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REVIEW OF THE FAMILY TARSONEMIDAE IN COSTA RICA

(ACARI: Heterostigmata)

Tesis sometida a la consideración del Comité Técnico Académico del Programa de Estudios de Posgrado en Ciencias Agrícolas y Recursos Naturales del Centro Agronómico Tropical de Investigación y Enseñanza, para optar al grado de:

MAGISTER SCIENTIAE

por

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DEDICATORY

To Cristina, my wife

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Biografía

El autor nació en la ciudad de San José, Costa Rica el 5 de marzo de 1959. Realizó sus estudios primarios y secundarios en el Colegio Calasanz, San Pedro, Costa Rica.

En 1977 inició sus estudios universitarios en la Facultad de Agronomía, Universidad de Costa Rica, donde obtuvo el grado de Bachiller en Ingeniería Agronómica en 1982 y Licenciado en Ingeniería Agronómica con énfasis en Fitotecnia en 1985, con Mención Honorífica por su trabajo de tesis.

De 1979 a 1983 laboró como Asistente del Curso de Entomología y del Museo de Entomología de la Facultad de Agronomía, Universidad de Costa Rica. De 1984 a 1986 como Asistente del Laboratorio de Acarología de la Facultad de Agronomía, Universidad de Costa Rica. De 1986 a 1987 laboró en el Departamento de Entomología, Dirección de Investigaciones, Ministerio de Agricultura y Ganadería, Costa Rica. De 1986 a 1989 ha laborado como profesor invitado de los cursos M-241 Métodos de Diagnóstico, Proyecto Manejo Integrado de Plagas/CATIE y AF-4403 Acarología, Universidad de Costa Rica.

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REVIEW OF THE FAMILY TARSONEMIDAE IN COSTA RICA

(ACARI: Heterostigmata)

ABSTRACT - New species, new genera and a new subgenus of the Family Tarsonemidae are described and illustrated: Daidalotarsonemus limonensis spec. nov., Daidalotarsoenemus ternifoliae spec. nov., Dendroptus irregularis spec. nov., Floridotarsonemus edule spec. nov., Neodendroptus genus nov., Neodendroptus perseae spec. nov., Spinatarsonemus genus nov., Spinatarsonemus alajuelensis spec. nov., Spinatarsonemus costarricensis spec. nov., Spinatarsonemus parsoni spec. nov., Tarsonemella (Paratarsonemella) ramirezi subgenus nov. spec. nov., Tarsonemus solengrandis spec. nov., Tarsonemus pseudokennedyi spec. nov., Steneotarsonemus comosus spec. nov., Steneotarsonemus kruseae spec. nov., Xenotarsonemus gordoni spec. nov., Xenotarsonemus camarae spec. nov. and Xenotarsonemus vargasi spec. nov. Notes on field characteristics, host symptomatology and relationships with other pathogens are mentioned. A key to the genera of Tarsonemidae found in Costa Rica is presented.

INTRODUCTION

Since 1970, the study of phytoparasitic mites in Costa Rica has increased due to growing recognition of their economic importance in agriculture, forestry, fruit production, ornamental and medicinal crops, weeds and stored grains and also the scarcity of information about them (Ochoa 1985).

Although, in some cases, the damage to plants caused by mites is less than that caused by insects, mite relative importance is increasing due to the following factors:

- lack of knowledge of the behavior, population dynamics, reproduction, development, morphology and taxonomy of the majority of phytoparasitic mites;

- the use of broad spectrum pesticides which eliminate predator insects and mites or induce the development of phytoparasitic mite resistence to pesticides;

- the use of specific mitecides which are not suitable for the species involved or are not used correctly;

- fertilization practices which increase production costs and necessitate greater control of potential pests whose development is favored by the increased food supply;

- the lack of quarantine procedures to avoid the spread of pests;

- the increasing diversity of crops, providing a range of hosts which allow favorable conditions for mite establishment;

- increased monoculture over large areas and/or planting without rotation, which provide conditions favorable for the development and extensive spread of phytoparasitic mites by assuring a food supply throughout the year (Freitez 1974; Ochoa and von Lindeman 1988).

The majority of these mites are found in the following families: Acaridae, Eriophyidae, Glycyphagidae, Nalepellidae, Rhyncaphytoptidae, Tarsonemidae, Tenuipalpidae, Tetranychidae and Tuckerellidae (Jeppson et

al 1975; Flechtmann 1977).

Most of the information available on mites in Costa Rica is related to red spider mites (Tetranychidae) and flat mites (Tenuipalpidae) (Freitez 1974, Ochoa 1985). Little is known about other families. Populations of Tarsonemidae have been found increasing frequently in agricultural fields in Costa Rica and, recently, also in Panama and El Salvador, causing severe yield losses in tomato (Lycopersicon esculentum L.), sweet pepper (Capsicum annuum L.) and strawberry (Fragaria sp.) (Calvo 1981; Gordon et al 1985; Ochoa and von Lindeman 1988; Ochoa & Aguilar 1989; Reyes et al 1989).

The Tarsonemidae include phytophagous, fungivorous and insectivorous mites, grouped into 31 genera (Lindquist 1986b). The family is originally tropical and subtropical (Beer 1954), characterized by very small size, rapid movement and migratory habits, making field recognition difficult. World wide, information on biology and control has increased but is practically nonexistent in Central America.

The Tarsonemidae of phytoparasitic importance feed on leaves, flowers, fruits and soft stems. Some transmit diseases. Typical symptoms include: chlorosis, malformed leaves, small leprosis, russeting and poor fruit development, dwarfism of the plant and, in the worst cases, die-back (Beer 1954; Flechtmann 1977; Lindquist 1986b). They have also been linked with diseases, insects and other mites, increasing the severity of the damage. Many of the symptoms are commonly confused with fungal and viral diseases making correct diagnosis difficult.

The plant damage they cause, aggressiveness and rapid development of these mites, make them ideal candidates for this study. The specific objectives of this work are to determine the species of Tarsonemidae of agricultural importance in Costa Rica, to compile information useful in their identification and to provide a list of host plants

and the symptoms they present. The overall objective is to develop a better recognition and understanding of these organisms to allow possible control or prevention of their damage.

LITERATURE REVIEW

Contributions on the taxonomic grouping and knowledge of the family Tarsonemidae Canestrini & Fanzago, have been made by Baker and Wharton (1952), Beer (1954, 1958, 1960), DeLeon (1956a, 1956b, 1962, 1966), Lindquist (1964, 1969b, 1969c, 1970, 1972, 1973, 1978, 1985a, 1985b, 1986b), Smiley (1964, 1967, 1969, 1972), Beer and Nucifora (1965), Flechtmann (1967, 1976), Attiah (1970), Mahunka (1972, 1974, 1981), Delfinado (1976, 1978), Livshits *et al* (1979), Emmanouel (1981), Goff (1986) and Yang *et al* (1987).

The family Tarsonemidae was proposed by Canestrini & Fanzago and Kramer, almost at the same time in 1877, but the classification is attributed to Canestrini & Fanzago (Lindquist 1985a, 1986b).

Both Beer (1954) and Lindquist (1986b) cite Ewing (1924, 1939), Oudemans (1931) and Vitzhum (1931, 1940-1943) among the first workers in classifying the family.

Baker and Wharton (1952) recognized five genera within the family: *Avrosia*, *Hemitarsonemus*, *Pseudotarsonemoides*, *Tarsonemella* and *Tarsonemus*.

Beer (1954) presented a review of the family citing five genera: *Hemitarsonemus*, *Rhynchotarsonemus*, *Steneotarsonemus*, *Tarsonemus* and *Xenotarsonemus*.

Later, Beer and Nucifora (1965) recognized 18 genera for the family: *Acarapis*, *Ceratotarsonemus*, *Chaetotarsonemus*, *Daidalotarsonemus*, *Fungitarsonemus*,

Hemitarsonemus, Lupotarsonemus, Moseria, Nasutitarsonemus, Parasteneotarsonemus, Rhynchotarsonemus, Steneotarsonemus, Tarsonemella, Tarsonemus, Ununguitarsonemus and Xenotarsonemus.

Lindquist (1986b) presented the most recent revision of the family, including detailed aspects of morphology, phylogenetics and systematics, with a total of 31 genera: Acarapis, Acaronemus, Amcortarsonemus, Asiocortarsonemus, Ceratotarsonemus, Coreitarsonemus, Daidalotarsonemus, Deleonia, Dendroptus, Eotarsonemus, Fungitarsonemus, Hemitarsonemus, Heterotarsonemus, Iponemus, Nasutitarsonemus, Neotarsonemoides, Ogmotarsonemus, Phytonemus, Polyphagotarsonemus, Pseudacarapis, Pseudotarsonemus, Pseudotarsonemoides, Rhynchotarsonemus, Steneotarsonemus, Suctarsonemus, Suskia, Tarsanonychus, Tarsonemella, Tarsonemus, Ununguitarsonemus and Xenotarsonemus.

The biology, ecology and control of many species within the Tarsonemidae have been studied by Smith & Goldsmith (1936), Huffaker & Kennett (1956), Cermeli (1961), Cabrera (1978), Mariconi et al (1978), Lo & Ho (1979), Calvo (1981), Hugon (1982, 1983), Oliveira & Dojas (1982) and Mingguang et al (1984).

Hambleton (1938), Gutierrez (1967), Alford (1972), Oliveira & Calcagnolo (1974), Denmark (1977, 1980, 1988), Freitez (1979), Aubert et al (1981), Barbosa & Castro (1981), Denmark & Nickerson (1981), Rao & Prakash (1984),

Gordon et al (1985) and Oliveira & Donadio (1985) have studied damage caused by this group of mites in Fragaria sp., Cocos nucifera L., Carica papaya L., Saintpaulia sp., Pittosporum sp., Lycopersicon esculentum Mill., Capsicum annuum L., Oryza sativa L., Gossypium spp., Psidium sp., Citrus spp. and other plants.

In Costa Rica, a variety of Tarsonemidae damage meriting study has been found in Fragaria sp., Lycopersicon esculentum Mill., Persea americana Mill., Capsicum annuum L., Glycine sp., Carica papaya L. and ornamentals. Gordon et al (1985), Ochoa & von Lindemann (1988) in Panama and Reyes et al (1989) in El Salvador have found Polyphagotarsonemus latus (Banks) causing severe damage to Lycopersicon esculentum, Capsicum annuum and Solanum melongena L.

Beer (1954) considers that the first reports of damage to agricultural crops were presented by Bancroften in 1877 and Targioni-Tozetta in 1878 in Australia and Italy respectively. Later, a variety of damage caused by mites of the Tarsonemidae family was found on the American continent. The first reports were probably made in the United States in 1883 and Brazil in 1928 (Smith & Goldsmith 1936; Oliveira & Donadio 1985).

There are currently a number of tarsonemids of economic importance. Some are insect parasites (Lindquist 1964, 1968, 1969a, 1969b, 1969c; Smiley & Moser 1974), predators of mite eggs (Smiley & Landwehr 1976; Lindquist & Smiley

1978), fungal consumers (Beer 1954; Lindquist 1986b) and parasites of animals, including man (Beer 1954).

Mites of the genus Iponemus are predators on eggs of Scolytidae (Ips sp.) and live as commensals in the galleries opened by these wood borers (Lindquist 1969b). The adult mites are phoretic and thus easily transported from gallery to gallery (Beer 1954; Lindquist 1964, 1969a, 1969b). Other tarsonemids are associated with bees (Delfinado-Baker & Baker 1982; Calvo & Vargas 1987). The majority of species in the genus Tarsonemus feed on fungi and algae (Beer 1954; Beer & Nucifora 1965; Lindquist 1986b), some of them have sporothecae (Moser 1985).

Among the species of agricultural importance are: Hemitarsonemus tepidariorum Warburton, Polyphagotarsonemus latus (Banks), Phytonemus pallidus (Banks), Steneotarsonemus ananas (Tryon), S. bancrofti (Michael), S. spirifex (Marchal), S. laticeps (Halbert), S. phyllophorus (Ewing), S. culmicolus (Reuter), S. canestrinii (Massalongo), S. madecassus Gutierrez, S. hatzinikolisi Emmanouel, S. spinki Smiley, S. furcatus DeLeon, S. konoi Smiley & Emmanouel, Suskia novaezelandiae Lindquist, Tarsonemus waitei Banks, T. randsi Ewing, T. myceliophagus (Hussey), T. granarius Lindquist, T. fusarii Cooreman and T. confusus Ewing (Beer 1954; Beer & Nucifora 1965; Lindquist 1986b).

Flechtmann (1977), Jeppson et al (1975), Krantz (1978), Lindquist (1986b), Doreste (1988) and others, consider species of Hemitarsonemus, Phytonemus, Polyphagotarsonemus

and Steneotarsonemus as the most agriculturally important, because of their cosmopolitan characteristics and numerous hosts.

Lindquist (1986b) noted the error of referring for more than 30 years to Phytonemus pallidus (Banks) (previously Tarsonemus pallidus Banks) as Steneotarsonemus. The genus Steneotarsonemus is associated with monocot plants (Amaryllidaceae, Marantaceae, Palmaceae, Bromeliaceae, Gramineae), whilst Phytonemus is associated with dicots (Lo & Ho 1979; Smiley & Emmanouel 1980; Lindquist 1986b). Polyphagotarsonemus has a wide range of hosts with an apparent preference for Solanaceae. While Tarsonemus can cause direct damage to certain plants, like Fungitarsonemus, it is also associated with fungi, both as a source of food and as a means for spreading it (Beer 1954; Mingguang et al 1984; Rao & Prakash 1984; Lindquist 1986b).

Steneotarsonemus furcatus DeLeon is mentioned in Venezuela as causing damage to Cocos nucifera L. resembling a white to yellow peeling, with longitudinal and transverse cracking in the form of fine necrotic bands. The mite initiates attack on the epidermis between the flower petals and carpels, where it establishes colonies (Freitez 1979).

In Oryza, Steneotarsus madecassus Gutierrez produces panicle deformation. Tarsonemus talpae Schaarschmidt and S. oryzae (Targioni & Tozzetti) cause rice sheath brown syndrome (Gutierrez 1967, Mingguang et al 1984).

