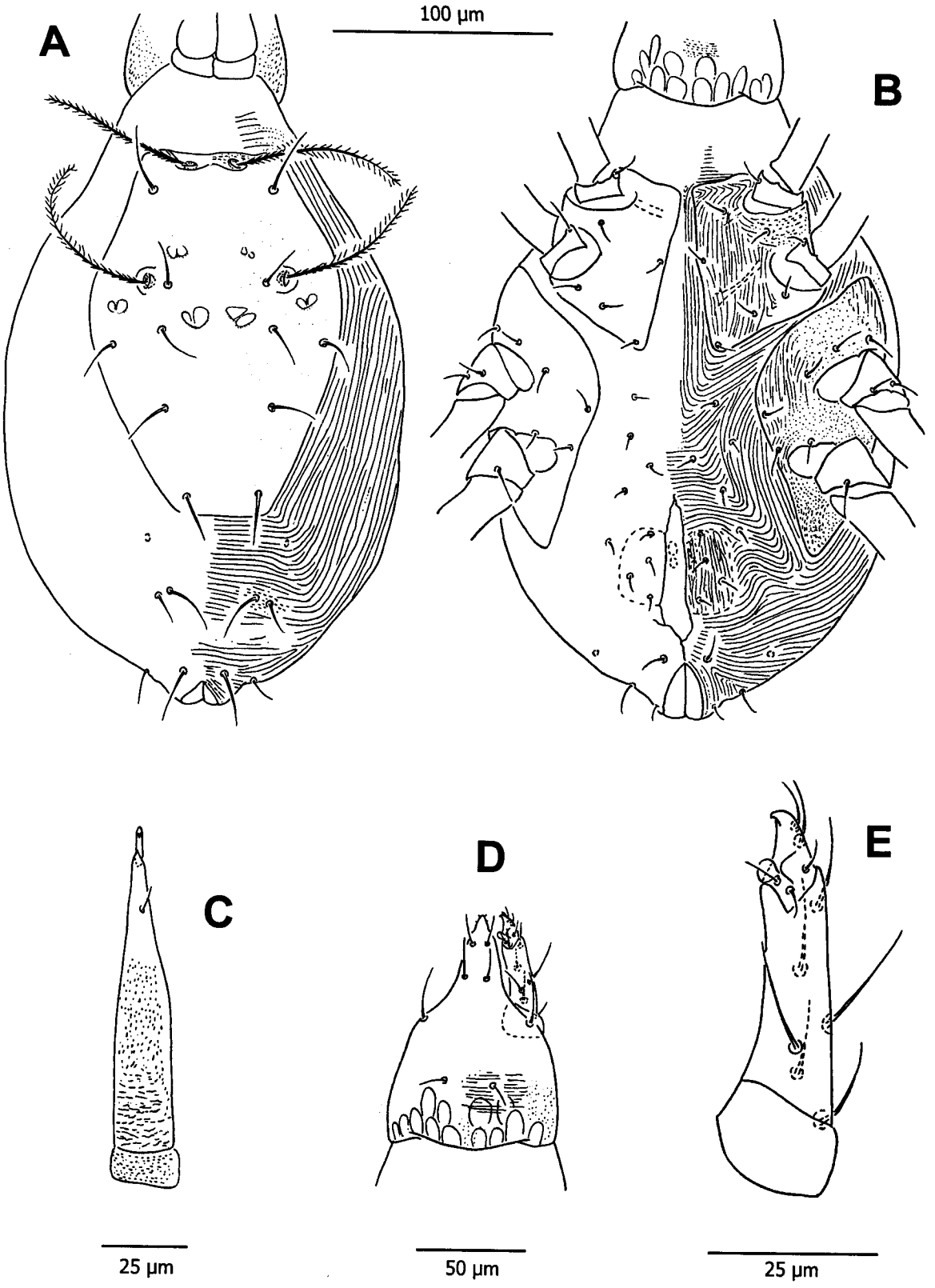

Figure 85. *Pulaeus villacarlosae,* female – A, dorsum; B, venter; C, palp; D, ventral hypostome.

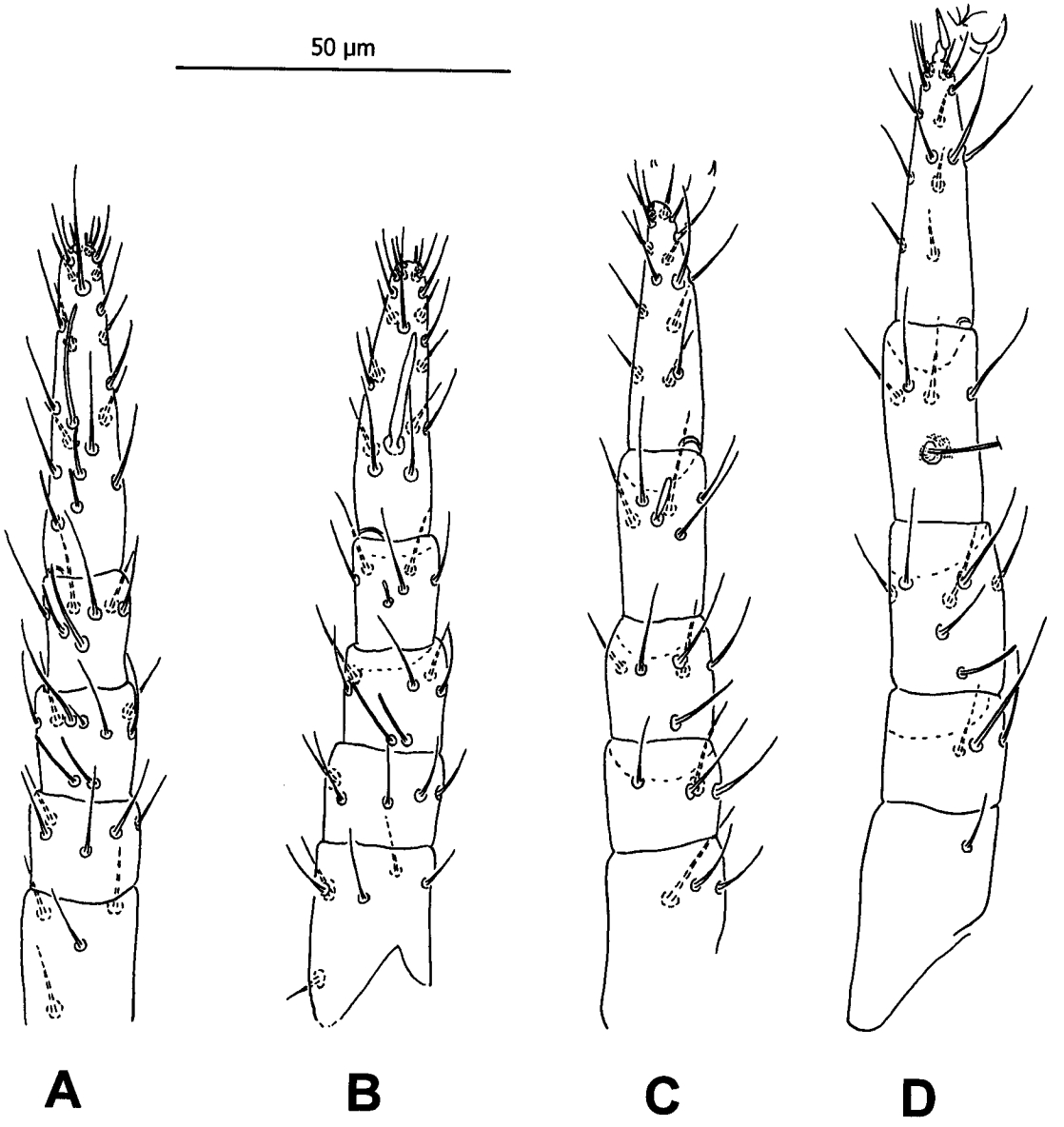

Figure 86. *Pulaeus villacarlosae,* female – A, leg I; B, leg II; C, leg III; D, leg IV.