Polyphagotarsonemus latus (Banks) and Phytonemus

pallidus (Banks) deform young shoots and leaf primordia in many plants. This leads to retarded growth and, in severe cases, dwarfism; both mites can deform the fruits of their hosts (Gellatley 1938; Hambleton 1938; Huffaker & Kennett 1956; Denmark 1977, 1980, 1988; Hugon 1982, 1983; Gordon et al 1985; Ochoa & von Lindeman 1988).

Baker & Warton (1952), Beer (1954), Hilop & Jeppson (1976) and Lindquist (1986b) discussed the mouthparts of the family. In these studies there are differences of opinion for the shape and size of the palps, chelicerae and sclerotized parts of the gnathosoma, depending on the genera observed and the interpretation of the author.

In Phytonemus pallidus (Banks) the gnathosoma shows a reduction in its structures. The oral apparatus is contained in the capitulum, the rostrum is tubiform and contains the palps, chelicerae and related structures (Hilop & Jeppson 1976). The palps are reduced, and Lindquist (1986b) points out that it is unknown whether they consist of two or three segments. The chelicerae are tiny and needle shaped (Hilop & Jeppson 1976). It is thought that in the case of P. pallidus, feeding is restricted to new growth since the short chelicerae are incapable of penetrating the epidermis of developed leaves (Hilop & Jeppson 1976).

The feeding mechanism used by the Tarsonemidae is important in understanding the different symptoms, but has not been determined (Hilop & Jeppson 1976, Lindquist 1986b).

BIOLOGY

P. pallidus (Banks) and Polyphagotarsonemus latus (Banks) pass through four different stages in their development from egg to adult (Flechtmann 1977). These mites are found in young, still folded leaves and along the central veins, damaging the leaf, primordia or corona before it is formed (Alford 1972; Flechtmann 1977; Ochoa & von Lindeman 1988).

The eggs are translucent and comparatively large, sometimes appearing as a white mass along the length of the central vein of the leaf. The surface can be smooth as in P. pallidus or dotted with blisters or pits as in P. latus (Hambleton 1938; Flechtmann 1977; Hugon 1983). The size varies between 80 and 120 um and length of incubation at 27°C varies from hours to 3 days (Hambleton 1938; Hugon 1983)

Under favorable conditions the female lays between 30 and 90 eggs from which mainly females emerge (Hambleton 1938; Hugon 1982; Reyes et al 1989). When the eggs are produced parthenogenetically, the majority are males. (Beer 1954).

The larva has 6 legs, ranging in length from 140 to 270 um, varies in color from translucent white to opaque white, is robust and very active (Hugon 1983).

The nymph is inactive and is referred to by many terms, some inaccurate such as "inactive larva", "pupa" or "chrysallis" (Hugon 1983; Lindquist 1986b). It is generally

pointed and measures between 160 and 270 um. The inactive nymph, which will moult to produce a female, is transported by the male, and copulation takes place upon ecdysis.

The females reproduce sexually and by parthenogenesis so that the male:female ratio varies depending on environmental factors (Beer 1954; Alford 1972; Hugon 1983; Lindquist 1986b). These factors also affect the populations and crop damage by P. latus and Phytonemus pallidus (Hambleton 1938; Alford 1972; Reyes et al 1989).

The male and female are translucent white to pale pink. They are mobile, aggressive, dynamic and almost invisible to the naked eye. The length of the life cycle depends on relative humidity and temperature; for example, at 14°C, 24°C and 30°C the life cycle is 18.3, 8.5 and 4 days, respectively (Hugon 1983).

MATERIALS AND METHODS

The materials analysed consisted of samples of mite-infested leaves, stems and fruits collected in various localities of Costa Rica. Processing of the samples and identification of the mites in the Tarsonemidae family was carried out in the Laboratory, CATIE, Turrialba. Identification of the first specimens and those considered doubtful were carried out through consultation with Mr. Robert L. Smiley of the Systematic Entomology Laboratory, USDA, ARS, Beltsville, Maryland, USA.

COLLECTION METHODS

Plastic pots: Two types of plastic pot were used for the majority of collections of affected leaves, stems or fruits. The first type were white, rigid plastic pots, with a truncated cone shape section and a convex base. The upper and lower diameters were 11 and 8.5 cm, respectively, the height 6.5 cm, and the capacity 400 ml. The tops of the pots were soft, semi-transparent or white plastic, allowing a hermetic seal under pressure. Collection data were noted on the tops in the field.

The second type of pot used was made of red, hard plastic, with a circular section and flat bottom, 6 cm in diameter, 6.6 cm high and 200 ml in volume. The tops were hard white plastic screw type, allowing a semi-hermetic seal. Collection data were noted on the tops in the field. Samples collected in the field were kept in these pots for transport to the laboratory and the presence of mites was confirmed with the aid of a 10-16x magnification hand lens.

In most cases the samples were processed within 72 hours of collection. When this was not possible, the samples were refrigerated at 4-8°C to keep them fresh and reduce the activity of the mites. Mites kept in this way remained alive for up to a week. In both cases it was possible to observe their behavior (colony organization and habits), major morphological characteristics (color, eggs), the action of predatory mites and insects, damage and symptoms in leaves, stems and fruits.

Plastic bags: Samples were also collected in medium sized (35 x 21 cm) polythene bags. Leaves and stems with mites were placed in the bags and these were inflated with air and tied at the ends with a wire tie attached to a cardboard label bearing data for sample's identification. Samples collected in this way were processed within 72 hours or kept refrigerated for up to a week.

PROCESSING OF COLLECTED MATERIAL

Removal of mites was carried out under a stereo-microscope using direct light. Mites were removed from the leaves, stems or fruits with the aid of a fine needle consisting of a metal handle with a hog's hair attached to the end. The hair was previously dampened with Hoyer's solution. Observations considered necessary or appropriate were carried out during removal.

Permanent mounting of mites: All microscope preparations were mounted in Hoyer's solution. This is made up from the following:

Distilled water.....50 g

Clean crystals of arabic gum.....30 g

Chloral hydrate.....200 g

Glycerine.....20 g

The ingredients were mixed in the sequence indicated at room temperature, making sure that each dry ingredient was thoroughly mixed before adding the next (Freitez 1974).

For the mounts, a drop of solution was placed in the center of a clean 3"x1" (0.96-1.06 mm thick) slide. The specimens were taken directly from the leaves, stems and fruits, avoiding bubbles, dust particles or debris which would impair the mount and subsequent study.

Once the mites (adults, nymphs or larvae) were placed in the required dorsal or ventral position, forceps were used to place a clean circular cover slip (Nº1, 17 mm diameter) on top, using a prepared outline diagram as a template guide.

Freshly prepared mounts were preheated nearly to the boiling point using a 90% alcohol lamp. This was done to eliminate any remaining bubbles and allow preclarification of the mounted specimen for preliminary microscopic examination. As a final step, the extremities were extended and the mites were fixed.

Prepared slides were put into a fixed temperature 50ºC

incubator for a minimum of three days to complete clarification of the specimens and drying of the solution.

The slides were subsequently sealed with GLYCEL, applied along the edges of the cover slip with a Nº2 brush. A revolving table was used to ensure an even seal and thus avoid rehydration of the hygroscopic Hoyer's solution. This solution can absorb water to such an extent that the cover slip is lifted off, damaging the mount. The slide was subsequently labelled on each side of the specimen; the left hand label providing details of the host, collection site, collection date, collector and an identifying code; the right hand label detailing family, genus, species and authority.

IDENTIFICATION

A 1500x binocular contrast fase microscope with built-in Koehler type illumination was used to study the morphological and taxonomic features of permanent mounts of the species mentioned in this work. On the basis of this, a detailed study of each species found was carried out.

Once preliminary identification had been completed, representative slides of doubtful species were examined with a specialist for identification.

PRESERVATION OF UNMOUNTED MITES

When large numbers of mites were found, they were preserved in 70% ethyl alcohol in 45 x 15mm glass, screw top

jars. The collection code was noted on the top.

REFERENCE COLLECTION

For each host plant, representative slides of the species collected were selected and registered in the laboratories of the Integrated Pest Management Project (CATIE) and Acarologia, Escuela de Fitotecnica, University of Costa Rica. The remaining slides were retained for teaching purposes and for exchange of material.

COLLECTION AND COLLECTORS

Samples were obtained from every province in Costa Rica, for an initial estimate of distribution.

Each collection was assigned a code, that indicates host, locality/province, date, collector and collection key.

The collection key consisted of the capital letters, CR- (Costa Rica), followed by the initials of reviewer, also in capital letters; the number of slide were represented by 001...999; and the last number indicated provinces as follows: 1. San Jose; 2. Alajuela; 3. Heredia; 4. Limon; 5. Cartago; 6. Puntarenas; 7. Guanacaste; resulting in codes such as: /CR-R0011/,.../CR-R0026/, /CR-IS0127/.

The collectors were identified by their full name.

TERMINOLOGY

Terminology used herein for the idiosoma is that of Smiley & Emmanouel 1980 and that of Lindquist 1986b. Leg chaetotaxy used is that of Suski 1968 and inpart Lindquist (1986b). All measurements are given in microns.

Drawings were made by the author freehand, using a *camera lucida* and fluorescent projector.

DESCRIPTIONS

Family TARSONEMIDAE Canestrini & Fanzago

Tarsonemidae Canestrini & Fanzago, 1877.
Tarsonemidae Kramer, 1877.

Classification:

Phylum:	Arthropoda von Siebold & Stannius, 1845.
Subphylum:	Chelicerata Heymons, 1901.
Class:	Arachnida Lamarck, 1802.
Subclass:	Acari Leach, 1817.
Order:	Acariformes Zakhatkin, 1952.
Suborder:	Heterostigmata Berlese, 1899.
Superfamily:	Tarsonemoidea Canestrini & Fanzago, 1887.
Family:	Tarsonemidae Canestrini & Fanzago, 1887.

The Tarsonemidae are very small, ranging in size between 100 and 300 (Beer 1954; Flechtmann 1977; Doreste 1988). They are characterized by the development of apodemes on the ventral side of the body. The integument is relatively hard in mature specimens and has a shiny surface (Beer 1954). The body is divided into three well defined parts: the gnathosoma, propodosoma and hysterosoma (Beer 1954; Flechtmann 1977). In some species, the dorsal surface of the propodosoma projects anteriorly forming a rostral shield. This shield is sometimes separated from the dorsal surface of the propodosoma by a suture (Beer 1954). The propodosoma is separated from the hysterosoma by the principal suture of the body which runs between the front and hind legs. The mouthparts consist of strong palps with

indistinct segmentation inserted into the apex of the gnathosoma and thin, stylet-like paired chelicerae, inserted into the central part of the base of the palps (Beer 1954; Krantz 1978; Lindquist 1986b). Beer (1954) considers that the tubular, paired structures situated centrally and internally in the gnathosoma are cheliceral sheaths.

The females are characterized by the posession of capitate form organs (bothridial setae) found dorsolaterally between coxae I and II (Beer 1954; Flechtmann 1975; Lindquist 1986b; Doreste 1988). Beer (1954) categorizes these structures as sensory organs, since they appear to have no connexion with the tracheal system. Females have 6 dorsocentral pairs of setae. The tarsonemids show pronounced sexual dimorphism. Males are smaller than females and the body outline is markedly different (Beer 1954; Flechtmann 1977). Males have a blunter posterior section and are equipped with a single structure called the genital capsule (Lindquist 1986b).

Classifications of the tarsonemids have mainly been based on the fourth pair of legs in the males, although classification has been presented based on females (Delfinado 1976, 1978). In some studies, several authors have based their classifications on the male or female, so that when both sexes are compared, confusion arises regarding the correct genus. In females, the fourth pair of legs end in a pair of flagelliform setae, generally without specific characteristics (Baker & Wharton 1952; Beer 1954).

Key to genera of Tarsonemidae in Costa Rica

1. Female and male with 3 or 4 pairs of metapodosomal coxal setae 2
   Female and male with 2 pairs of metaposomomal coxal setae 3

2. Female with idiosoma elongate and stout; legs short and robust .....Tarsonemella
   Female with idiosoma oval; legs long and slender; leg I with strong empodial claw. Male with button-like claw on tarsus IV .....Polyphagotarsonemus

3. Female and male with cheliceral stylets greater than 1/2 the length of the gnathosoma; female without bothridial setae .....Acarapis
   Female and male with cheliceral stylets less than 1/2 the length of the gnathosomashort; female with bothridial setae 4

4. Female and male with some dorso-idiosomal setae modified; tarsus II with 4 setae and 1 solenidion ....Daidalotarsonemus
   Female and male with dorso-idiosomal setae smooth, finely pilose or serrate 5

5. Female with ventrocaudal lobe long, slender and triangular .....Xenotarsonemus
   Female with ventrocaudal lobe wider than long, rounded distally 6

6. Female and male with 3 setae on femur I .....Dendroptus
   Female and male with 4 setae on femur I 7

7. Female and male with idiosoma elongate or oval-elongate .....Steneotarsonemus
   Female and male with idiosoma oval or pyriform 8

8. Males with flanges on leg IV 9
   Males without flanges on leg IV 12

9. Male with small triangular or flattened flange on femorogenu IV 11
   Male with prominient flange on femorogenu IV 10

10. Male with rounded flange on leg IV .....Phytonemus
    Male with nipplelike flange on leg IV ....Neodendroptus genus nov.

11. Male with bladelike claw on leg IV .....
.....Floridotarsonemus
Male with normal curved claw on leg IV.....
.....Spinatarsonemus genus nov.

12. Female with setae Sc_2 displaced anteriorly bothridial setae .....Fungitarsonemus
Female with setae Sc_2 after bothridial setae.....
.....Tarsonemus

Key to species of Tarsonemus in Costa Rica

1. Male with leg IV longer than leg III 2
Male with leg IV shorter or same long as leg III 4

2. Male with apodeme IV uniting with posteriomedian apodeme .....Tarsonemus randsi Ewing
Male with apodeme IV not uniting with posteriomedian apodeme 3

3. Male with anteromedian apodeme uniting with transverse apodeme .....Tarsonemus waitei Banks
Male with anteromedian apodeme not uniting with transverse apodeme .....Tarsonemus bakeri Ewing

4. Male with solenidion on tarsus I and II about same size .....Tarsonemus scaurus Ewing
Male with solenidion on tarsus I and II not equal in size 5

5. Male with small spinelike modified setae on femorogenu IV .....Tarsonemus pseudokennedyi spec. nov.
Male without spinelike modified setae on femorogenu IV 6

6. Male with tactile setae on tibia IV longer than leg IV .....Tarsonemus simplex Ewing
Male with tactile setae on tibia IV shorter than leg IV 7

7. Male with tibiotarsus on leg IV 8
Male with tibia and tarsus on leg IV.....
.....Tarsonemus fusarii Cooreman

8. Male with solenidion on tarsus II long and wide .....
.....Tarsonemus solengrandis spec. nov.
Male with solenidion on tarsus II stout 9

9. Male with femur IV angulate at the base.....10
Male with femur IV not angulate at the base .....
.....*Tarsonemus floridanus* (Attiah)

10. Male with leg IV of medium size, and with short claw ...
.....*Tarsonemus inornatus* (Attiah)
Male with leg IV small, and with small curved claw ....
.....*Tarsonemus minutus* (Attiah)

Genus Acarapis Hirst

Acarapis Hirst, 1921: 378; Lindquist, 1986b: 257.

This genus is distinguished by having stout and short legs, long cheliceral stylets, lacking bothridial setae, and parasitic feeding on insects (Delfinado-Baker & Baker 1982; Lindquist 1986b).

Acarapis woodi (Rennie)

Acarapis woodi (Rennie), Delfinado-Baker & Baker, 1982: 212.
Tarsonemus woodi Rennie, 1921: 769.

This species was found by Calvo & Vargas (1987), in the tracheal system of Apis mellifera L., in some apiaries of the area of Santa María de Dota.

HOST AND LOCALITY: Apis mellifera L., Santa María de Dota, San José (Calvo & Vargas, 1987).

Genus Daidalotarsonemus DeLeon

Daidalotarsonemus DeLeon, 1956b: 163.

Females of this genus are distinguished by their ovalated body. Idiosoma shield with varied shaped reticulation, setae in region of metapodosoma lanceolate and pilose, some globulate, as well as smooth and simple (DeLeon 1956b; Smiley 1972; Lindquist 1986b).

Daidalotarsonemus deleoni (Smiley)

Daidalotarsonemus deleoni (Smiley), Lindquist, 1986b: 320.
Hemitarsonemus deleoni Smiley, 1967: 133.

HOST AND LOCALITY: Cupressus sp., Guápiles, Limón (Coll. I. Obando, 1989).

REMARKS: This mite was found with spores of fungus adhered to its body.

Daidalotarsonemus limonensis spec. nov.

DIAGNOSIS: The female of D. limonensis spec. nov. is similar to female of D. jamesbakeri Smiley. It can be distinguished by the reticulations in the dorsal region being elongate on D. jamesbakeri and areolate in this species and the setae h is longer and pilose in this species, but smooth or simple in D. jamesbakeri.

MALE: Unknown.

FEMALE: (Figs. 2-4) Color ligth-black with some parts green, length 140.62, width 99.37. Gnathosoma, color translucent-white, length 22.5, width 20.62; with anterolateral and ventral setae simple. Palpi sligthly approximate, directed anteromedially. Cheliceral stylets short. Pharynx long, dense, with muscular-sclerotized walls.

Idiosoma, body oval. Propodosoma with dorsomedial and central reticulations very irregular. Hysterosoma dorsomedial and dorsocentral aereolate rugose, and dorsolateral smooth. Setae v_1 curved and moderately long, setae Sc_2 about same length as v_1 but thicker. Base of Sc_2 anterocentral to Sc_1. Bothridial setae global, finely pilose (11.84). Setae c_1 thicker than setae c_2, and 1/3 longer. Setae d and f same size. Setae e 1/2 as long as f; setae e about as long as setae h. Setae f (27.5), d (25), h

and e lanceolate and pilose. Apodeme I short, apodeme II strong and curved, not uniting with transverse apodeme. Apodeme III equal in length to apodeme II. Apodeme IV uniting with posteromedian apodeme. Setae 2a twice as long as 1a; 2a and 3b same size. Setae 3a 1/3 longer than 2a. Claws of legs I-III, strong curved.

Legs I and II subequal in length; leg III longer than legs I, II and IV. Ta v of tarsi I-III spinelike. Setation respectively on femur, genu, tibia and tarsus of leg I: 3-4-5(3)+7(1); leg II: 3-3-4-4(1); leg III: 1+3-4-4. Tibiotarsus I with tibial cluster of 3 sensilla. Leg IV slender, about as long as combined length of femorogenu and tibia III, not reaching to posterolateral edge of idiosoma. Terminal setae about same length as subterminal setae, but slender.

HOST AND LOCALITY: Holotype female was collected at 28 Millas, ASBANA, Limón (Coll. R. Rodríguez, 1983), on Annona muricata L. Holotype: deposited in the Collection of Lab. Acarología, Facultad de Agronomía, Universidad de Costa Rica, San José, Costa Rica.

ETYMOLOGY: This species is named for the locality where it was found, the province of Limón, Costa Rica.

REMARKS: This mite was found on fruits of Annona muricata L.. Fungus spores were found adhered to the dorsum of mites.

Daidalotarsonemus ternifoliae spec. nov.

DIAGNOSIS: The male of this species resembles that of D. leonardi and D. somalatus, but is distinguished by the size of the solenidion on tarsus I and II, and by having the base of solenidion nearly below the base of tactile setae on tibia IV.

MALE: (Figs. 5-6) Length 176.25 ± 1.25, width 90 ± 2.33. Gnathosoma, length $\bar{X}$ 21.31, width $\bar{X}$ 20.72; with anterolateral simple setae slightly longer than ventral setae. Palpi short, nearly parallel, directed anteriorly. Cheliceral stylets short. Pharynx elongate, with finely sclerotized muscular walls.

Idiosoma; body elongate medially, oval, slightly broadest in posterior region of metapodosoma. Prodorsal shield subrectangular. Setae v_2 1/2 as long as setae v_1; Sc_2 about 2/3 as long as Sc_1 (35.38 ± 0.14); v_1 about same length as Sc_2 (29.35 ± 1.5). Hysterosoma with setae c_2 attenuate, slender, about same size as c_1; setae d (36.26) 1/4 longer than c_1, both strong and pilose. One pair of pores or cupules anteromediad of setae c_1. Ventral region with finely granulate areas. Anteromedian apodeme extending posteriorly behind apodemes II, finely uniting with transverse apodeme. Apodeme II uniting with anteromedian apodeme. Apodeme III, IV and posteromedian, united forming a "V" as figured. Coxal setae 2a about 2x as long as 1a. Coxal setae 3a about same size as 3b.

Leg III longer than legs I and II; leg III about same

length as leg IV. Ta v present on tarsi I, II and III, spinelike. Setation respectively on femur, genu, tibia and tarsus of leg I: 3-4-5(3)-8(1); leg II: 3-3-4-4(1); leg III: 1-3-4-3. Solenidion Ta ω in tarsus I and II rodlike, long, robust and about same size (11.59 ± 0. 92). Tibia I with cluster of 3 sensilla comprised of short clavate solenidion (Ti ω), with finely stalked, thinly capitate solenidion, and with setiform seta. Leg IV robust, femorogenu elongate with 3 simple setae; tibial rodlike solenidion, short and located anteriorly to tactile seta (67.3 ± 0.7); tarsus with 3 simple small setae and strong curved claws.

FEMALE: Unknown.

HOSTS AND LOCALITIES: Holotype male was collected at Desamparados, Vivero América, San José (Coll. M. González, 1985), on Macadamia ternifolia F.; paratype male was collected at Zarcero, Alfaro-Alajuela (Coll. L. Solis, 1985), on Persea americana Mill. Holotype and paratype: deposited in the Collection of Lab. Acarologia, Facultad de Agronomia, Universidad de Costa Rica, San José, Costa Rica.

ETYMOLOGY: This species is named for its host, Macadamia ternifolia F.

REMARKS: This mite was found in Persea americana Mill. with mites of the genus Tarsonemus.

Genus Dendroptus Kramer

Genus Dendroptus Kramer, 1876: 28; Lindquist, 1986b: 295.

This genus is distinguished by the presence of three

setae in femorogenu I, cluster with 2 setae on tibia I, rounded flange on femorogenu IV (Lindquist 1986b).

Dendroptus irregularis spec. nov.

DIAGNOSIS: This species is distinguished from other species of Dendroptus by having irregular flange on femorogenu IV, and small spinelike setae on tarsus II.

MALE: (Figs. 7-8) Length 142.5, width 82.5. Gnathosoma, length 29.6, width 29.6; with anterolateral simple setae about same size as ventral setae. Palpi approximate, directed anteriorly. Cheliceral stylets short. Pharynx with muscular sclerotized walls.

Idiosoma, body oval. Prodorsal shield subrectangular. Setae v_2 1/2 as long as setae v_1; Sc_1 about 2x as long as Sc_2; v_1 sligthly longer than Sc_2. Hysterosoma with setae c_2 attenuate, smooth, slender and slightly longer than c_1; c_1 and d wide, serrate and same size. Pores or cupules on horizontal plane of setae c_1. Ventral region finely punctate. Anteromedian apodeme extending posteriorly behind apodemes II, not uniting with transverse apodeme. Apodeme II slightly curving inward, not uniting with anteromedian apodeme. Apodeme III not uniting with apodeme IV; apodeme IV uniting with posteromedian apodeme. Coxal setae 1a about same length of setae 2a, setiform; 3a about 1/3 longer than 3b.

Leg III longer than legs I, II and IV; leg I about same size as leg II. Ta v present on tarsi I, II and III,

spinelike. Setation respectively on femur, genu, tibia and tarsus of leg I: 3-4-5(2)-8(1); leg II: 3-3-4-5(2); leg III: 1-3-4-4. Tibia I with cluster of two sensilla comprised of short clavate solenidion (Ti a), with setiform setae. Tarsus II with solenidion Ta a 1/2 as long as that of tarsus I, solenidion of tarsus I long (7.91 ± 0.22). Leg IV (41.62 ± 0.37) robust; femorogenu with small irregular flange as figured; tibia with rodlike solenidion large (10.73 ± 0.37), tactile setae (24.05 ± 0.37). Tarsal claws curved.

FEMALE: Unknown.

HOST AND LOCALITY: Holotype male was collected at Guápiles, Limón (Coll. I. Obando, 1989), on Cupressus sp. Holotype deposited at Lab. Acarología, Facultad de Agronomía, Universidad de Costa Rica.

ETYMOLOGY: This species is named for its irregular flange on femorogenu IV.

Genus Floridotarsonemus Attiah

Floridotarsonemus Attiah 1970: 190.

This genus is distinguished by the elongate pharynx with sclerotized oval-like walls on adults; by small and flattened flange, with bladelike claw on leg IV of the male (Attiah 1970; Lindquist 1986b). Lindquist (1986b) reports Floridotarsonemus with immovably femorogenu and tibia on females, and femorogenu on males. Mounts of F. edule present lightly crystalline sutures on femorogenu III. Therefore, division of femur and genu III is visible on the

male, or femorogenu and tibia on leg III of the female.

Floridotarsonemus edule spec. nov.

DIAGNOSIS: The male of F. edule spec. nov. resembles that of F. scaber Attiah, but is distinguished by the same size of solenidion on tarsus I and II, and by the small subtriangular flange flange on leg IV. Setae 3a and 3b are the same size on F. scaber, but are unequal on this new species. The female is distinguished by the flange on femur II, and a rod-shaped solenidion on tarsus II on F. scaber, and small flange and lanceolate pilose seta on femur II on F. edule spec. nov.

MALE: (Figs. 9-11) Length 166.25 ± 4.05, width 87.49 ± 3.85. Gnathosoma, length 24.37 ± 1.87, width 29.06 ± 0.94; anterolateral simple setae about same length as ventral setae. Some males have the distal portion slightly blunt. Palpi slightly separated, directed anteriorly. Cheliceral stylets short. Pharynx elongate, sclerotized, with oval-like walls.

Idiosoma, body pyriform, broadest in anterior region of hysterosoma. Prodorsal shield subrectangular. Setae v_2 2/3 as long as setae v_1; Sc_1 about 3x as long as Sc_2; v_2 about same length as Sc_2. Hysterosoma with setae c_2 smooth and slender, about 2/3 as long as c_1; setae d about same length as c_1. Setae c_1 and d wide, finely serrated. Setae e 1/3 as long as d. One pair of pores or cupules anteromediad of setae c_1. Ventral region smooth. Anteromedian apodeme

extending posteriorly behind apodemes II, uniting with transverse apodeme. Apodeme II curving inward, not uniting with anteromedian apodeme. Apodeme III slightly uniting with apodeme IV. Apodeme IV slightly uniting with posteromedian apodeme. Coxal setae 1a slightly shorter than 2a, both slender. Coxal setae 2a about same size as 3a (14.8 ± 0.1). Coxal setae 3b (20.72 ± 0.03) 1/4 longer than 3a.

Leg III longer than legs I, II and IV; leg I about same size as leg II. Ta ∨ present on tarsi I-III, spinelike. Setation respectively on femur, genu, tibia and tarsus of leg I: 4-4-5(3)-10(1); leg II: 3-3-4-5(1); leg III: 1-3-4-4. Tibia I with cluster of three sensilla comprised of short clavate solenidion (Ti a 2.96 ± 0.01), with finely stalked, thinly capitate solenidion (2.81 ± 0.01), with setiform seta (4.14 ± 0.01). Tarsus I with solenidion Ta a slightly shorter than that of tarsus II. Tarsus II with solenidion Ta a thick (5.92 ± 0.01 long). Leg IV (70.31 ± 3.1) moderately robust, shorter than leg III; femorogenu with small flange as figured. Tibial rodlike solenidion short. Leg IV with bladelike claw.

FEMALE: (Figs. 12-15) Length 226.87 ± 4.05, width 138.75 ± 7.01. Gnathosoma, length 33.12 ± 3.18, width 34.37 ± 2.34; including palpi, cheliceral and pharyngeal structures similar to that of male.

Idiosoma oval; dorsal shields smooth. Ventral surface finely punctate. Prodorsal shield subrectangular as

figured, covering from 1/2 to 2/3 of gnathosoma. Bothridial setae capitate, finely spiculate (17.76 ± 0.04). Setae v_1 about 1/3 as long as setae Sc_2 (74 ± 1.8). Setae c_1 about same size as setae c_2; base of setae c_1 not on horizontal plane with c_2, situated slightly below base of c_2. Setae d, e, f and h small, pilose and about same size. Tergites D and EF with pores. Anteromedian apodeme extending posteriorly apodemes II, uniting with transverse apodeme. Posteromedian apodeme present, uniting with apodeme IV. Ventrocaudal lobe between leg IV small, wider than long, rounded distally. Coxal setae 2a slightly longer than 1a. Coxal setae 2a and 3b about same size; setae 3b 2/3 as long as 3a.