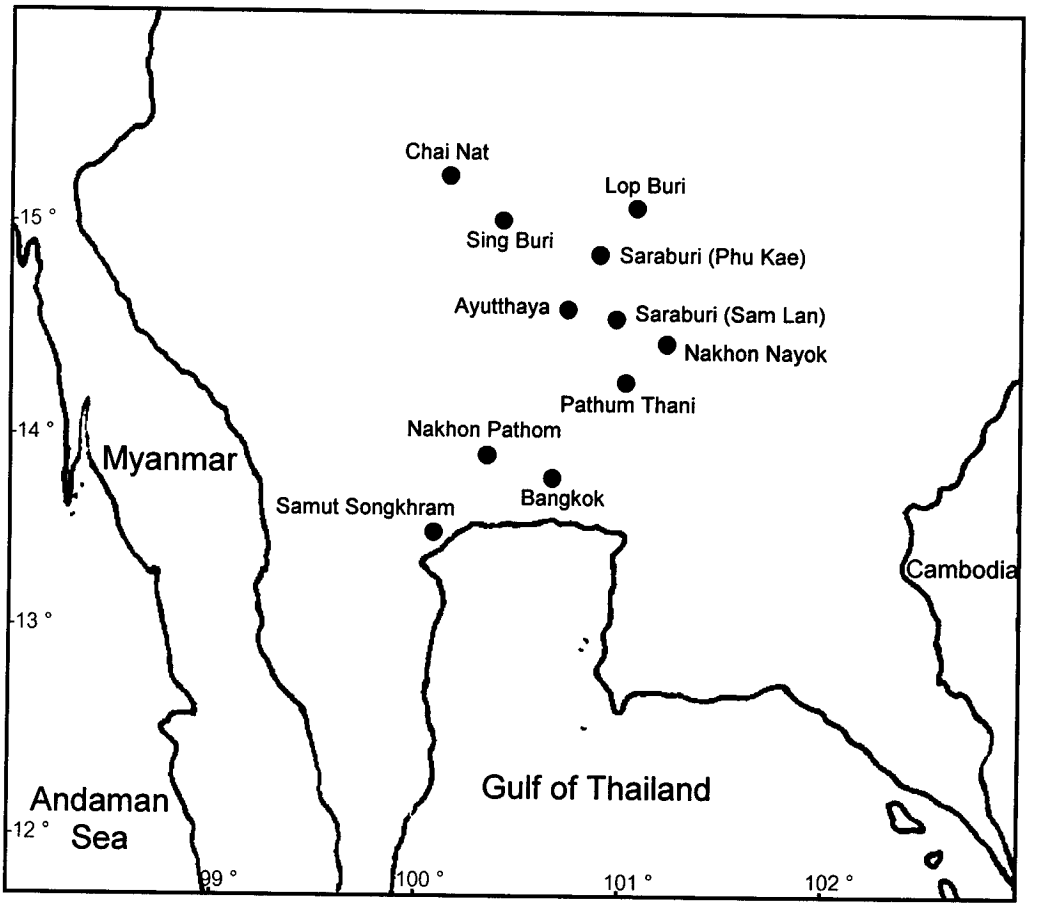

Figure 87. Collecting sites of *Pulaeus villacarlosae* in central Thailand.

31. *Pulaeus* sp. 1

(Figs. 88 and 89)

Diagnosis – This species is similar to *P. glebulentus* Den Heyer, 1980 (Den Heyer 1980b) in that the dorsal plate has a broken striae, and the presence of sclerotized area anterior to genital plates. However, it differs from the latter in the number of ventral setae between genital and lateral plates. There are six pairs of setae in the former rather than five pairs in the latter.

Female – Dimension - Length of idiosoma 335-400 (368.33), width 185-265 (223.33); length of hypognathum 133-140 (136.17), width X85-100 (92.17); length of palp 78-83 (81.17); length of chelicera 115-130 (123.5); length of legs: I 185-210 (195.83); II 170-185 (175.83); III 195-210 (202.5); IV 220-240 (232.5).

Gnathosoma - Hypostome (Fig. 88D) subrectangular, coneshaped distally, ventral hypostome with a row of subcuticular cells, and four pairs of *hg* setae, hg_4 longest, and two pairs of adoral setae. Palp with three segments (Fig. 88E) and palpal chaetotaxy as follows: Trochanter with no setae; femurogenua with six simple setae; tibiotarsus with three outer lateral simple setae, basally on inner surface with one bladder-like apophysis, one subtriangular tubercle, and two simple setae, terminating with a claw; chelicerae (Fig. 88C) with two segments, segment I granulated, segment II dorsobasally papiliated, with one simple seta behind chela.

Dorsum (Fig. 88A) – Idiosoma with a large shield extending from propodosoma into hysterosoma, surface with broken striae, bearing two pairs of sensillae *vi* and *sci*, and six pairs of simple setae *ve*, *sce*, c_1, c_2, d_1 and e_1. Integument outside the shield striated, setae f_1 and f_2 simple and arised on a small plate, setae h_1 and h_2 also simple and born on a small plate; the cupules *ip* behind the posterior corners of the dorsal shield.

Venter (Fig. 88B) – Coxae I+II divided not fused medially, surface striate, and with six pairs of simple setae; coxae III and IV fused as a lateral shields of each side, with six simple setae each, surface striate on inner side but granulated or broken striae on outer side; genital shields with four pairs of simple setae, surface striate; integument between ventral shields with the small round sclerotized area, and 13 setae (six pairs?); anal region with two pairs of anal setae ps_1 and ps_2, and one pair of cupule *ih*.

Legs (Fig. 89) – All legs shorter than idiosoma; tarsi I-IV stout and without terminal lateral lobes. Number of setae on leg segments I-IV as follows: Coxae 3-3-3-

3; trochanters 1-1-2-1; basifemora 4-6-3-2; telofemora 5-5-4-3; genu I, 4 attenuate solenidia, 1 micrcroseta + 4; genu II, 1 attenuate solenidia + 5; genu III, 1 attenuate solenidion + 5; genu IV, 1 attenuate solenidion + 5; tibia I, 2 attenuate solenidia + 5; tibia II, 1 short blunt solenidion + 5; tibia III, 1 short blunt solenidion + 5; tibia IV, 1 trichobothrium + 4; tarsi I, 4 attenuate solenidia, + 24 [including "dt" and "tsl" of Den Heyer (1979a)]; tarsi II, 1 blunt solenidion + 22; tarsi III, 17; tarsi IV, 16.

Male – Unknown.

Material examined - 48FF, Ban Nong Pongnok, Kamphaeng Saen, Nakhon Pathom 14°02′57′′N 99°56′08′′E, alt. 20 m., on litter under unknown plant (Leguminosae), 16. III. 2003; 11FF, as previous data but on litter under *Tamarindus indicus*, Linn.; 6FF, as previous data but on litter *Azadirachta indica*, and *Leucaena leucocephala* , 3FF, Pho Chon Kai, Bang Rachan, Sing Buri 15°10′16′′N 100°05′33′′E, alt. 27 m., on *Tamarindus indicus* litter, 20. X. 2002; 9FF, as previous data but 28. III. 2003; 3FF, Tha Chai, Muang, Chai Nat 14°02′57′′N 99°56′08′′E, alt. 20 m., on *Tamarindus indicus* litter, 28. III. 2003; 11FF, as previous data but on litter of unknown plant; 2FF, Sala Ya, Phuthamonthon, Nakhon Pathom 13°48′45′′N 100°17′29′′E, alt. 5 m., on litter under *Citrus grandis*, 16. III. 2003; 2FF, Bang Plama, Suphan Buri, on *Acacia* sp. litter, 16. III. 2003; 2FF, Sala Loy, Tha Ruae, Ayutthaya, on litter under *Tamarindus indicus*, 23. III. 2003; 1F, Phumoung, U Thong, Supanburi 14°20′91′′N 99°51′60′′E, alt. 27 m. on forest litter, 16. III. 2003; 2FF, Bueng Chawak, Suphan Buri 14°55′49′′N 100°02′49′′E, alt. 17 m., on litter under *Delonix* sp., 28. III. 2003; 5FF, as previous data but on litter under *Muntingia* sp.; 11FF, as previous data but litter under banana and coconut; 10FF, Bang Khan Taek, Samut Songkhram 13°22′39′′N 99°57′18′′E, on litter under *Citrus grandis*, 25. III. 2003; 8FF, Bang Khan Taek, Samut Songkhram 13°22′61′′N 99°57′ 43′′E, alt. 1 m., on litter under *Zizyphus mauritiana*, 25. III. 2003; 11FF, Bang Khan Taek, Smut Songkhram 13°22′46′′N 99°57′24′′E, on coconut litter, 25. III. 2003; 5FF, Bang Khan Taek, Smut Songkhram, on litter under bee nest, *Apis cerana*, in coconut tree hole, 6. IX. 2002; 2FF, Bang Khan Taek, Smut Songkhram 13°23′16′′N 99°52′45′′E, on soil-litter, 13. II. 2003; 1F, Bang Khan Taek, Smut Songkhram 13°22′39′′N 99°57′18′′E, on decomposed grasses, 23. VII. 2002; 5F, Tha Ruae, Ayutthaya, 14°37′73′′N 100°42′14E, alt. 12 m., on litter, 30. XII. 2003.