Leg I and II about same size; leg III longer than legs I, II and IV. Ta a present on leg I. Ta ν of tarsi I-III, spinelike. Setation respectively on femur, genu, tibia and tarsus of leg I: 4-4-5(3)+9(1); leg II: 3-3-4-5(2); leg III: 1+3-4-4. Tibiotarsus I with tibial cluster of 3 sensilla like that of male. Femur II with small, rounded flange as figured. Setae d^{ν} of femur II lanceolate, pilose as figured. Leg IV slender, about as long as combined length of femorogenu and tibia III, not reaching to posteriad edge of idiosoma; femorogenu about 4x as long as tibiotarsus, subterminal seta of tibiotarsus about 2/3 length of movable part of leg IV; terminal seta about 2x as long as subterminal seta.

HOST AND LOCALITIES: Holotype male, allotype female,

paratypes 4 females and 1 males, were collected at Ujarrás, Paraíso-Cartago, (Colls: S. Medina, A. Garcia, 1972); paratype 2 males, were collected at Finca Coghi, Ujarrás-Cartago (Coll. L.A. Salas, 1983), on Sechium edule (Jacq.) Sw. Holotype male and paratypes 2 females (N°CR-HT-3): deposited in the U.S. National Museum Collection, Acari Collection, at Beltsville, M.D. 20705. Allotype female, paratypes 3 males and 2 females: deposited in the Collection of Lab. Acarología, Facultad de Agronomía, Universidad de Costa Rica, San José, Costa Rica.

ETYMOLOGY: This species is named for its host, Sechium edule (Jacq.) Sw.

REFERENCE SPECIMEN EXAMINED: Holotype (N°47) male of Floridotarsonemus scaber Attiah, on deposit in the Florida State Collection of Arthropods, Division of Plant Industry, Florida Department of Agriculture, at Gainesville, Florida 32602.

Genus Fungitarsonemus Cromroy

Fungitarsonemus Cromroy, 1958: 113; Lindquist, 1986b: 303.

This genus is distinguished by the female having the base of Sc_2 displaced anteriorly of bothridial setae. The male is distinguished by his femorogenu and tibia of leg IV elongate (Beer 1954; Lindquist 1986b).

Fungitarsonemus cocosi (DeLeon)

Fungitarsonemus cocosi (DeLeon), Lindquist, 1986b: 307.
Hemitarsonemus cocosi DeLeon, 1956a: 109.

MALE: Length 141.25, width 80. Gnathosoma; length 18.5, width 18.5; with anteolateral simple setae twice as long as ventral setae. Pharynx sclerotized, with oval-like walls; c_1 1/4 longer than c_2. Coxal setae 2a about 2x length of setae 1a; 3a and 3b same size. Apodemes I nearly reaching with anteromedian apodeme, apodeme II straight, not uniting with transverse apodeme. Solenidion in tarsus I and II short (3.18 ± 0.22). Leg IV elongate (72.0 ± 0.5).

HOST AND LOCALITY: Cocos nucifera L., Westfalia, Limón (Colls. L.A. Salas, M. Dormond, R. Ochoa, 1982).

REFERENCE SPECIMEN EXAMINED: Paratype (Nº967-16) male of F. cocosi (DeLeon), on deposit in the Florida State Collection of Arthropods, Division of Plant Industry, Florida Department of Agriculture, at Gainesville, Florida 32602.

Fungitarsonemus lodici (DeLeon)

Fungitarsonemus lodici (DeLeon), Lindquist, 1986b: 307.
Hemitarsonemus lodici DeLeon, 1956a: 110.

DIAGNOSIS: The male of F. lodici resembles that of F. cocosi (DeLeon). It can be distinguished by the gnathosoma with anterolateral and ventral setae same size, the solenidion in tarsus I and II elongate (8.60 ± 0.34), c_1 1/3 longer than c_2, setae 1a and 2a same size, 3a and 3b same size, anteromedian apodeme extending posteriorly behind

apodeme II and uniting with transverse apodeme, apodemes II curved and not uniting with anteromedian apodeme on, F. lodici.

HOST AND LOCALITY: Macadamia ternifolia F., Vivero América, Desamparados, San José (Coll. M. González, 1985).

REFERENCE SPECIMEN EXAMINED: Paratype (Nº 1145-9) 2 males, 1 female of F. lodici (DeLeon), on deposit in the U.S. National Museum Collection, Acari Collection, at Beltsville, MD. 20705.

REMARKS: This mite was found with spores of fungus adhered to its body.

Fungitarsonemus peregrinus (Beer)

Fungitarsonemus peregrinus (Beer), Lindquist, 1986b: 307.
Hemitarsonemus peregrinus Beer, 1954: 1300.

DIAGNOSIS: The male of F. peregrinus resembles that of F. cocosi (DeLeon). It can be distinguished by the setae c_1 1/4 longer than c_2, and coxal setae 2a about 2x length of setae 1a on F. cocosi, and setae c_2 about 3x length of c_1, coxal setae 1a and 2a slender and same size in this species.

MALE: Length 184.00 ± 4.83, width 100.9 ± 7.28. Gnathosoma; length 29.6, width 29.6. Pharynx long and thin with muscular sclerotized walls. Setae c_2 about 3x length of c_1. Coxal setae 1a and 2a slender and same size. Setae 3a and 3b slender and same size. Solenidion in tarsus I (4.12 ± 0.12) slightly smaller than solenidion in tarsus II (5.25 ± 0.01). Leg IV elongate (93.75 ± 1.93).

FEMALE: Length 238.75 ± 11.25, width 129.1 ± 4.22.

Bothridial setae 14.5 ± 0.1.

HOST AND LOCALITY: Saccharum officinarum L., Turrialba, Cartago (Colls. R. López, F. Freitez, 1973).

REFERENCE SPECIMEN EXAMINED: Paratype (Nº Q-33156) male of E. peregrinus (Beer), on deposit in the U.S. National Museum Collection, Acari Collection, at Beltsville, MD. 20705.

REMARKS: Fungus spores were found adhered to the dorsum of mites.

Neodendroptus genus nov.

This genus is distinguished by the presence of prominient nipplelike flanges on legs IV of the male, and with femur I having 4 setae. The small spinelike tarsal setae on leg II, the moderately large cheliceral levers and the usually inconspicuous paired glands behind the pharynx are other distinctive characters. The female of Neodendroptus resembles females of Phytonemus and Dendroptus; of Phytonemus by the shape of the idiosoma and by having 4 setae on femur I. Females of this genus are more closely related to Dendroptus by the shape of the gnathosoma and apodemes, but are distinguished by the cluster of three solenidion on tibia I and a ventrocaudal lobe between legs IV longer than wide.

Neoendroptus perseae spec. nov.

MALE: (Fig. 16) Length 156.25 ± 3.42, width 93.75 ±

0.88. Gnathosoma, length $\bar{X}$ 25, width $\bar{X}$ 27.5, anterolateral and ventral setae simple and slender about same size. Palpi approximate, directed anteriorly, cheliceral stylets short. Pharynx long and thin with muscular sclerotized walls.

Idiosoma, body pyriform. Prodorsal shield subrectangular. Setae v_1 about same length as v_2 and Sc_2, all slender and finely pilose. Sc_1 4x as long as Sc_2, sligthly pilose. Hysterosoma with setae c_1, c_2 and d slightly pilose. c_2 3/4 as long as c_1. Setae d 1/2 as long as c_1. Setae c_2 fine or thin distally. Ventral region smooth. Anteromedian apodeme extending posteriorly behind apodeme II, not uniting with transverse apodeme. Apodemes II curving inward, not uniting with anteromedian apodeme. Apodeme III uniting with apodeme IV. Apodeme IV uniting with posteromedian apodeme. Ventral setae 1a, 2a, 3a and 3b simple and about same size.

Leg III longer than legs I, II, and IV; leg I slightly longer than leg II. Tarsus II with setae β spinelike adjacent to solenidion ω_1, femur II with setae lanceolate and pilose. Setation respectively on femur, genu, tibia and tarsus of leg I: 4-4-5(3)-9(1); leg II: 3-3-4-5(2); leg III: 1+3-4-5. Tibia I with cluster of 3 sensilla comprised of short solenidion (Ti ω_1 3.2 $\pm$ 0.2), with finely stalked, thinly setiform solenidion (Ti β 3.4 $\pm$ 0.1). Tarsus II with solenidion Ta ω_1 longer (7.2 $\pm$ 0.1) and thicker than that of tarsus I. Leg IV robust, shorter than leg III, with strong femorogenu flange lobe as figured. Tibial solenidion

small, rodlike; tactile seta long (66.6 ± 0.2). Tarsal claws stout, uncinate distally, longer than wide.

FEMALE: (Fig. 17) Length 183.3 ± 17.8, width 120.2 ± 13.5. Gnathosoma, length 32.7 ± 0.2, width 32.8 ± 0.2, including palpi, cheliceral, and pharyngeal structures, similar to that of male.

Idiosoma oval; dorsal shields unornamented, smooth as on ventral surface. Prodorsal shield subrectangular. Bothridial setae global and finely pilose (12.21 ± 0.45). Setae v_1 slender finely pilose about 1/3 as long as setae Sc_2. Setae c_1 and c_2 thin, base of setae c_1 not on horizontal plane with c_2, situated below base of c_2. Setae d, e and f same size and finely serrated. Setae h 2x as long as setae f. One pair of pores or cupules between setae c_1 and d. Tergites D, EF and H with pores. Anteromedian apodeme extending posteriorly slightly beyond apodemes II, uniting with transverse apodeme. Posteromedian apodeme present. Apodeme IV uniting posteromedian apodeme. Ventro caudal lobe between leg IV subtriangular. Coxal setae 1a, 2a and 3b slender and same size. Coxal setae 3a slightly longer than 3b.

Leg I and II about same length; leg III longer than legs I and II. Ti a present on leg I. Ta ν of tarsi I-III spinelike. Setation respectively on femur, genu, tibia and tarsus of leg I: 4-4-5(3) + 8(1); leg II: 3-3-4-5(2); leg III: 1 + 3-4-4. Tibiotarsus I with tibial cluster of 3 sensilla like that of male. Leg IV slender about as long as

combined length of femorogenu and tibia III, reaching to posterolateral edge of idiosoma; femorogenu 3x as long as tibiotarsus, subterminal seta of tibiotarsus about 1/2 length of movable part of leg IV; terminal seta about 3x as long as subterminal seta.

HOST AND LOCALITY: Holotype male, allotype female and 8 paratypes, males and females were collected at San Ramón de Tres Ríos, Cartago (Coll. L.A. Salas, 1983-1984), on Persea americana Mill. Holotype, allotype, 4 paratypes females; deposited in the Collection of Lab. Acarología, Facultad de Agronomía, Universidad de Costa Rica, San José, Costa Rica; paratype (N°CR-R0011) 2 males, 2 females: deposited in the U.S. National Museum Collection, Acari Collection, at Beltsville, MD. 20705.

ETYMOLOGY: This species is named for its host, Persea americana Mill.

REMARKS: In Persea americana Mill. two kinds of damage were observed in fruits: 1) fine leprosis covering from 5-10% of the epidermis with few mites moving and hiding in striations; 2) in association with the fungus Sphaceloma perseae Jenkis causing damage on the surface. Asca sp. (Ascidae) was found as predator of Neodendroptus perseae spec. nov.

Genus Phytonemus Lindquist

Phytonemus Lindquist, 1986b: 291.

This genus is distinguished by the presence of rounded

flanges on legs IV of males, and by the tibia and tarsus being fused on leg IV, and by the single solenidion on tarsus II. In the female the posteromedian apodeme is partly reduced (Lindquist 1986b).

Phytonemus pallidus (Banks)

Phytonemus pallidus (Banks), Lindquist, 1986b: 291.
Tarsonemus pallidus Banks, 1901: 294; Beer, 1954: 1267.
Tarsonemus fragariae Zimmenran, 1905: 91.
Steneotarsonemus pallidus (Banks), Beer, 1954: 1267.
Phytodromus pallidus (Banks), Denmark, 1989: 1.

In the males of P. pallidus (Banks) on legs IV, there are variations in shapes, sizes and angles of the rounded flange. Setae 3a and 3b in some males of P. pallidus were of similar size. In some females, legs IV extend to the posterolateral edge of the idiosoma. The posteromedian apodeme is not reduced and apodeme IV unites with the posteromedian apodeme.

MALE: (Figs. 18-19) Length 192.72 ± 6.36, width 101.81 ± 6.25. Leg IV 69.43 ± 2.45, rounded flanges with slight variations in shapes, but always mantaining the angle.

FEMALE: Length 256.71 ± 4.61, width 144.53 ± 21.79.

HOSTS AND LOCALITIES: Capsicum annuum L., San Isidro de Coronado-San José (Colls. E. Hidalgo, 1982, L. Hidalgo 1984); Fragaria sp., San José de la Montaña-Heredia (Colls. A. Medina, 1980; I. Calvo, 1980; L.A. Salas, R. Ochoa, 1984), San Rafael-Herdia (Colls. J. Hernández, I. Solís, 1974), Barva-Herdia (Coll. O. Arias, 1974), San Ramón de

Tres Rios-Cartago (Coll. I. Calvo, 1981); Saintpaulia sp., San Ididro de Coronado-San José (Coll. L. Hidalgo, 1978), San José (Coll. V. Quesada, 1982), La Paulina, San José (Coll. J. Chaverri, 1979); Saintpaulia ionantha Wendl., Barrio La Granja, San José (Colls. M. Morales, V. Cruz, 1972); Gloxinia sp., San José (Coll. E. Castro, 1984).

REFERENCE SPECIMEN EXAMINED: Male (Nº 70DI-43 det. by T. Kono) of P. pallidus (S. pallidus) is on deposit in the Lab. Acarologia, Facultad de Agronomia, Universidad de Costa Rica, San José, Costa Rica.

REMARKS: This is one of the most well known and taxonomically conflicting groups. Because of the discrepancy in morphology, biology and damage to host it is not clear if P. pallidus (Banks) = P. fragariae Zimmerman. Smith & Goldsmith (1936) report in the United States that they are the same species, but that P. pallidus observed in 1883 on Cyclamen, was not found on Fragaria sp. until 45 years later. Alford (1972) reports the difficulty in distinguishing P. pallidus from P. fragariae, but he did not treat them as synonyms.

Eyndhoven & Groenewold (1959) and Karl (1965, 1969) recognize differences in their material, for some authors it is conclusive and for others it is still incomplete. Lindquist (1986b) reported P. fragariae as a subspecies of P. pallidus, and mentions the existence of a species-complex.

In Costa Rica P. pallidus was present on Capsicum

annuum L. in areas where Fragaria sp. previously had been cultivated. Extensive planting of C. annuum and the ability of this species to adapt to differents crops, perhaps obligated attack because its former host was removed.

Damage, agressiveness and morphological variations of this mite on different crops, add to the question if they are the same species or a complex. I think that more pathogenesis tests, life tables on different crops, tests of responses to different products and genetic studies are necessary for the P. pallidus complex to determine if they are the same species or subspecies.

On Fragaria sp. tender foliols become deformed (spoonlike) and in some cases, necrotic. Fruits may be deformed and be affected plant have little regrowth.

On Saintpaulia spp. tender leaves become deformed, light-green and cracked and in the worst cases, dye-back occurs.

On Capsicum annuun L., leaf symptomatology is equal to damage done by P. latus in this crop.

P. pallidus is not susceptible to sulphur products.

Genus Polyphagotarsonemus Beer & Nucifora

Polyphagotarsonemus Beer & Nucifora, 1965: 38.
Neotarsonemus Smiley, 1967: 137; Lindquist, 1986b: 234

This genus is distinguished by the presence of a smaller triangular flange and buttonlike claw on leg IV of the male, and by females having eggs with symetrically

areolated figures (Hambleton 1938; Smiley 1964; Hugon 1983; Beer & Nucifora 1965; Lindquist 1986b).

Polyphagotarsonemus latus (Banks)

Polyphagotarsonemus latus (Banks), Beer & Nucifora, 1965: 42.
Hemitarsonemus latus (Banks) Ewing, 1939: 54.
Tarsonemus latus Banks, 1904: 615.
Acarus translucens Green, 1890: 12.
Tarsonemus translucens (Green) Green, 1913, 2.

MALE: (Fig. 20) Color brigth-white or translucent light-pink; length 184.05 ± 6.67, width 101.87 ± 4.78. Leg IV 77.14 ± 3.87, the button-like claw slightly varying in shape.

FEMALE: Length 230.71 ± 29.17, width 150.67 ± 7.57. Strong conspicuous tarsal claw (8.85 ± 1.01) in leg I. Eggs with symmetrically areolated figures.

HOSTS AND LOCALITIES: Annona cherimolia Mill., Campus Universidad de Costa Rica, San José (Coll. F. Morales, 1978); Capsicum annuum L., Campus Universidad de Costa Rica, San José (Coll. L.A. Salas, 1979), Atenas-Alajuela (Colls. L.A. Salas, M. Dormond, 1982), Desamparados, San José (Coll. R. Ochoa, 1982); Capsicum sp., La Paulina, San José (Coll. L.A. Salas, 1984); Citrus aurantium L., Campus Universidad de Costa Rica, San José (Coll. J. Arias, 1985); Citrus reticulata Blanco, La Garita-Alajuela (Coll. G. Iglesias, 1972), Campus Universidad de Costa Rica, (Colls. H. Aguilar, R. Ochoa, 1986); Codiaeum variegatum Blume, Siempre Verde, Pocora, Limón (Coll. H. Aguilar); Cupressus sp., Guápiles, Limón (Coll. I. Obando, 1989); Datura stramonium

L., Campus Universidad de Costa Rica, San José (Coll. F. Morales, 1980); Datura arborea L., San Pablo-Heredia (Colls. L.A. Salas, G. Ulate, F. Freitez, 1971), San Pedro de Montes de Oca (Colls. R. Fairron, F. Freitez, 1972); Glycine max (L.) Mell., Campus Universidad de Costa Rica, San José (Coll. R. Ortiz, 1982); Impatiens sp., La Paulina, San Pedro (Coll. L.A. Salas, 1982), CATIE, Turrialba (Coll. R. Ochoa, 1989); Lycopersicon esculentum Mill., Campus Universidad de Costa Rica, San José (Coll. L.A. Salas, 1979); Mangifera indica L., Campus Universidad de Costa Rica, San José (Coll. L.A. Salas, 1975); Phaseolus vulgaris L., Campus Universidad de Costa Rica, San José (Coll. F. Huete, 1978); Solanum tuberosum L., Campus Universidad de Costa Rica, San José (Colls. R. Barroso, F. Freitez, 1973); Schefflera sp., San Carlos, Alajuela (Coll. E. Vargas, 1985).

NOTE: Hosts and localities in Panamá and El Salvador: Solanum melongena L., C. annuum L., L. esculentum Mill, Ludwigia sp., Clibadium sp., Los Santos, Region de Azuero, República de Panamá (Gordon et al. 1985; Ochoa & von Lindeman 1988); C. annuum L., Valle de Zapotitán, La Libertad, El Salbador (Reyes et. al. 1989).

REFERENCE SPECIMEN EXAMINED: Type (Nº CIP 4-83) male of P. latus (Banks), on deposit in the U.S. National Museum Collecion, Acari Collection, at Beltsville, MD. 20705.

REMARKS: P. latus is a serious pest of food crops and ornamentals in Central America (King & Saunders 1984). Gordón marked in 1983 the importance of P. latus as a pest

of C. annuum and L. esculentum for Central American region (E. Alvarado, personal conversation, 1989).

In El Salvador P. latus is considered an important pest on C. annuum L. (Reyes et al 1989).

In Panamá, P. latus causes extensive damage to C. annuum L., Solanum melongena L. and L. esculentum Mill. Attacked plants present slow growth, leaves become colorless, distorted and rough (Gordon et al 1985; Ochoa & von Lindeman 1988). The most ample damage in Central America caused by this species was observed in Panamá from 1983 to 1987 in about 700 ha., with symptoms like plant dwarfing, flower fall, defoliation, plant death (Gordon, personal conversation, 1987). Some cultivated zones with C. annuum L. and L. esculentum Mill. were affected during the whole year. Crop loss averaged about 40%, ranging from 30-100% depending of the area and the planting time (Ochoa & von Lindemann 1987). On Solanum melongena L. leaves present lateral wrinkling, with iregular development. Light cracking on fruit carpels may be related to this mite (C.H.W. Flechtmann, personal conversation, 1989).

Damage to C. annuum L. in Costa Rica was not as severe and extensive as in Panamá. The undersides of the leaves are wrinkled, becoming brittle with age, and growth is retarded. Undersides of some leaves may become red-brown. Damage is similar on seedlings. Fruits may be deformed and present slight cracking of the epidermis. Some varieties of Capsicum spp. may be tolerant to P. latus attack.

P. latus was observed on some plants in association with Bemisia spp. (Aleyrodidae), moving at random between the nymphs of this insects. Mites may be found frequently on this insects indicating, as reported from India, that Bemisia carries P. latus (Natarajan 1988).

On Citrus aurantium L. tender leaves are cupped undersides. Mites were located around main veins and from one to five groups of eggs were found in the cavities. Lateral cupping with red-brown coloration was observed on the oldest leaves; specimens were rarely located on this area.

On Codiaeum variegatum Blume the undersides of the leaves present lateral wrinkling, with iregular development, and growth is retarded. Leaves distortion was very severe, resulting an important economic damage (H. Aguilar, personal conversation, 1989).

On Cupressus sp. terminal leaves present yellowness; plants with mites present apparently low growth, compared with sane plants.

On Glycine max (L.) Mell. cupping of the surface is upward. Amblyseius largoensis (Muma) (Phytoseiidae) was found as a predator of P. latus on this host.

On L. esculentum Mill. and Impatiens sp. damage symptoms may be as presented for C. annuum L., but the damage is more apparent. On L. esculentum, insects as Thysanoptera and Hemiptera were found feeding old leaves and using the caves of P. latus.

On Solanum tuberosum L. leaves are cupped undersides, resembling virus damage.

On Schefflera sp. tender foliolos present irregular corrugation undersides; the corrugations caused old foliols to resemble a corkscrew. This damage is attractive for many plant collectors, but because of lack of growth of the main veins, the foliols die and fall.

Specimens of P. latus were generally collected on tender leaves and foliolos and their eggs were observed on the undersides. Fungus spores were found adhered to the body of mites.

P. latus showed susceptibility to sulfur products.

Damages found on some plants where P. latus was present, resemble that caused by lack of boro (C.H.W. Flechtmann, personal conversation, 1989).

Spinatarsonemus genus nov.

This genus is distinguished by the presence of a small triangular shaped flange on the femorogenu on leg IV of the male. Males of this genus resemble males of Heterotarsonemus, but are distinguished by having fused tibia and tarsus. Females resemble those of Hemitarsonemus, but are distinguished by having a curved empodial claw on tarsus I and 4 setae on femur I.

The presence of a cluster of 3 sensilla on tibia I and a cluster of 2 sensilla on tibia II, places this genus in the Tribe Tarsonemini.

Spinatarsonemus alajuelensis spec. nov.

MALE: (Figs. 21-23) Length 144.37 ± 4.19, width 82.49 ± 1.32. Gnathosoma, length 20.34 ± 1.41, width 20.15 ± 0.8; with anterolateral simple setae about same size as ventral setae. Palpi approximate, directed anteriorly. Cheliceral stylets short. Pharynx elongate with muscular sclerotized walls. Neck present.

Idiosoma. Body pyriform. Prodorsal shield subrectangular. Setae v_2 slender, 2/3 as long as setae v_1; v_1 thick; v_2 and Sc_2 same size; Sc_2 about 3x as long as Sc_1; base of Sc_2 on horizontal plane with Sc_1. Hysterosoma with setae c_2 attenuate, smooth, slender and about same size as c_1; setae c_1 about 2x as long as e; c_1 slightly longer than d, both thick and serrate. Pores or cupules not easily seen. Ventral region finely punctate. Anteromedian apodeme not extending posteriorly behind apodemes II, not uniting with transverse apodeme. Apodeme II curving inward, not uniting with anteromedian apodeme. Apodeme III uniting with apodeme IV and apodeme IV not uniting with posteromedian apodeme. Coxal setae 1a as long as setae 2a, both slender, attenuate; 3a slightly longer than 3b, slender.

Leg III longer than legs I, II and IV; leg I about same size as leg II. Ta ν present on tarsi I, II and III, spinelike. Setation respectively on femur, genu, tibia and tarsus of leg I: 4-4-5(3)-8(1); leg II: 3-3-4-5(2); leg III: 1-3-4-4. Tibia I with cluster of 3 sensilla comprised of

short clavate solenidion (Ti a), with finely stalked, thinly capitate solenidion, with setiform setae. Tarsus II with solenidion Ta a (5.62 ± 0.2) longer than that of tarsus I. Leg IV (63.28 ± 0.81) robust; femorogenu with small triangular shaped flange as figured; tibiotarsus with rodlike solenidion short; tactile setae (26.6 ± 0.4) shorter than length of femurgenu. Tarsal claws curved.

FEMALE: (Figs. 24-25) Length 174.37 ± 3.24, width 105.18 ± 6.14. Gnathosoma, length 27.54 ± 0.91, width 24.9 ± 0.8, including palpi and cheliceral structures similar to that of male. Pharynx elongate, with muscular sclerotized walls.

Idiosoma oval, propodosoma covering 1/3 of the gnathosoma, dorsal and ventral shields finely punctate. Prodorsal shield subrectangular. Bothridial setae capitate, finely spiculate (11.1 + 1.1). Setae Sc_2 2x as long as v_1. Setae c_2 about same size as c_1, both slender; base of setae c_1 not on horizontal plane with c_2, situated below base of c_2. Setae d, e, f and h about same size. Tergites D and EF with pores. Anteromedian apodeme extending in fragments posteriorly apodemes II, not uniting with transverse apodeme. Apodeme II curving inward, not uniting with anteromedian apodeme. Posteromedian apodeme present. Apodeme IV uniting with posteromedian apodeme. Ventrocaudal lobe between leg IV small, wider than long, rounded distally. Coxal setae 1a, 2a, 3a and 3b slender. Coxal

setae 2a slightly longer than 1a; setae 3a slightly longer than 3b.

Leg I and II about same length; leg III longer than legs I, II and IV. Ta ω present on leg I. Ta ν of tarsi I-III spinelike. Setation respectively on femur, genu, tibia and tarsus of leg I: 4-4-5(3)+8(1); leg II: 3-3-4-6(1); leg III: 1+3-4-4. Tibiotarsus I with tibial cluster of 3 sensilla like that of male. Leg IV slender, about same size than combined length of femorogenu and tibia III, not reaching to posteriad margin of idiosoma; femorogenu 3x as long as tibiotarsus, subterminal setae of tibiotarsus about 2/3 length of movable part of leg IV; terminal setae about 2x longer than subterminal setae.

HOST AND LOCALITY: Holotype male, allotype female, paratypes 3 males and 3 females were collected at Turrucares, Alajuela (Coll. G. Ulate, 1971), on Citrus paradisi Macf. Holotype, allotype: deposited in the U.S. National Collection, Acari Collection, at Belstville, MD. 20705; Paratypes: deposited in the Collection of Lab. Acarologia, Facultad de Agronomia, Universidad de Costa Rica, San José, Costa Rica.

ETYMOLOGY: This species is named for the locality where it was found, province of Alajuela, Costa Rica.

Spinatarsonemus costarricensis spec. nov.

MALE: (Fig. 26) Length 150, width 120. Gnathosoma, length 56.25, width 48.75; with anterolateral simple setae

2x as long as ventral setae. Palpi approximate, directed anteriorly. Cheliceral stylets short. Pharynx elongate with muscular sclerotized walls.

Idiosoma. Body pyriform. Prodorsal shield subrectangular. Setae v_2 2/3 as long as setae v_1; v_2 and Sc_2 same size; Sc_2 about 3x as long as Sc_1; base of Sc_2 on horizontal plane with Sc_1. Hysterosoma with setae c_2 attenuate, smooth, slender and slightly longer than c_1; c_1 thick and finely serrate, twice as long as d. Pores or cupules anteromediad of setae c_1. Ventral region finely punctate. Anteromedian apodeme extending posteriorly behind apodemes II, uniting with transverse apodeme. Apodeme II uniting with anteromedian apodeme. Apodeme III uniting with apodeme IV and apodeme IV uniting with posteromedian apodeme. Coxal setae 1a about same length as setae 2a, and both slender; 3a 1/2 longer than 3b, slender, attenuate.