Distribution – Thailand, additional localities from this study (Fig. 90): Ayutthaya, Nakhon Pathom, Samut Songkhram, Sing Buri, Suphan Buri

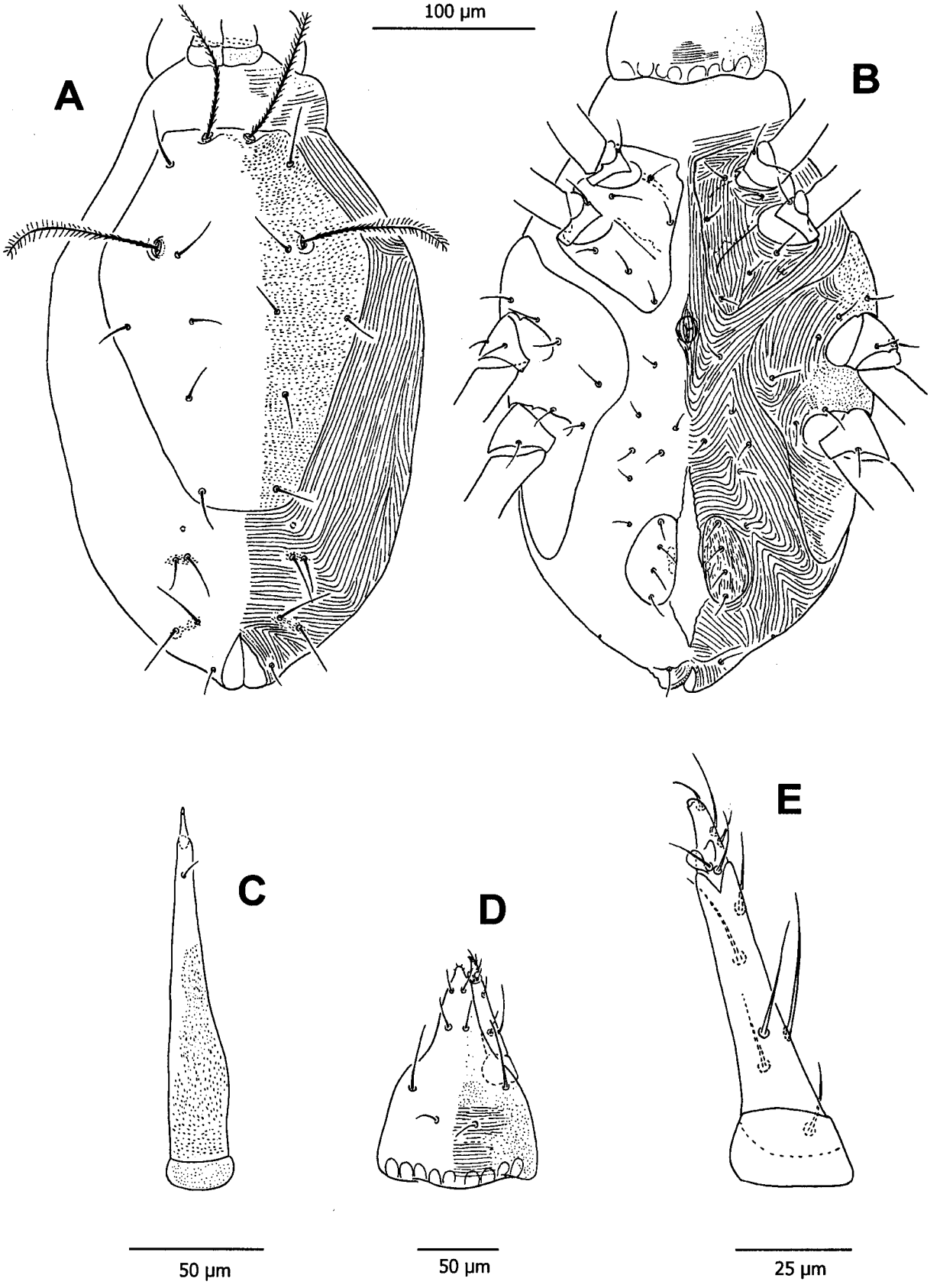

Figure 88. *Pulaeus* sp.1, female – A, dorsum; B, venter; C, chelicera; D, ventral hypostome; E, palp.

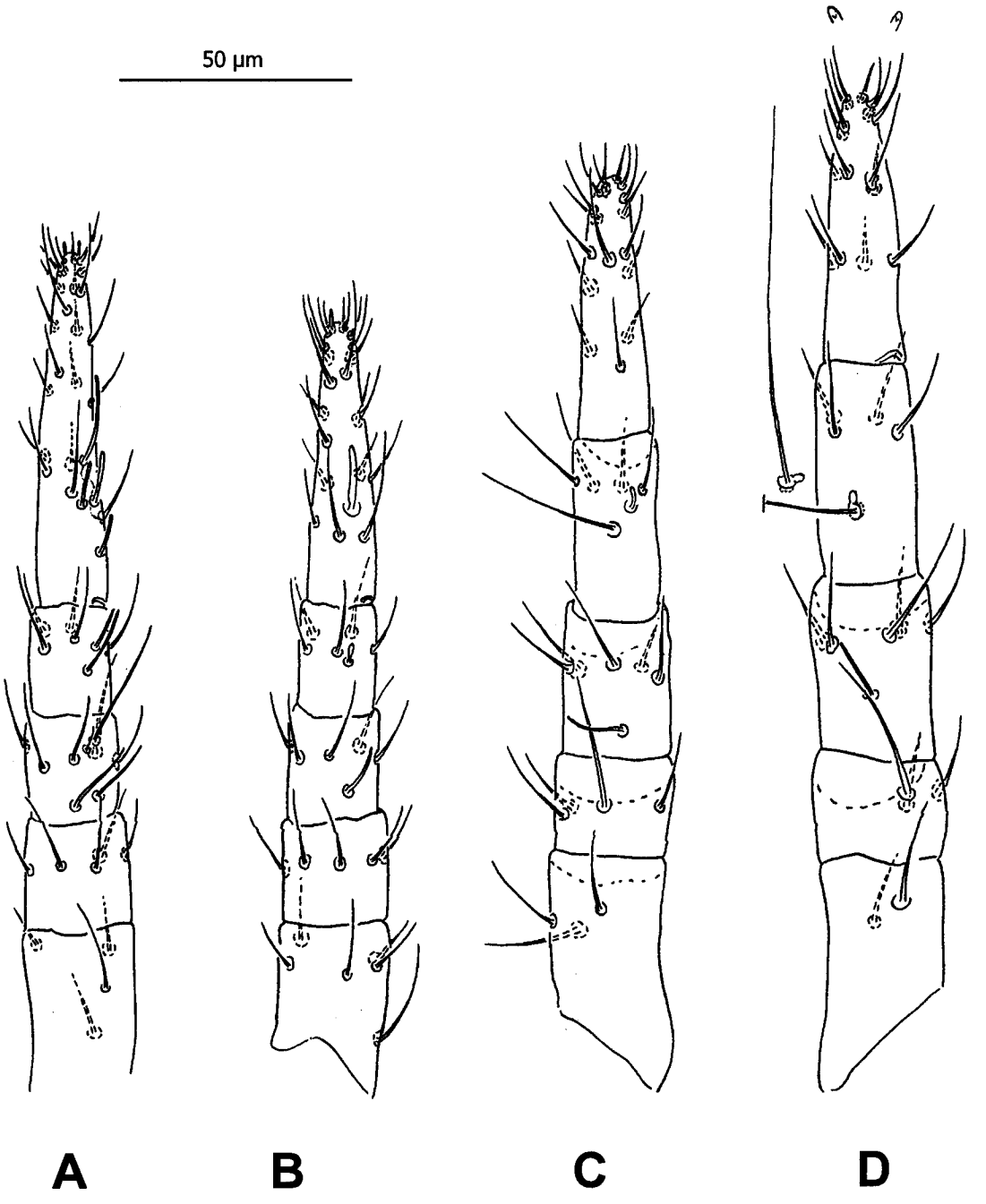

Figure 89. *Pulaeus* sp. 1, female – A, leg I; B, leg II; C, leg III; D, leg IV.

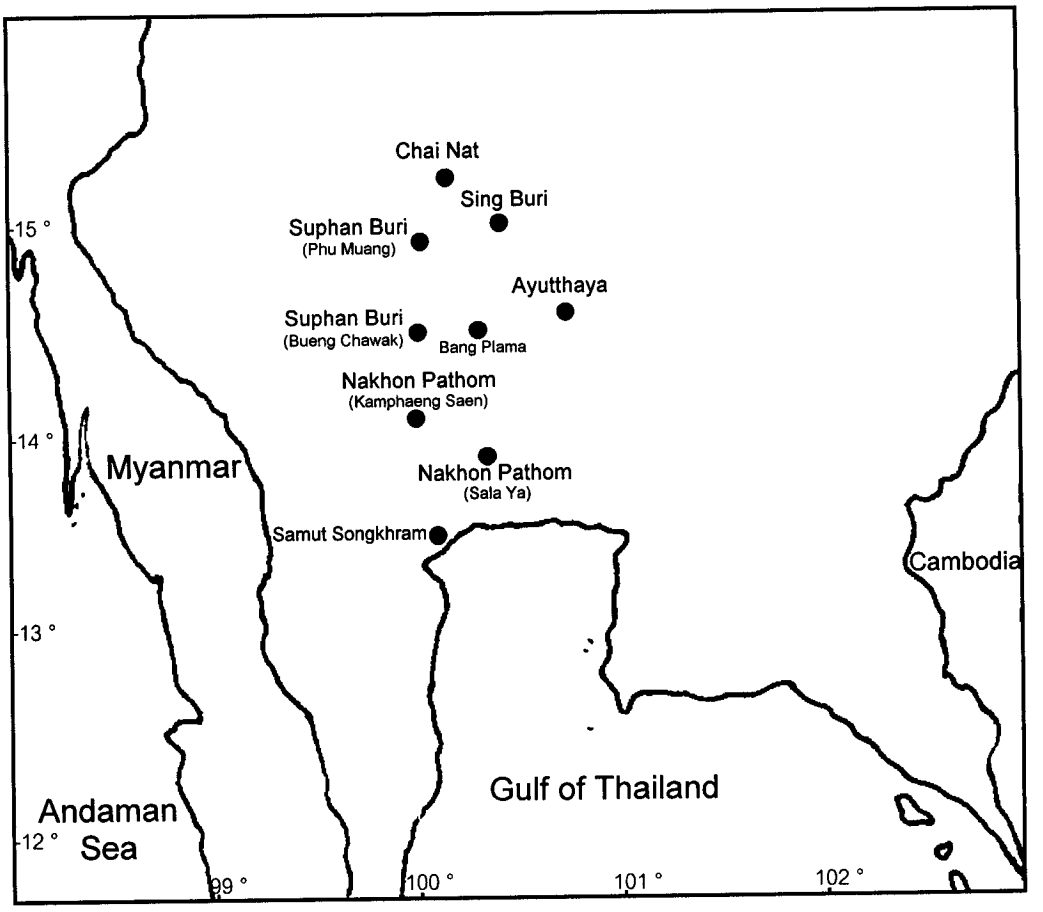

Figure 90. Collecting sites of *Pulaeus* sp. 1 in central Thailand.

32. *Pulaeus* sp. 2

(Figs. 91 and 92)

Diagnosis – This species is similar to *P. rimandoi* Coruz-Raros 1996 in having a relatively long gnathosoma, about half as long as idiosoma; palp tibiotarsus with a bladder-like apophysis and a subtriangular tubercle on inner basal surface. However, it differs from the latter in that the palp femurogenua has six setae (rather than five), and 15 ventral setae between ventral shields.

Female – Dimension - Length of idiosoma 325-400 (368.33), width 200-250 (225); length of hypognathum 175-183 (177.67), width 90-100 (96); length of palp 113-120 (116); length of chelicera 165-170 (167.67); length of legs: I 245-250 (247.5); II 205-215 (210); III 230-235 (232.5); IV 265-265 (265).

Gnathosoma – gnathosoma relatively long about half as long as idiosoma, hypostome (Fig. 91D) subrectangular, coneshaped distally; ventral hypostome with a row of subcuticular cells, surface with striated on central region and punctuated on the rest nda four pairs of *hg* setae, hg_3 longest. Palp relatively long and slender, with three segments (Fig. 91C) and palpal chaetotaxy as follows: Trochanter with no setae; femurogenua with six simple setae; tibiotarsus with two outer lateral simple setae, basally on inner surface with one bladder-like apophysis, one subtriangular tubercle, and three simple setae, terminating with a claw,

Dorsum (Fig. 91A) – Idiosoma with a large shields extending from propodosoma into hysterosomal region, posterior edge slightly concaved, bearing two pairs of setose sensillae, *vi* and *sci*, and six pairs of simple setae *ve*, *sce*, c_1, c_2, d_1 and e_1. The shield surface near the margin and around *sci* noticeably broken striae, the shield with granulate inside; integument outside the shield striated, setae f_1 and f_2 simple and born on a small plate, setae h_1 and h_2 also simple but not arising from the same platelet; the cupules *ip* behind the posterior corners of the dorsal shield.

Venter (Fig. 91B) – Coxae I+II divided, not fused medially, surface with broken striae, and with six pairs of simple setae; coxae III and IV fused as a lateral shield of each side, with six simple setae each, shield surface with broken striae. Genital shields finely broken striate, and four pairs of simple setae, arranged as shown in figure 91B., two pairs of genital papillae present. Integument between ventral shields with a round sclerotized area, and with 15 simple setae. Anal region with two pairs of anal setae ps_1 and ps_2, and one pair of cupule *ih*.

Legs (Fig. 92) – All legs shorter than idiosoma; tarsi I-IV stout and without terminal lateral lobes. Number of setae on leg segments I-IV as follows: Coxae 3-3-3-3; trochanters 1-1-2-1; basifemora 4-6-3-2; telofemora 5-5-4-3; genu I, 3 attenuate solenidia, 1 micrcroseta + 4; genu II, 2 attenuate solenidia + 5; genu III, 1 attenuate solenidion + 5; genu IV, 1 attenuate solenidion + 5; tibia I, 2 attenuate solenidia + 5; tibia II, 1 short blunt solenidion + 5; tibia III, 1 short blunt solenidion + 5; tibia IV, 1 trichobothrium + 4; tarsi I, 4 attenuate solenidia, + 22 [including "dt" and "tsl" of Den Heyer (1979a)]; tarsi II, 1 blunt solenidion + 21; tarsi III, 16; tarsi IV, 17.

Material examined - 1F, Bang Khan Taek, Samut Songkhram, 13°22′39′′N 99°57′18′′E, on decomposing grasses and banana leaves, 23. III. 2003; 2FF and 1M, Khon Kaen, on compost, 17. IX. 1999, by P. Nanok.

Distribution – Thailand, additional localities from this study (Fig. 93): Khon Kaen and Samut Songkhram.