Leg III longer than legs I, II and IV; leg I about same size as leg II. Ta ω present on tarsi I, II and III, spinelike. Setation respectively on femur, genu, tibia and tarsus of leg I: 4-4-5(3)-8(1); leg II: 3-3-4-5(2); leg III: 1-3-4-4. Tibia I with cluster of 3 sensilla comprised of short clavate solenidion (Ti ω), with finely stalked, thinly capitate solenidion, with setiform setae. Tarsus I with solenidion Ta ω 1/2 as long as that of tarsus II, solenidion of tarsus II large (15.1 ± 0.1). Leg IV (48.84 ± 1.2) slender; femorogenu with small triangular shaped flange as figured; tibiotarsus with rodlike solenidion short; tactile

setae short (32.56 ± 0.2). Tarsal claws curved.

FEMALE: (Figs. 27-28) Length 170.62, width 112.5. Gnathosoma, length 26.25, width 22.5, including palpi and cheliceral structures similar to that of male. Pharynx elongate, with muscular sclerotized walls.

Idiosoma oval, propodosoma covering 1/2 of the gnathosoma, dorsal shields finely granulate; ventral surface finely punctate. Prodorsal shield subrectangular. Bothridial setae capitate, finely spiculate (14.8 ± 0.1). Setae v_1 and Sc_2 about same size. Setae c_2 about same size as c_1, both slender; base of setae c_1 not on horizontal plane with c_2, situated below base of c_2. Setae d, e, f and h about same size. Pores not easily seen. Anteromedian apodeme extending posteriorly apodemes II, uniting with transverse apodeme. Apodeme II not uniting with anteromedian apodeme. Posteromedian apodeme present. Apodeme IV uniting with posteromedian apodeme. Ventrocaudal lobe between leg IV small, wider than long, rounded distally. Coxal setae 1a, 2a, 3a and 3b slender. Coxal setae 3a slightly longer than 3b; setae 2a slightly longer than 1a.

Leg I and II about same length; leg III longer than legs I, II and IV. Ta a present on leg I. Ta v of tarsi I-III spinelike. Setation respectively on femur, genu, tibia and tarsus of leg I: 4-4-5(3)+8(1); leg II: 3-3-4-6(1); leg III: 1+3-4-4. Tibiotarsus I with tibial cluster of 3 sensilla like that of male. Leg IV slender, shorter than

combined length of femorogenu and tibia III, not reaching to posteriad margin of idiosoma; femorogenu 3x as long as tibiotarsus, subterminal setae of tibiotarsus about 2/3 length of movable part of leg IV; terminal setae about 1/4 longer than subterminal setae.

HOST AND LOCALITY: Holotype male, allotype female, 4 paratypes females were collected at Cascajal, Coronado, San José (Colls. L.A. Salas, 1988; W. Portilla, 1988), on Rubus sp. Holotype, allotype: deposited in the U.S. National Collection, Acari Collection at Beltsville, MD. 20705; Paratypes: deposited in the Collection of Lab. Acarología, Facultad de Agronomía, Universidad de Costa Rica, San José, Costa Rica.

ETYMOLOGY: This species is named for the country where it was found, Costa Rica.

Spinatarsonemus parsoni spec. nov.

MALE: (Fig. 29) Length 200.62, width 157.49. Gnathosoma, length 31.87, width 28.12; with anterolateral simple setae 2x as long as ventral setae. Palpi approximate, directed anteriorly. Cheliceral stylets short. Pharynx sclerotized, with small wishbone-shaped walls.

Idiosoma, length 165, width 157. Body pyriform. Prodorsal shield subrectangular. Setae v_2 2/3 as long as setae v_1; Sc_1 about 3x as long as Sc_2; v_1 sligthly longer than Sc_2, base of Sc_2 on horizontal plane with Sc_1. Hysterosoma with setae c_2 attenuate, smooth, slender and

slightly longer than c_1; c_1 wide and serrate, twice as long as d. Pores or cupules anteromediad of setae c_1 not easily seen. Ventral region smooth. Anteromedian apodeme extending posteriorly behind apodemes II, not uniting with transverse apodeme. Transverse apodeme reduced to lateral fragments. Apodeme II slightly curving inward, not uniting with anteromedian apodeme. Apodeme III uniting with apodeme IV and apodeme IV uniting with posteromedian apodeme. Coxal setae 1a about same length of setae 2a, and both slender; 3b about 2x longer than 2a.

Leg III longer than legs I, II and IV; leg I about same size as leg II. Ta ν present on tarsi I, II and III, spinelike. Setation respectively on femur, genu, tibia and tarsus of leg I: 4-4-5(3)-9(1); leg II: 3-3-4-5(2); leg III: 1-3-4-4. Tibia I with cluster of 3 sensilla comprised of short clavate solenidion (Ti a 3.84 ± 0.01), with finely stalked, thinly capitate solenidion (2.96 ± 0.01), with setiform setae (5.18 ± 0.01). Tarsus I with solenidion Ta a 1/2 as long as that of tarsus II, solenidion of tarsus II long (15.54 ± 0.02). Leg IV (79,6 ± 0.4) robust, shorter than leg III; femorogenu with small triangular shaped flange as figured. Tibiotarsus with rodlike solenidion short (8.8 ± 0.01), tactile setae (44.4 ± 0.01). Tarsal claws curved.

FEMALE: (Fig. 30) Length 221.25 ± 10.5, width 138.75 ± 3.75. Gnathosoma, length 31.82 ± 2.22, width 30.34 ± 0.74, including palpi and cheliceral structures similar to that of male. Pharynx elongate, with muscular sclerotized walls.

Idiosoma oval, propodosoma covering 1/2 of the gnathosoma, dorsal shields finely granulate, as on ventral surface. Prodorsal shield subrectangular. Bothridial setae capitate, finely spiculate (16.65 ± 0.37). Setae v_1 about 1/2 as long as setae Sc_2. Setae c_2 slightly longer as c_1, both slender; base of setae c_1 not on horizontal plane with c_2, situated below base of c_2. Setae d, e and f same size; setae h slightly longer than setae f. Tergites D and EF with pores. Anteromedian apodeme extending posteriorly apodemes II, uniting with transverse apodeme. Posteromedian apodeme present. Apodeme IV reduced to small fragments. Ventrocaudal lobe between leg IV small, wider than long, rounded distally. Coxal setae 1a, 2a, 3a and 3b slender and about same size.

Leg I and II about same length; leg III longer than legs I, II and IV. Ta ω present on leg I. Ta ν of tarsi I-III spinelike. Setation respectively on femur, genu, tibia and tarsus of leg I: 4-4-5(3)+8(1); leg II: 3-3-4-4(2); leg III: 1+3-4-4. Tibiotarsus I with tibial cluster of 3 sensilla like that of male. Leg IV slender about as long as combined length of femorogenu and tibia III, not reaching to posteriad edge of idiosoma; femorogenu 3x as long as tibiotarsus, subterminal setae of tibiotarsus about 1/2 length of movable part of leg IV; terminal setae about 2x as long as subterminal setae.

HOST AND LOCALITY: Holotype male, allotype female and paratype female, were collected at San Ramón de Tres Ríos,

Cartago (Coll. M. González, 1983), on Persea americana Mill. Holotype, allotype, paratype female: deposited in the Collection of Lab. Acarologia, Facultad de Agronomia, Universidad de Ccosta Rica, San José, Costa Rica.

ETYMOLOGY: This species is named in memory of Dr. Frank Parson, for his dedication to the Programm of Crops improvement in Costa Rica.

Genus Steneotarsonemus Beer

Steneotarsonemus Beer, 1954: 1229.
Parasteneotarsonemus Beer & Nucifora, 1965: 40, Lindquist, 1986b: 274.
Neosteneotarsonemus Tseng & Lo, 1980: 127; Lindquist, 1986b: 274.

This genus is characterized by the presence of a hyaline flange on leg IV of the male, both female and male have the gnathosoma about as wide as long, and with the body generally elongate. Members of this genus are usually found on monocotyledonous plants (Beer 1954; Smiley & Emmanouel 1980; Lindquist 1986b).

Steneotarsonemus comosus spec. nov.

DIAGNOSIS: The male of S. comosus spec. nov. resembles that of S. madecassus Gutiérrez, but is distinguished by the short and slightly square-shape flange on leg IV.

MALE: (Figs. 31-32) Length 198.75 ± 2.43, width 93.75 ± 1.16. Gnathosoma, length $\bar{X}$ 26.62, width $\bar{X}$ 30; distal region slightly snub, with anterolateral simple setae 2x as long as ventral setae. Palpi approximate, directed

anteriorly. Cheliceral stylets short. Pharynx strongly sclerotized, with oval-like walls.

Idiosoma, length $\bar{X}$ 168.75, width $\bar{X}$ 93. Body elongate oval, slightly broadest in anterior region of hysterosoma. Prodorsal shield subrectangular. Setae v_2 2/3 as long as setae v_1; Sc_1 about 2x as long as Sc_2; v_1 about same length as Sc_2. Hysterosoma with setae c_2 smooth and slender about 1/3 longer than c_1; setae d about same length as c_1. One pair of pores or cupules anteromediad of setae c_1. Ventral region smooth. Anteromedian apodeme extending posteriorly behind apodemes II, uniting with transverse apodeme. Apodeme II curving inward, not uniting with anteromedian apodeme. Apodeme III uniting with apodeme IV. Coxal setae 1a small about same size of setae 2a. Coxal setae 3a about 2x as long as 3b.

Leg III longer than legs I, II and IV; leg I about same size as leg II. Ta ν present on tarsi I-III, inconspicuously dentate. Setation respectively on femur, genu, tibia and tarsus of leg I: 4-4-5(3)-10(1); leg II: 3-3-4-5(2); leg III: 1-3-4-4. Tibia I with cluster of 3 sensilla comprised of short clavate solenidion (Ti ω 3.7 ± 0.2), with finely stalked, thinly capitate solenidion, with setiform seta. Tarsus I with solenidion Ta ω about same length as that of tarsus II. Leg IV moderately robust, shorter than leg III; femorogenu with flange as figured. Tibial rodlike solenidion short (5.18 ± 0.12), tactile seta (23.68 ± 0.20). Tarsal claws smooth and curved distally.

FEMALE: Length 277.5 ± 2.15, width 123.1 ± 2.1. Gnathosoma, length $\bar{X}$ 30, width $\bar{X}$ 30, including palpi, cheliceral and pharyngeal structures similar to that of male.

Idiosoma elongate; dorsal shields smooth, as on ventral surface. Prodorsal shield subrectangular. Bothridial setae capitate, finely spiculate (15). Setae v_1 about 1/2 as long as setae Sc_2. Setae c_1 about same size as setae c_2; base of setae c_1 not on horizontal plane with c_2, situated slightly below base of c_2. Setae d, e and f about same size; setae h 2x as long as setae f. Tergites EF and H with pores. Anteromedian apodeme extending posteriorly to apodemes II, not uniting with transverse apodeme. Transverse apodeme reduced to 2 horizontal fragments. Posteromedian apodeme partly reduced. Ventrocaudal lobe between leg IV wider than long, rounded distally. Coxal setae 1a and 2a about same size. Coxal setae 3a slender and 2x as long as setae 3b.

Leg I and II about same size; leg III longer than legs I and II. Ti ω present on leg I. Ta ν of tarsi I-III inconspicuously dentate distally. Setation respectively on femur, genu, tibia and tarsus of leg I: 4-4-5(3) + 8(1); leg II: 3-3-4-5(2); leg III: 1 + 3-4-5. Tibiotarsus I with tibial cluster of 3 sensilla like that of male. Leg IV slender about as long as combined length of femorogenu and tibia III, not reaching to posteriad margin of idiosoma; femorogenu 4x as long as tibiotarsus, subterminal seta of

tibiotarsus about 1/2 length of movable part of leg IV; terminal seta about 3x as long as subterminal seta.

HOST AND LOCALITY: Holotype male, allotype female and 9 paratypes male and females were collected at Buenos Aires, Puntarenas (Colls. H. Aguilar, O. Salazar, R. Ochoa, 1989), on Ananas comosus (L.) Mell. Holotype, allotype, 7 paratypes females: deposited in the Collection of Lab. Acarologia, Facultad de Agronomia, Universidad de Costa Rica, San José, Costa Rica; paratype (N°CR-R0016) male and female deposited in the U.S. National Museum Collection, Acari Collection, at Beltsville, MD. 20705.

ETYMOLOGY: This species is named for its host, Ananas comosus (L.) Mell.

REMARKS: In Ananas comosus (L.) Mell. this mite attacks tender leaves of the crowns of fruits, resulting a fruit with multiple crown.

Steneotarsonemus kruseae spec. nov.

DIAGNOSIS: The male of S. kruseae spec. nov. resembles that of S. konoi Smiley & Emmanouel but is distinguished by the fine punctations in the ventral region and one pair of pores or cupules approximate and adjacent to setae c_1.

MALE: (Figs. 33-34) Length 205.62 ± 20.14, width 100.00 ± 16.42. Gnathosoma; length $\bar{X}$ 32.5, width $\bar{X}$ 30; with anterolateral simple seate twice as long as ventral setae. Palpi approximate, directed anteriorly. Cheliceral stylets short. Pharynx slightly sclerotized, with wishbone-shaped

walls, with small pair of glandular structures near its posterior extremity.

Idiosoma, length $\bar{X}$ 180, width $\bar{X}$ 100. Body elongate oval, broadest in anterior region of hysterosoma. Prodorsal shield subtrectangular. Setae v_1 1/2 as long as v_2; Sc_1 about 2x as long as v_2 and Sc_2. Hysterosoma with setae c_2 smooth and slender, about 1 1/2 as long as c_1. Setae d about 2x longer than c_1; about same length as c_2, but thicker. One pair of pores or cupules approximate adjacent to setae c_1, and another pair anterolaterally adjacent to setae e on lateral edges of subterminal tergite EF. Ventral region finely punctate. Anteromedian apodeme extending posteriorly behind apodemes II, uniting with transverse apodeme. Apodemes II curving inward, not uniting with anteromedian apodeme. Apodeme III not uniting with apodeme IV. Coxae I and II heavily punctated, stronger than punctations on coxae III. Coxal setae 2a slender, small and 2x as long as setae 1a; setae 3a slightly longer than 3b; 3a and 3b slender.