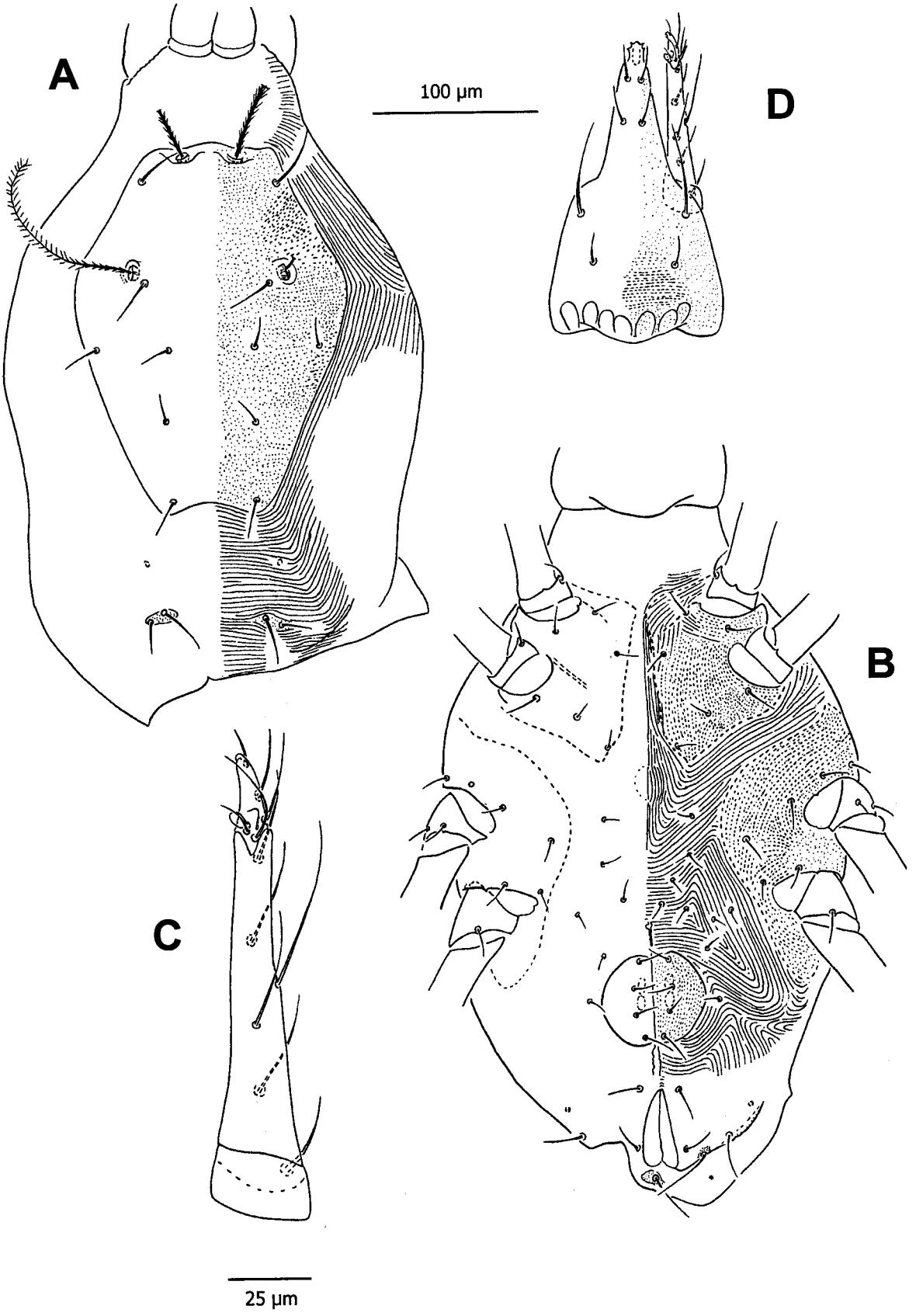

Figure 91. *Pulaeus* sp. 2, female – A, dorsum; B, venter; C, palp; D, ventral hypostome.

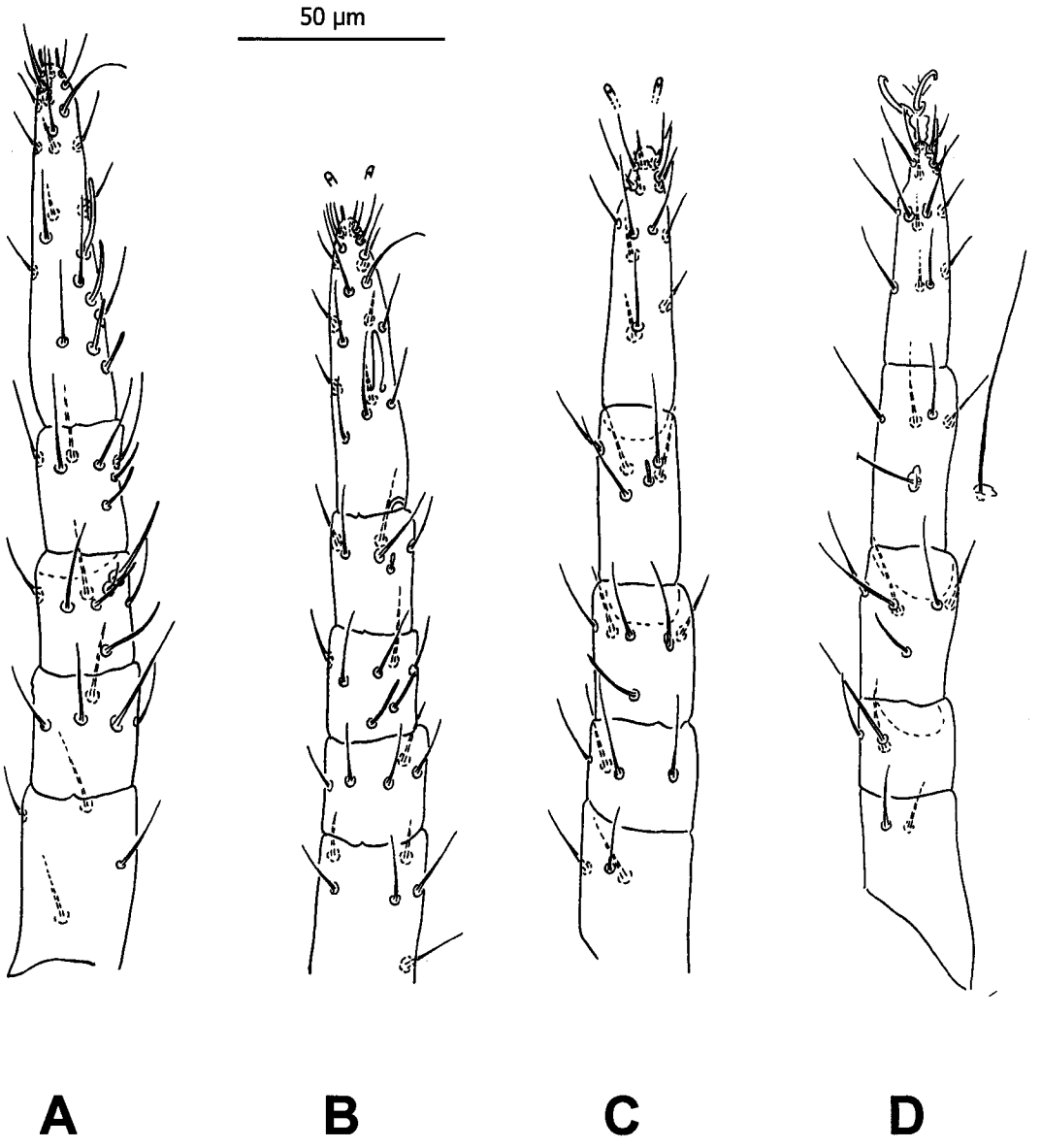

Figure 92. *Pulaeus* sp. 2, female – A, leg I; B, leg II; C, leg III; D, leg IV.

Figure 93. Collecting sites of *Pulaeus* sp. 2 in central Thailand.

33. *Pulaeus* sp. 3

(Fig. 94 and 95)

Diagnosis –This is similar to *Pulaeus* sp. 2 in having long gnathosoma, about half as long as idiosoma, palp tibiotarsus possessing a bladder-like apophysis and a subtriangular tubercle on inner basal surface. The ornamentation of the dorsal shield will separate these two species, that is, the dorsal shield is totally broken striation in *Pulaeus* sp. 3 while granulated, and broken striae on the anterior portion above setae *sci* in *Pulaeus* sp. 2.

Female – Dimension - Length of idiosoma 225-325 (287.5), width 170-215 (188.75); length of hypognathum 133-140 (136.5), width 98-108 (102,75); length of palp 75-85 (80.75); length of chelicera 130-133 (130.75); length of legs: I 170-175 (173.75); II 135-155 (145); III 170 (170); IV 180-195 (186.67.25).

Gnathosoma – gnathosoma relatively thick and long about half as long as idiosoma, hypostome (Fig. 94D) subrectangular, coneshaped distally, ventral hypostome with a row of subcuticular cells, surface striated on central region and punctuated on the rest, with four pairs of *hg* setae, hg_4 longest. Palp relatively long, with three segments (Fig. 94C) and palpal chaetotaxy as follows: Trochanter with no setae; femurogenua with six simple setae; tibiotarsus with three outer lateral simple setae, basally on inner surface with one bladder-like apohysis, one subtriangular tubercle, and two simple setae, terminating with a claw,

Dorsum (Fig. 94A) – Idiosoma with a large shield extending from propodosoma into hysterosomal region, posterior edge slightly concaved, bearing two pairs of sensillae, *vi* and *sci*, and six pairs of simple setae *ve*, *sce*, c_1, c_2, d_1 and e_1. The shield surface finely broken striae; integument outside the shield striated, setae f_1 and f_2 simple and born on a small platelet, setae h_1 and h_2 also simple but not arising from platelets; the cupules *ip* behind the posterior corners of the dorsal shield.

Venter (Fig. 94B) – Coxae I+II divided, not fused medially, surface with broken striae, and with six pairs of simple setae; coxae III and IV fused as a lateral shield of each side, with six simple setae each, shield surface striate and granulated. Genital shields with four pairs of simple setae, suface striate but granulated centrally; integument between ventral shields without a round sclerotized area, and with six pairs of simple setae; anal region with two pairs of anal setae ps_1 and ps_2, and one pair of cupule *ih*.

Legs (Fig. 95) – All legs shorter than idiosoma; tarsi I-IV stout and without terminal lateral lobes. Number of setae on leg segments I-IV as follows: Coxae 3-3-3-3; trochanters 1-1-2-1; basifemora 4-6-3-2; telofemora 5-5-4-3; genu I, 3 attenuate solenidia, 1 micrcroseta + 4; genu II, 1 attenuate solenidia + 5; genu III, 1 attenuate solenidion + 5; genu IV, 1 attenuate solenidion + 5; tibia I, 2 attenuate solenidia + 5; tibia II, 1 short blunt solenidion + 5; tibia III, 1 blunt solenidion + 5; tibia IV, 1 trichobothrium + 4; tarsi I, 4 attenuate solenidia, + 24 [including "dt" and "tsl" of Den Heyer (1979a)]; tarsi II, 1 blunt solenidion + 20; tarsi III, 16; tarsi IV, 17.