Leg III longer than legs I, II and IV; leg I about same size as legs II. Ta ν present lightly dentate on tarsi II-III, not dentate distally on tarsi I. Setation respectively on femur, genu, tibia and tarsus of leg I: 4-4-4(3)-7(1); leg II: 3-3-4-5(2); leg III: 1-3-4-4. Tibia I with cluster of 3 sensilla comprised of short clavate solenidion (Ti ω 2.0 - 2.5 long), with finely stalked, thinly capitate solenidion (Ti β 3 long), with rodlike seta (Ti γ 5 long);

dorsal seta Ti d' inserted mediad of sensory cluster, not as long as tarsus. Tarsus II with solenidion Ta a' wider than that of tarsus I. Femora I and II without markings of flanges ventrally beside Fe a'. Leg IV moderately robust, shorter than leg III; femorogenu with flange as figured. Tibial solenidion large, rodlike, tactile seta attenuate, about same length as solenidia. Tarsal claws stout, longer than wide.

FEMALE: Length 288.95 ± 26.3, width 114.06 ± 12.6. Gnathosoma length $\bar{X}$ 32.6, width $\bar{X}$ 34.2; including palpi, cheliceral and pharyngeal structures similar to that of male.

Idiosoma elongate; dorsal shields smooth, as on ventral surface. Prodorsal shield subrectangular. Bothridial setae capitate, finely spiculate (17.9 ± 1.23). Setae v_1 about 1/2 as long as setae Sc_2. Setae c_1 is thicker than setae c_2; base of setae c_1 not on horizontal plane with c_2, situated below base of c_2. Setae e and h equal in length, setae d and f same length, about 1/3 longer than e and h. Tergites D, EF and H with pores; in some females this pores were not easily seen on tergites EF and H. Anteromedian apodeme extending posteriorly slightly beyond apodemes II, not uniting with transverse apodeme. Transverse apodeme reduced to lateral fragments. Posteromedian apodeme absent. Ventrocaudal lobe between leg IV subtriangular. Coxal setae 1a slender about 1/2 length of setae 2a. Coxal setae 3a attenuate, 2x as long as other coxal setae. Coxal setae 3b

equal in length to 2a.

Leg I slightly longer than leg II; leg III longer than legs I and II. Ti a present on leg I. Ta ν of tarsi I-III blunt, inconspicuously dentate distally. Setation respectively on femur, genu, tibia and tarsus of leg I: 4-4-5(3)+9(1); leg II: 3-3-4-4(3); leg III: 1+3-4-5. Tibiotarsus I with tibial cluster of 3 sensilla like that of male. Leg IV slender about as long as combined length of femorogenu and tibia III, not reaching to posterolateral margin of idiosoma; femorogenu 2x as long as tibiotarsus, subterminal seta of tibiotarsus about 1/2 length of movable part of leg IV; terminal seta about 3x as long as subterminal seta.

HOST AND LOCALITIES: Holotype male, allotype female and paratypes 12 females and male were collected at Paso Ancho de Oreamuno, Cartago (Colls. L. Salas, G. Ulate, F. Freitez, 1971); paratype male was collected at Poasito, Alajuela (Colls. L. Salas, G. Ulate and F. Freitez, 1974); 2 paratypes males and 5 paratypes females were collected at Llano Grande, Cartago (Colls. L. Salas, W. Quesada, F. Freitez, 1973), on Pennisetum clandestinum Hoechts. Holotype, allotype, paratypes 2 males and 3 females: Deposited in the collection of Lab. Acarologia, Facultad de de Agronomia, Universidad de Costa Rica, San José, Costa Rica; paratype (CR-IS-2) 2 females, male deposited in the U.S. National Museum Collection, Acari Collection, at Beltsville, M.D. 20705.

ETYMOLOGY: This species is named for my wife Cristina Kruse, for her devotion and dedicated help in this work.

REMARKS: On P. clandestinum Hoechts. causes ramification of leaves resembling small fans.

Genus Tarsonemella Hirst

Tarsonemella Hirst, 1923: 995; Lindquist, 1986b: 242.

This genus is distinguished by the absence of bothridial setae and c_3, and by the length of the cheliceral stylets and their retractable action (Lindquist 1986b).

Tarsonemella (Paratarsonemella) ramirezi, subgenus nov. and spec. nov.

DIAGNOSIS: Adult females (the only instar known) of Paratarsonemella are similar to females of Tarsonemella Hirst by having large robust idiosoma, strong short legs and tibiotarsus I with a large strong hooked-sessile claw; and by having cheliceral stylets very long with large conspicuous basal levers. Bothridial setae and setae 3c are present, both mentioned as being absent by Lindquist (1986b) in Tarsonemella.

MALE: Unknown.

FEMALE: (Figs. 35-36) Length 313.59 ± 21.84, width 155.62 ± 10.09. Gnathosoma, length 51.09 ± 2.43, width 48.27 ± 4.05; anterolateral simple setae 2x as long as ventral setae. Palpi directed anteriorly, slightly curved and approximate distally, each with 2 minute setae

dorsolaterally, 2 minute pits ventrally. Cheliceral stylets strong and very long with large conspicuous basal levers. Pharynx short and slightly sclerotized.

Idiosoma, body elongate and stout. Prodorsal shield subrectangular. Setae v1 1/2 as long as Sc2. Sc1 (bothridial setae) capitate finely spiculate (17.81 + 1.14). Sc1 anterior to Sc2. Setae c1 and c2 smooth and simple. Setae c1 about 1/2 length of c2. Base of setae c1 not on horizontal plane with c2, situated below base of c2. Setae d, e and f equal in length. Setae h and ps slightly serrate, ps longer than other dorsal setae; h 1/3 length of ps, e and f 1/2 length of h. Tergite H with pores. Pores on tergites D and EF not easily seen. Ventral anteromedian apodeme extending posteriorly to transverse apodeme, apodemes I and II uniting with anteromedian apodeme. Apodeme III not uniting with posteromedian apodeme. Apodeme IV uniting with posteromedian apodeme. Posteromedian apodeme barely visible. Ventrocaudal lobe between leg IV large and spadelike. Coxal setae 1a and 2a short, slender and equal in length, about 1/3 length of 3a and 3b. Setae 3a, 3b, 3c and 4b same length.

Legs I, II and III short and robust; leg III longer than legs I and II. Three spine-like setae adjacent to sessile claw present on leg I. Ta ω present on leg I. Ta ω of tarsi II-III strong, and conspicuously dentate distally. Setation respectively on femur, genu and tibia and tarsus of leg I: 3-4-5(3)+10(1); leg II: 3-3-4-5(2); leg III: 1+3-4-5.

Tibiotarsus I with tibial cluster of 3 sensilla. Leg IV stout about as long as combined length of femorogenu and tibia III, not reaching to posterolateral margin of idiosoma; femorogenu 2x as long as tibiotarsus, subterminal setae of tibiotarsus about 1/2 length of movable part of leg IV; terminal setae about 6x as long as subterminal setae. Ambulacrum of legs I, II and III with a well-developed membranous structure, bearing strong claws.

HOST AND LOCALITY: Holotype female, 7 paratypes females were collected at Campus Universidad de Costa Rica, San José (Coll. W.L. Ramírez, 1989), on Ficus sp. Holotype, 3 paratypes females: deposited in the Collection of Lab. Acarología, Facultad de Agronomía, Universidad de Costa Rica, San José, Costa Rica; 2 paratypes deposited in the Collection of Proyecto MIP, CATIE; paratype (N°CR-R0021) 2 females: deposited in the U.S. National Museum Collection, Acari Collection, at Beltsville, 20705.

ETYMOLOGY: This species is named in honor of Dr. William L. Ramírez, Escuela de Fitotecnia, Universidad de Costa Rica, for his dedication to the study of fig wasps and their interrelations.

REMARKS: This new species may present a completely new genus. If not, the generic definition of Tarsonemella must be redefined. Lindquist (1986b) ilustrates and discusses the type of Tarsonemella africanus (Hirst). This new taxon differs by the following characters. The bothridial setae and setae 3c are absent in Tarsonemella but are present on

this species. This species has long and retractable cheliceral stylets as does T. africanus. The ventral setae are smooth and simple whereas they are spinelike on T. africanus. Setae v'G and v'Ti on leg IV as designated by Lindquist are subequal in length on this species and are not equal on T. africanus. Also, setae h and ps are slightly serrate on this new species but are smooth on T. africanus.

This subspecies, Tarsonemella ramirezi is associated with fig wasps of the genus Pegoscapus (HYMENOPTERA) which pollinate Ficus hemsleyana Stand. Apparently, this species is transported by Pegoscapus, and that they possibly feed on pollen, seed or some fungus when they are inside the fruit; but the strong theory is that they feed on pollen. Fig wasps may transport eggs of T. ramirezi in the coxal corbiculae (W. Ramirez, personal conversation, 1989).

Genus Tarsonemus Canestrini & Fanzago

Tarsonemus Canestrini & Fanzago, 1876: 141; Beer, 1954: 1115; Lindquist, 1986b: 333.
Chironemus Canestrini & Fanzago, 1876: 110; Beer, 1954: 1115; Lindquist, 1986b: 333.
Cheylurus Trouessart, 1885: 90; Canestrini, 1888: 311; Lindquist, 1986b: 333.
Tarsonemoides Tragardh, 1905: 101; Beer & Nucifora, 1965: 34; Lindquist, 1986b: 333.
Chaetotarsonemus Beer & Nucifora, 1965: 38; Lindquist, 1986b: 333.
Lupotarsonemus Beer & Nucifora, 1965: 38; Lindquist, 1986b: 333.
Metatarsonemus Attiah, 1970: 188; Lindquist, 1986b: 333.
Cheylotarsonemus Tseng & Lo, 1980: 125; Lindquist, 1986b: 333.

This genus has numerous species and variations in its morphology, which make it easy to confuse and misidentify

species. Lindquist (1986b) gives a detailed discussion about it and place some genera and species in synonymy, there by rearranging this genus.

Variation in length of opisthosoma, size and union of apodemes, and size of solenidion, slightly differ between species and also within the same species.

A complete study of all species of this genus, with their respective keys and drawings like that presented by Beer in 1954, is required.

Tarsonemus bakeri Ewing

Tarsonemus bakeri Ewing, 1939: 20; Beer, 1954: 1125; Lindquist, 1978: 1038, 1986b: 339.

The male of this species is distinguished by having long slender leg IV with a strong tarsal claw and wihich is about same length as that of tibia IV. Apodeme IV uniting with posteromedian apodeme forming a Y-shaped juncture anteriorly. Apodeme III uniting with apodeme IV anteriorly, forming a rectangular coxal plate. Setae c_2 and c_1 equal in length.

HOST AND LOCALITY: Cleome sp., Parrita, Puntarenas (Coll. H. Aguilar, 1987).

REMARKS: This species was collected in a population of Tetranychus sp. and Brevipalpus sp.

Tarsonemus floridanus (Attiah)

Tarsonemus floridanus (Attiah), Lindquist, 1986b: 341.
Lupotarsonemus floridanus Attiah, 1970: 184.

The male of this species is distinctive by having fused tibia and tarsus on leg IV, tactile seta of tibiotarsus about same length as femur. Leg III is longer than leg IV.

HOSTS AND LOCALITIES: Bactris gasipaes H.B.K., Villa Colón, San José (Coll. M. Musmani, 1981); Citrus sinensis (L.) Osbeck, Grecia-Alajuela (Coll. L.A. Salas, 1980).

REMARKS: Fungus spores were found adhered to the dorsum of mites.

Tarsonemus fusarii Cooreman

Tarsonemus fusarii Cooreman, 1941: 1; Delfinado, 1976: 260; Lindquist, 1986b: 340.

The male of this species is distinctive by having dorsal and ventral setae of femorogenu IV about same length, and by having tibia and tarsus of leg IV fused. Solenidion on leg II stout, and extremely long, solenidion on leg I small, slender, 2/3 as long as that of leg II. Posteromedian apodeme not uniting with apodeme IV, anteromedian apodeme visible, but not extending posteriorly behind apodeme II.

HOSTS AND LOCALITIES: Acnistus arborescens Schlecth, Campus Universidad de Costa Rica, San José (Coll. L.A. Salas, 1977); Citrus sinensis (L.) Osbeck, Salitral de Acosta, San José (Coll. L.A. Salas, R. Gurdián, G. Ulate, F.Freitez, 1972); Persea americana Mill., Laguna de Zarcero,

Alajuela (Coll. U. Alfaro, R. Ochoa, 1984); Rosa sp., San Pedro de Montes de Oca, San José (Coll. V. Espinoza, F. Freitez, 1971).

REFERENCE SPECIMEN EXAMINED: Type (Nº15-334) male of T. fusarii Cooreman, on deposit in the U.S. National Museum Collection, Acari Collection at Beltsville, MD. 20705.

REMARKS: This species was found on Persea americana Mill. with a population of Eriophyes sp. Fungus spores were found adhered to the dorsum of mites.

Tarsonemus solengrandis spec. nov.

DIAGNOSIS: The species of T. solengrandis spec. nov. resembles that of T. fusarii Cooreman, but is distinguished by its elongate neck on the gnathosoma and big solenidion on tarsus II.

MALE: (Figs. 37-40) Length 166.32, width 86.25. Gnathosoma, length 22.5, width 22.5; with anterolateral simple setae about same size as ventral setae. Palpi approximate, directed anteriorly. Cheliceral stylets short. Pharynx strongly sclerotized, with wide oval-like walls, reaching posteriad edge of gnathosoma. Neck elongate as figured.

Idiosoma, body oval. Prodorsal shield subrectangular. Setae v_2 2/3 as long as setae v_1; Sc_1 about 2x as long as Sc_2; v_1 about same length as Sc_2. Hysterosoma with setae c_2 smooth and slender about 1/3 longer than c_1; setae d about same length as c_1 and pilose. One pair of pores or cupules

between setae c_1 and d. Ventral region smooth. Anteromedian apodeme extending posteriorly behind apodemes II, not uniting with transverse apodeme. Apodeme II curving inward, lightly uniting with anteromedian apodeme. Apodeme III uniting with apodeme IV and with posteromedian apodeme. Transverse apodeme reduced to fragments. Coxal setae 1a about same size of setae 2a. Coxal setae 3a about 2x as long as 2a. Coxal setae 3a and 3b about same size.