Male – Unknown

Material examined - 4FF, near Sarika waterfall, Nakhon Nayok 14°18′17′′N 101°15′33′′E, on forest litter, 7. IV. 2003.

Distibution – Thailand, additional localities from this study (Fig. 96): Nakhon Nayok.

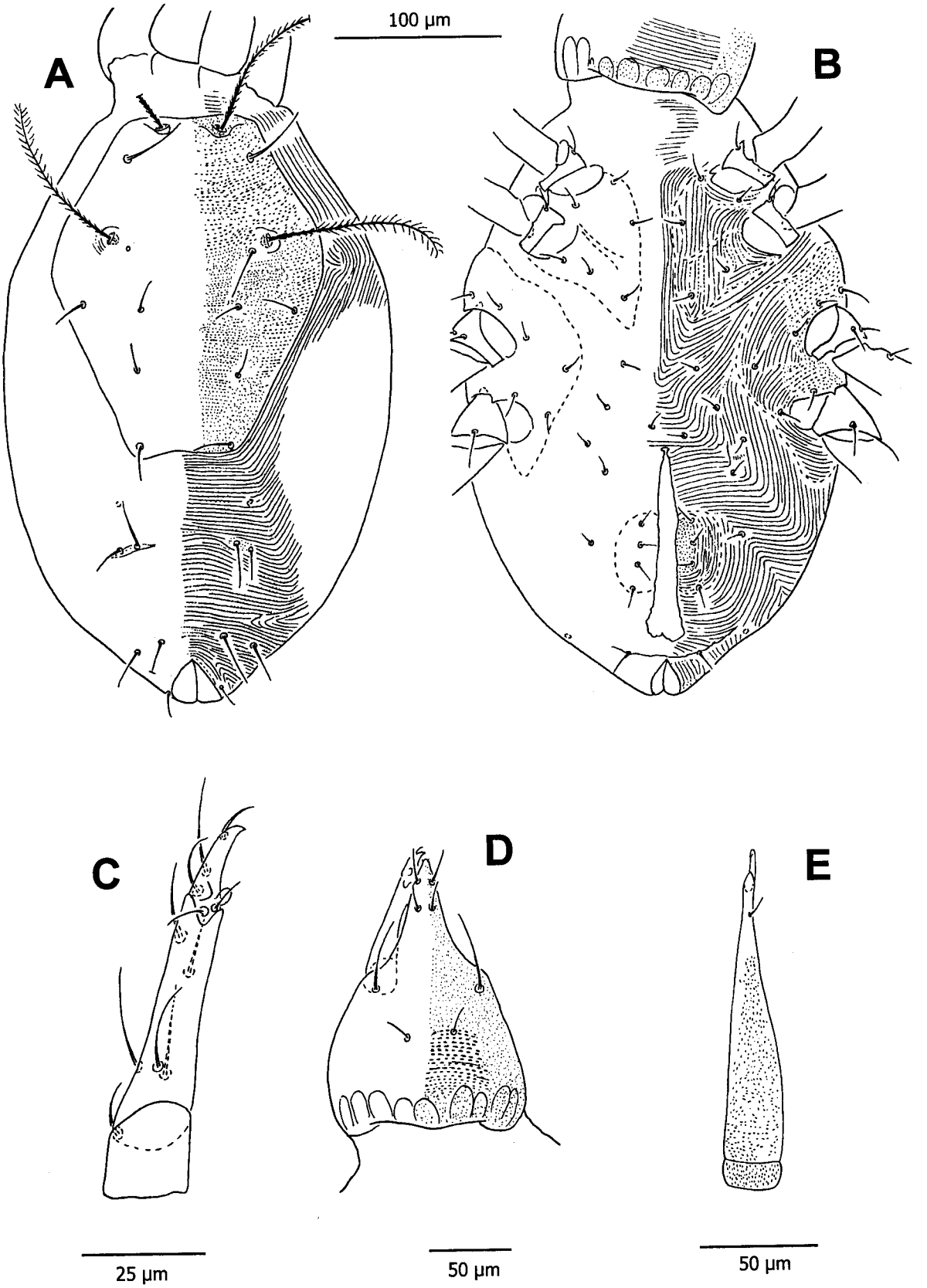

Figure 94. *Pulaeus* sp. 3, female – A, dorsum; B, venter; C, palp; D, ventral hypostome; E, chelicera.

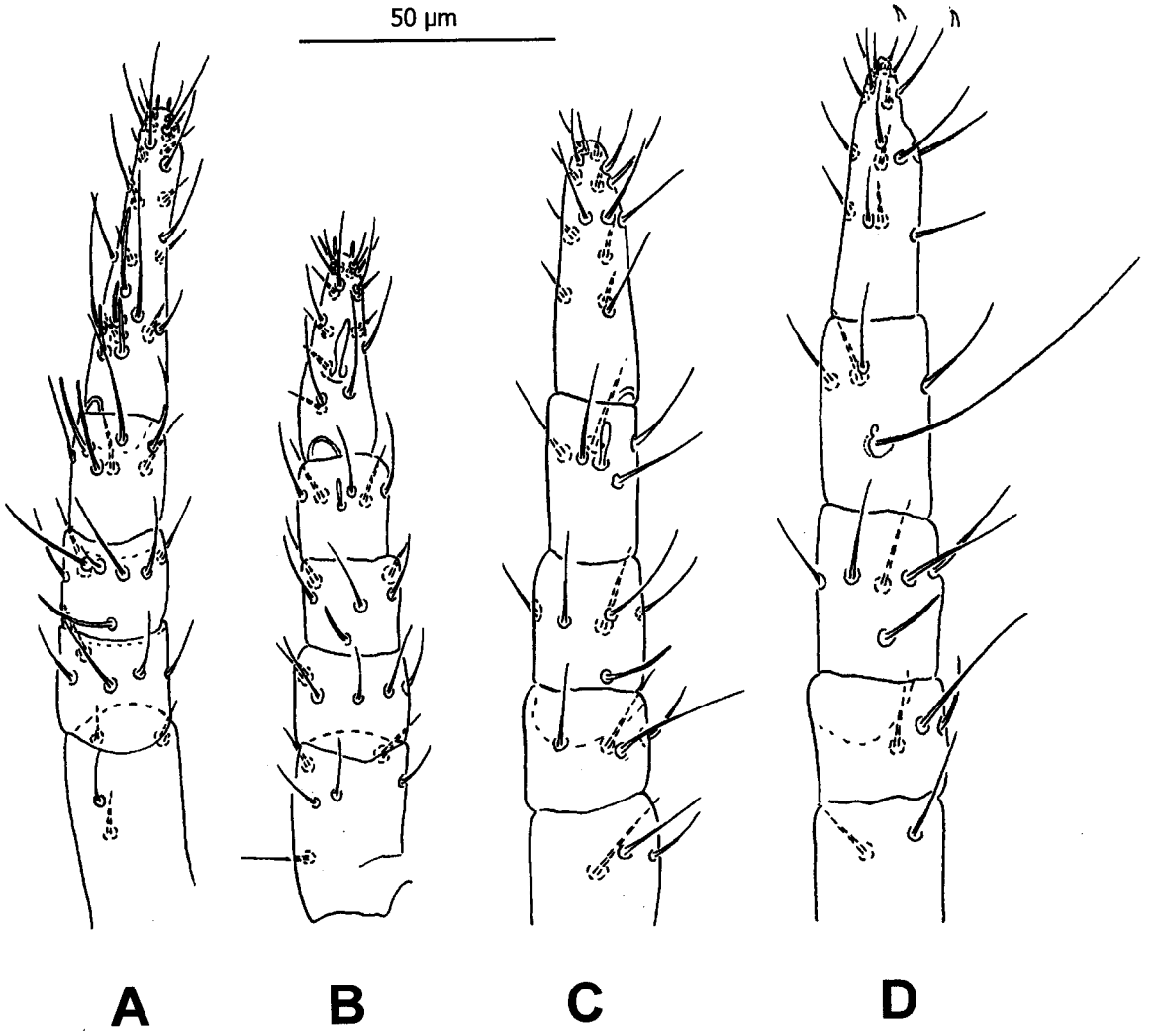

Figure 95. *Pulaeus* sp. 3, female – A, leg I; B, leg II; C, leg III; D, leg IV.

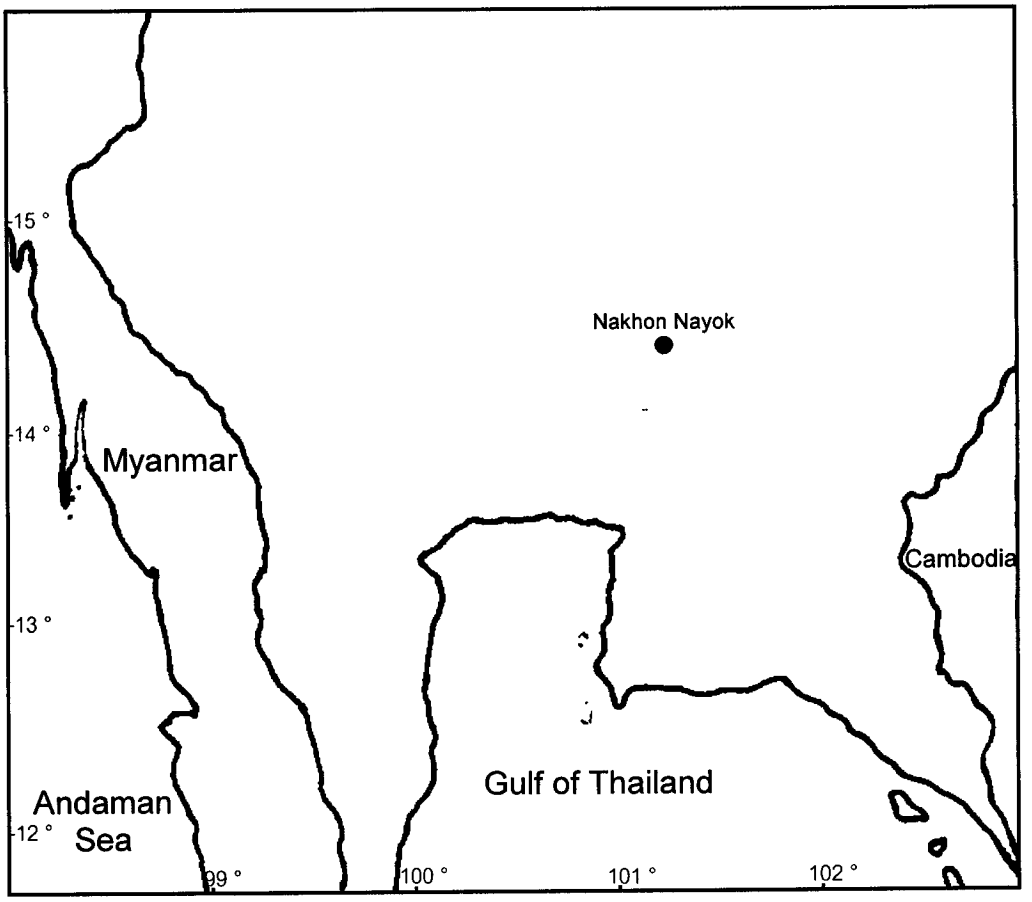

Figure 96. Collecting sites of *Pulaeus* sp. 3 in central Thailand.

Table 4-10. A comparison of main characters between species belonging to the genus *Pulaeus*.

Characters	*P. lenis*	*P. villacarlosae*	*P.* sp.1	*P.* sp. 2	*P.* sp. 3
numbers of setae on palp femurogenua	6	6	6	6	6
Ratio palp femurogenua length/width	4.5	4.5	5	6	4.5
surface of dorsal shiled	smooth	smooth	broken striae	broken striae	broken striae
posterior margin of dorsal shield	straight	straight	concaved	concaved	concaved
Numbers of ventral setae on membrane	4 pairs	5 pairs	6 pairs	6 pairs	?
roundly sclerotized area on ventral idiosoma	present	absent	present	present	absent
genital shields	broken striae	broken striae	broken striae	granulated	granulated
chaetotaxy of basifemora I-II-III-IV	4-6-3-2	4-6-3-1	4-6-3-2	4-6-3-2	4-6-3-2
chaetotaxy of telofemora I-II-III-IV	5-5-4-3	5-5-4-3	5-5-4-3	5-5-4-3	5-5-4-3
number of solenidia on genu I-II-III-IV	3-2-1-1	3-2-1-2	4-1-1-1	3-2-1-1	3-1-1-1
number of solenidia on tibia I-II-III-IV	2-1-1-0	2-1-1-0	2-1-1-0	2-1-1-0	2-1-1-0
number of solenidia on tarsi I-II-III-IV	3	4	4	4	4

4.4. Biology

During the speciemens examination under stereo-microscope, *Cunaxa vizcayana* was found on ventral side of the leaf near the median vein. The predatory behavior of this mite was also observed. The prey, a tarsonemid mite was rapidly grasped and penetrated by cunaxid' s palp and chelicerae, respectively to obtain the prey's body fluid.

In addition, guarding behavior of male *Cunaxa vizcayana* was observed in this examination. The male mite stayed around the pharate female, which was non-active under moulting period, for mating. When the second male approached, it was attacked and was drived off by the first guarding male. Further observation could not be done because they were dead later.

4.5. Ecology

In this study, the cunaxid mites were collected from two habitats: ground or soil-litter, and canopy. Thirty-one species were collected from soil-litter while five species were collected from conopy level. However, three of them could be found on both ground and canopy (Table 4-11). Therefore, all of these cunaxid mites could be tentatively divided into three main groups depending on habitats: (1) Ground or soil-litter inhabitants (2) Canopy inhabitants, and (3) Ground-Canopy inhabitants.

Table 4-11. Species list with habitats of cunaxid mites in central Thailand.

No.	species	habitats	
		ground	canopy
1.	*Armascirus taurus*	X	X
2.	*Armascirus* sp. 1	X	X
3.	*Cunaxa lukoschusi*	X	
4.	*Cunxa grobleri*	X	
5.	*Cunaxa romblonensis*	X	
6.	*Cunaxa setirostris*	X	
7.	*Cunaxa venusae*	X	X
8.	*Cunaxa vizcayana*		X
9.	*Cunaxa* sp.1	X	
10.	*Cunaxa* sp.2	X	
11.	*Cunaxa* sp. 3		X
12.	*Dactyloscirus* sp 1.	X	
13.	*Dactyloscirus* sp 2.	X	
14.	*Coleoscirus bakeri*	X	
15.	*Coleoscirus simplex*	X	
16.	*Coleoscirus tuberculatus*	X	
17.	*Coleoscirus* sp.1	X	
18.	*Coleoscirus* sp.2	X	
19.	*Neoscirula ogawai*	X	
20.	*Neoscirula* sp. 1	X	
21.	*Pseudobonzia clathratus*	X	
22.	*Pseudobonzia gruezoi*	X	
23.	*Pseudobonzia* sp.1	X	
24.	*Scutascirus pentascutellus*	X	
25.	*Neocunaxoides neopectinatus*	X	
26.	*Neocunaxoides philippinensis*	X	
27.	*Neocunaxoides* sp.1	X	
28.	*Neocunaxoides* sp. 2	X	
29.	*Pulaeus lenis*	X	
30.	*Pulaeus villacarlosae*	X	
31.	*Pulaeus* sp. 1	X	
32.	*Pulaeus* sp. 2	X	
33.	*Pulaeus* sp. 3	X	

CHAPTER 5

DISCUSSION

5.1 Fauna of Cunaxidae in Central Thailand

The predatory mite family Cunaxidae was recently revised by Smiley (1992) recognizing 166 species in 17 genera and 9 subfamilies. Additional species were subsequently reported from various parts of the world. The numbers of described species to date (March, 2004) are summarized in Table 4-1. Thirty-three species (13.30 % of the world fauna) in 9 genera and 4 subfamilies of cunaxid mites were found in this study. Of these, 16 species are recorded for the first time in Thailand.

Armascirus taurus (Kramer), *Cunaxa capreolus* (Berlese), *Cunaxa setirostris* (Herman), *Cunaxa rackae* Smiley, and *Cunaxa thailandicus* Smiley were previously reported from Thailand (Boonkong *et al.*, 1986; Smiley, 1992). Three of them, *C. capreolus*, *C. setirostris*, and *A. taurus*, were found in this study and their existences in Thailand were confirmed. *C. capreolus* is not treated here because its locality is beyond the scope of this study. *C. rackae* and *C. thailandicus* were not found in this study. However, their existences should be confirmed because their description were based on specimens associated with agricultural products of Thailand that were exported to the United State of America. As Swift (1996) noticed, the study of mites and their distributions depended on the presence of acarologists in some parts of the world. Many more species are waiting to be discovered. More study and research are needed.

5.2 Morphology and Taxonomy

The family Cunaxidae and its closely related family, Bdellidae, are placed under superfamily Bdelloidea on the basis of gnathosomal morphology which is snout-like, the chelicerae are separated and hinged at base, two pairs of sensillae are on dorsal propodosoma.

The Cunaxidae are distinguished from Bdellidae by the presence of two pairs of genital papillae, leg with claw-like empodium, palp terminating with a claw except for the genus *Parabonzia*. The trichobothrium is presented only on tibia IV, not on tarsi III and IV, and tibiae I and IV. The genus *Parabonzia*, not found in this study, is

considered as a most primitive group of Cunaxidae (Smiley, 1992) because a number of characters found in Bdellidae are found in this genus.

In prostigmata, the primitive set of 6 pairs of cupules which is homologous with lyrifissures of Mesostigmata, Opilioacarida, Holothyrida is found on idiosomal integument. It is maintained in Terpnacaridae and some Micropsammidae (Kethley, 1990), but cunaxids generally have only 2 pairs (*ip* and *ih*) except for the genus *Parabonzia* processing 4 pairs (*ia*, *im*, *ip*, and *ih*) (Den Heryer, 1975) as in Bdellidae.

The palp of cunaxids may either be three (Cunaxoidiinae), four (Sirulinae), or five segments (such as Cunaxiinae, Coleoscirinae, Bonziinae). These numbers of palp segments and its setal type, number of dorsal setae, types of setae hg_1, types of pretarsi, and types of solenidia on basal part of tarsi I are used in characterization of cunaxid genera and subfamilies.

The geniculated setae hg_1 on ventral hypostome characterized subfamily Bonziinae comprising three genera: *Parabonzia*, *Bonzia*, and *Neoscirula* (Smiley, 1992). Only one genus *Neoscirula* with two species was found in this study. It differs from two other genera in having a spinelike seta, not multi-branch seta, on palp telofemur. A comparison of main characters between two species of *Neoscirula* are given in Table 4-2.

Subfamily Coleoscirinae consists of the genera *Coleoscirus*, *Pseudobonzia,* and *Scutascirus*. The characters shared by these genera are as follows: five segments palpi, distal apex of palp tibiotarsus with a long seta, simple setae hg_1, and the present of setae f_2.

The genus *Coleoscirus* are characterized by having a dorsal plate extending from propodosoma into hysterosomal region, Left and right coxae I-II are fused as a sternal plate, and without subtriangular shield adjacent to genital shields. Four species of this genus were found. Comparisons between their characters are given in Table 4-4.

The genus *Pseudobonzia* differs from other two genera of Coleoscirinae in that dorsal shield are confined to propodosomal region and a sternal plate is absent. Four species of this genus were found in this study. In addition to key to species of the genus, the comparison of characters between them are given in Table 4-5.

The genus *Scutascirus* is easily distinguished from other the genera of the family by processing a pair of subtriangular shields adjacent to genital shields. Not like other cunaxids, the cuples *ip* of *Scutascirus* are slit like on the main dorsal shield. Only one species was discovered in this study.

The subfamily Cunaxiinae also have five-segmented palp. But its chaetotaxy differs considerably from other five-segmented palp cunaxids. The Cunaxiinae consists of three genera, *Armascirus, Cunaxa,* and *Dactyloscirus*. Their palpi are elongate; each segment usually bears spinelike setae and/or apophyses.

The genus *Armascirus* are closely similar to *Dactyloscirus* in having a long apophysis on apical part of palp genu. However, the elongate-based solenidion on basal part of tarsi I can be found only in the genus *Dactyloscirus* and, in my opinion, this character, although minute, is useful for separating it from *Armascirus*, which possess a simple solenidion. Two species of each genus were found in this study. The comparisons of characters between members of *Armascirus* and *Dactyloscirus* are presented in Table 4-6. and Table 4-8, respectively.

In the genus *Cunaxa,* not like *Armascirus* and *Dactyloscirus,* the apophysis on apical part of palp genu is absent. It also has a relative slender and attenuate tarsus. Nine species of *Cunaxa* were found in this study. A comparison of their main characters is given in Table 4-7

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The cunaxids with three-segmented palp were placed under the subfamily Cunaxoidinae viz, *Cunaxoides*, *Neocunaxoides*, and *Pulaeus*. The genus Cunaxoides was not found in this study. Many species were reported from palaearctic and ethiopian regions, except for one species from oriental region (India) (Smiley, 1992). *Neocunaxoides* can be easily distinguished from *Pulaeus* by the absence of setae f_2, while this setae is present in *Pulaeus*. However, Inayatullah and Shahid (1989)

described two new species of *Neocunaxoides* from Pakistan, but were not presented in Smiley (1992)'s publication. Their figures clearly show the presence of setae f_2. These two species, based on Smiley (1992), should be transferred to the genus *Pulaeus*. Four species of *Neocunaxoides* and 5 species of *Pulaeus* were recognized in this study. The comparisons of characters of both genera are presented in Table 4-9 and Table 4-10, respectively.

5.3 Biology

Members of family Cunaxidae are all predators, feeding on smaller microarthropods, and nematodes (Den Heyer, 1981; Walter and Kaplan, 1991; Smiley, 1992). However, their knowledge on biology is very limited. In this study, *Cunaxa vizcayana* was observed that it fed on a tarsonemid mites on pomello leave. *Coleoscirus simplex* and probably other cunaxids usually attack mobile preys such as living nematodes and other mites. They ignored eggs of nematodes and microarthropods. Mites of Subfamily Cunaxiinae did not fed on nematodes, but they usually attack arthropod preys (Walter and Kaplan, 1991).

Walter and Kaplan (1991) found that *Coleoscirus simplex* is cruise predator that locates prey by searching preys constantly while cunaxine mites (*Armascirus, Cunaxa,* and *Dactyloscirus*) are ambush predators waiting for a long time to catch the approached preys. This behavior was also observed in *Cunaxa vizcayana.*

In this study, guarding pharate tritronymph female by male of *Cunaxa vizcayana* was observed. Walter and Kaplan (1991) also reported this behavior in other species of cunaxid mites namely *Coleoscirus simplex* and *Dactyloscirus innermis*. However, their mating was not been observed, but probably occurred by direct insemination since spermatophores were not observed and male had an aedeagus. (Walter and Kaplan, 1991; Evans, 1992). Precopulation can also be found in Tarsonemina, Cheyletidae, Tydeidae (Evans, 1992).

5.4 Ecology

Cunaxid mites live in soil and decomposing plant materials, on tree trunk, in canopy level, and store products. This study suggested that members of the genera *Neoscirula*, *Coleoscirula*, *Pseudobonzia*, *Scutascirus*, *Neocunaxoides*, *Pulaeus*, and

Dactyloscirus are soil-litter inhabiting. None of them were collected from canopy level. *Armascirus* and *Cunaxa* can be found on ground level and canopy levels (Table 4-11). However, more studies are needed to confirm their ranges of habitats.

The high number of individuals and species of mites in soil-litter may be explained by the complexity of this habitat, which provides a variety of niches to be used by cunaxid mites (Walter and Procter, 1999)

CHAPTER 6

CONCLUSION AND RECOMMENDATIONS

6.1 Conclusion

Taxonomy of the predatory mite family Cunaxidae of Thailand was studied for the first time, especially in the central region of Thailand. Thirty-three species were recognized in 9 genera and 4 subfamilies:

Subfamily Bonziinae:	1 genus,	2 species.
Subfamily Coleoscirinae:	3 genera,	9 species.
Subfamily Cunaxiinae:	3 genera,	13 species.
Subfamily Cunaxoidinae:	2 genera,	9 species

Of these, 16 species were first records for Thailand and 15 unidentified species were recognized. All of them were described and illustrated.

Classification and identification are based on female characters which are (1) types of setae on ventral hypostome, (2) numbers of palp segments and their chaetotaxy, (3) shape of tarsi, (4) number of dorsal setae, (5) numbers and details of idiosomal shields, (6) types and length of various dorsal setae, and (7) chaetotaxy of legs.

The most number of cunaxid species were found in soil-litter habitats.

6.2 Recommendations

(1) Male and nymphal stages of each species should be studied and incorporated with female characters.

(2) More sampling should be done in other parts of Thailand.

(3) Since the large numbers of cunaxid species occur in soil-litters, their roles in this habitat should be investigated, especially their influence on pests living in soil such as nematodes.

(4) More investigation should be done on cunaxids associated with mite pests of economic plants. The results obtained will be of great benefit for consideration and development of their potential in regulating mite pest populations.

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Publications

Fuangarworn, M., Lekprayoon, C. and Pradatsundarasa, A. 2002. Short-term effects of atrazine herbicide on soil oribatid mites in an mango orchard. Natural History Journal of Chulalongkorn University 2(2): 1-5.