Leg III longer than legs I, II and IV; leg I about same size as leg II. Ta v present on tarsi I, II and III, spinelike. Setation respectively on femur, genu, tibia and tarsus of leg I: 4-4-5(3)-9(1); leg II: 3-3-4-4(2); leg III: 1-3-4-3. Tibia I with cluster of 3 sensilla comprised of short clavate solenidion (Ti a 2.5 ± 0.1), with finely stalked, thinly capitate solenidion (2.96 ± 0.1) with setiform seta (4.29 ± 0.1). Tarsus I with solenidion Ta a 2/3 as long as that of tarsus II (length 12.43 ± 0.03; width 1.77 ± 0.01). Leg IV moderately robust (50.32 ± 0.4), with tibiotarsus; femorogenu presenting striations medially, without flange. Tactile seta (34.04 ± 0.2). Tarsal claws normal, uncinated.

FEMALE: Unknown.

HOST AND LOCALITY: Holotype male was collected at Villa Colón, San José (Coll. M. Musmani, 1981), on Bactris gasipaes H.B.K. Holotype: deposited in the Collection of Lab. Acarología, Facultad de Agronomía, Universidad de Costa Rica, San José, Costa Rica.

ETYMOLOGY: This species is named for its big solenidion on tarsus II.

REMARKS: This mite was found with spores of the fungus Cladosporium sp. adhered to its body.

Tarsonemus inornatus (Attiah)

Tarsonemus inornatus (Attiah), Lindquist, 1986b: 341.
Lupotarsonemus inornatus Attiah, 1970: 180.

The male of T. inornatus is distinguished by the dorsal and ventral setae of femorogenu IV being about the same size, and by the fused tarsus and tibia IV; and by the tactile seta on tibiotarsus IV being about same length of the femorogenu. Other distinguishing characters are: solenidion II stout, longer than that of tarsus I; setae c_1, c_2 and d about same length.

HOSTS AND LOCALITIES: Anacardium occidentale L., Esparza, Puntarenas (Coll. C. Chinchilla, 1979); Bactris gasipaes H.B.K., Guápiles, Limón (Colls. M. Dormond, 1981, C. Ramírez, 1982, L.A. Salas, R. Ochoa, 1983); Capsicum annuum L., San Isidro de Coronado, San José (Coll. L. Hidalgo, 1983); Lantana camara L., Ojo de Agua, Pto. Cortés, Puntarenas (Colls. O. Fonseca, G. Ulate, R. Faerron, F. Freitez, 1972); Persea americana Mill., Zarcero, Alajuela (Coll. L. Solis, 1985); Sechium edule (Jacq.) Sw., Ujarrás, Paraíso, Cartago (Colls. S. Mediana, A. García, 1972) Vitis vinifera L., Cartago city (Coll. L. Hidalgo, 1971).

REFERENCE SPECIMEN EXAMINED: Holotype (Nº12) male of T. inornatus (Attiah), on deposit in the Florida State

Collection of Arthropods, Division of Plant Industry, Florida Department of Agriculture, at Gainesville, Florida 32602.

REMARKS: This mite was found on fruits of Anacardium occidentale L.

On Capsicum annuum L. this species was found with fungus spores adhered to its body.

On Persea americana a mite was found dead because of the fungus Hirsutella sp.

Tarsonemus minutus (Attiah)

Tarsonemus minutus (Attiah), Lindquist, 1986b: 341.
Lupotarsonemus minutus Attiah, 1970: 180.

Characters distinguishing minutus are: claw on leg IV, slender and short. Solenidion on tarsus II thick and elongated. Tarsus and tibia fused to form tibiotarsus. Setae 2a and 3a same size, slender and attenuate. Setae c_2 and c_1 about same size. Tactile setae of tibiotarsus IV about equal in length of leg IV. Anteromedian apodeme extending posteriorly behind apodemes II, not uniting with transverse apodeme. Apodeme II uniting with anteromedian apodeme.

HOSTS AND LOCALITIES: Acnistus arborescens Schlecht, Campus Universidad de Costa Rica, San José (Coll. L.A. Salas, 1977); Anacardium occidentale L., Esparza, Puntarenas (Coll. C. Chinchilla, 1979); Byrsonima crassifolia L., Volcán, Buenos Aires, Puntarenas (Coll. L.A. Salas, R. López, F. Freitez, 1973); Carica papaya L., Atenas, Alajuela

(Coll. R. Faerron, 1971); Musa sp., Siquirres, Limón (Coll. R. Falcón, 1971).

REFERENCE SPECIMEN EXAMINED: Holotype (Nº11) male of T. minutus (Attiah), on deposit in the Florida State Collection of Arthropods, Division of Plant Industry, Florida Department of Agriculture, at Gainesville, Florida 32602.

Tarsonemus pseudokennedyi spec. nov.

DIAGNOSIS: Species of T. pseudokennedyi spec. nov. resembles that of T. kennedyi Smiley & Moser, but is distinguished by having short, modified spinelike seta with striations on the femorogenu of leg IV, and by the pharynx sharpened distally. The closely related T. kennedyi has a similar modified seta on the femorogenu of leg IV, but this seta is without striations.

MALE: (Figs. 41-42) Length 157.5, width 86.25. Gnathosoma, length 22.5, width 22.5; with anterolateral simple setae 2/3 as long as ventral setae. Palpi parallel, directed anteriorly. Cheliceral stylets short. Pharynx long, slender, strongly sclerotized, oval proximally.

Idiosoma, body oval, slightly broadest in anterior region of hysterosoma. Prodorsal shield subrectangular. Setae v_2 1/2 as long as setae v_1; Sc_1 about 3x as long as Sc_2; v_1 about same length as Sc_2; base of setae Sc_1 and Sc_2 on same horizontal plane. Hysterosoma with setae c_2 smooth and slender, attenuate, slightly longer than c_1; c_1, d and e

about same length, finely serrate. Pores or cupules not easily seen. Dorsum with finely longitudinal striations, dorsum of genital capsule reticulate. Ventral region smooth. Anteromedian apodeme extending in fragments posteriorly behind apodemes II, not uniting with transverse apodeme. Apodeme II curving inward, not uniting with anteromedian apodeme. Apodeme III not uniting with apodeme IV. Posteromedian apodeme present, terminating bifurcately on distaly portion. Coxal setae 1a small, about 1/2 as long as 2a. Coxal setae 3b and 2a equal in length.

Leg III longer than legs I, II and IV; leg I about same size as leg II. Ta $\vee$ present on tarsi I, II and III, spinelike. Setation respectively on femur, genu, tibia and tarsus of leg I: 4-4-5(3)-9(1); leg II: 3-4-4-4(2); leg III: 1-3-4-2(2). Tibia I with cluster of three sensilla comprised of short clavate solenidion, with irregular stalked, thinly capitate solenidion, with small setiform seta. Tarsus I with solenidion Ta ω (4.4 $\pm$ 0.1) shorter than that of tarsus II (7.4 $\pm$ 0.1). Tarsus III with duplex setae, one of them spinelike. Leg IV atipical for genus, femorogenu distinctive by possessing small spinelike modified setae (2.96 $\pm$ 0.1) on inner margin, with striations rising from the base. Tibia IV slender, tactile setae long (74 $\pm$ 1.5). Tarsal claw normal, uncinated.

FEMALE: Length 221.6 $\pm$ 6.09, width 131.25 $\pm$ 9.4. Gnathosoma, length 29.24 $\pm$ 2.54, width 28.87 $\pm$ 2.24, including palpi, cheliceral and pharyngeal structures

similar to that of male.

Idiosoma elongate oval; dorsal shields smooth, as on ventral surface. Prodorsal shield subrectangular. Bothridial setae strongly pilose (14.8 ± 1.2). Setae v_1 about 1/2 as long as setae Sc_2. Setae c_2 about 2x as long as setae c_1; base of setae c_1 not on horizontal plane with c_2, situated slightly below base of c_2. Setae d, e, f and h small, slender, finely pilose and about same size. Tergites D, EF and H with pores. Anteromedian apodeme extending posteriorly apodemes II, uniting with transverse apodeme. Apodeme II curving inward, not uniting with anteromedian apodeme. Posteromedian apodeme present, uniting apodeme IV. Ventrocaudal lobe between leg IV small, wider than long, rounded distally. Coxal setae 1a, 2a, 3a and 3b about same size and slender.

Leg I and II about same size; leg III longer than legs I and II. Ta ѱ present on leg I-III, spinelike. Setation respectively on femur, genu, tibia and tarsus of leg I: 4-4-5(3)+9(1); leg II: 3-3-4-5(2); leg III: 1+3-4-4. Tibiotarsus I with tibial cluster of 3 sensilla like that of male. Tarsus II with a cluster of two sensilla, comprised of short clavate solenidion and strong spinelike solenidion, both same size. Leg IV slender about as long as combined length of femorogenu and tibia III, not reaching to posteriad margin of idiosoma; femorogenu 4x as long as tibiotarsus, subterminal seta of tibiotarsus about same size of movable part of leg IV; terminal seta about 2x as long as

subterminal seta.

HOST AND LOCALITY: Holotype, allotype and 7 paratypes females were collected at Villa Colón, San José (Coll. M. Musmani, 1981), on Bactris gasipaes H.B.K.l. Holotype, 5 paratypes females: deposited in the Collection of Lab. Acarología, Facultad de Agronomía, Universidad de Costa Rica, San José, Costa Rica; holotype and 2 paratype females (Nº CR-00031) deposited in the U.S. National Museum Collection, Acari Collection, at Beltsville, MD. 20705.

ETYMOLOGY: This species is named for its resemblance with I. kennedyi Smiley & Moser.

REMARKS: Some females have pharynxs more oval than others.

I. kennedyi is associated with bark beetles, but I. pseudokennedyi was found on fruits of Bactris gasipaes H.B.K. Spores of the fungus Cladosporium sp. were found adhered to the body of this mite.

Tarsonemus randsi Ewing

Tarsonemus randsi Ewing, 1939: 25; Beer, 1954: 1133.
Tarsonemus iowensis Ewing, Beer, 1954: 1133.

This species is distinctive by having apodemes III and IV closed anteriorly to form M-shaped junctures.

HOST AND LOCALITY: Limonium sp., San Ramón de Tres Ríos, Cartago (Coll. H. Noriega, 1987).

Tarsonemus scaurus Ewing

Tarsonemus scaurus Ewing, 1939: 28; Beer, 1954: 1213; Lindquist, 1987: 340.

This species resemble that of T. minutus, but is distinguished by having long, thick and same size solenidia on tarsus I and II.

HOSTS AND LOCALITIES: Lantana camara L., Ojo de Agua, Pto. Cortés, Puntarenas (Colls. O. Fonseca, G. Ulate, R. Faerron, F. Freitez, 1972); Musa sp., Bataan, Limón (Colls. L.A. Salas, G. Ulate, 1970); Myristica sp., Siquirres, Limón (Coll. R. Falcón, G. Ulate, F. Freitez, 1971); Pennisetum clandestinum Hoechts, Hcda. Terranova, Poasito, Alajuela (Colls. L.A. Salas, G. Ulate, F. Freitez, 1971).

REMARKS: This mite was found in a population of Oligonychus zeae B. & P. on Musa sp. Fungus spores were found adhered to the dorsum of mites.

Tarsonemus simplex Ewing

Tarsonemus simplex Ewing, 1939: 32; Beer, 1954: 1188; Lindquist, 1987: 339.

This species resemble that of T. fusarii Cooreman, but is distinguished by having a long tactile seta on tibia IV.

HOST AND LOCALITY: Cocos nucifera L., Puntarenas (Coll. J. Azofeifa, 1980).

REMARKS: This mite was found on fruits of Cocos nucifera L., affected by Eriophyes guerreronis (Keifer).

Tarsonemus waitei Banks

Tarsonemus waitei Banks, 1904: 96; Beer, 1954: 1181; Lindquist, 1978: 1024, 1986b: 339.
Tarsonemus setifer Ewing, Lindquist, 1978: 1024.
Tarsonemus pauperoseatus Suski, 1967: 267; Lindquist, 1978: 1024.

Species of T. waitei have solenidia on tarsus II thicker and longer than those of tarsus I. Leg IV robust, but not thick; setae over peduncles on femorogenu IV.

HOSTS AND LOCALITIES: Coffea arabica L., La Montaña/ CATIE, Turrialba, Cartago (Coll. J. Monterrey, 1989); Prunus persica (L.) Zieb. & Zucc., Barrio Escalante, San José (Coll. G. Ulate, 1972), San José city (Coll. M. Musmani, 1972).

REFERENCE SPECIMEN EXAMINED: A male (Nº66E26.22 det. by T. Kono) of T. waitei (T. setifer) Ewing, on deposit in the Lab. Acarología, Facult. Agronomía, Universidad de Costa Rica, San José, Costa Rica.

REMARKS: On Prunus persica, this mite was found with spores of the fungus Cladosporium adhered to its body.

Tarsonemus spp.(p?)

Tarsonemus spp.(p?).

Females are similar to that of T. smileyi Delfinado in the shape of the apodemes. This material is being reviewed on the U.S. National Collection, Acari Collection, at Beltsville, MD. 20705.

HOSTS AND LOCALITIES: Citrus sp., San Isidro, Coronado, San José (Coll. F. Freitez, 1971); Prunus persica

(L.) Zieb. & Zucc. San Pedro, San José (Coll. L.A. Salas, 1970); Spondias purpurea L., Guadarrama, Desamparados, San José (Coll. R. Ochoa, 1985).

REMARKS: Urediniospores of the fungus Tranzschelia discolor (Fckl.) Tranz. & Litv. were found adhered to the body of this mite on Prunus persica.

In Citrus sp. this mite was found on peduncles of the fruits.

Genus Xenotarsonemus Beer

Xenotarsonemus Beer, 1954: 1314.

Females of this genus are recognized by having ventrocaudal lobes between leg IV, slender, long and usually rounded to triangular apically. Males by having slender tarsal claws, and short, stout setae on the femur and tibiotarsus of leg IV (Beer 1954, 1960; Lindquist 1986b).

Xenotarsonemus gordoni spec. nov.

DIAGNOSIS: Females of this species resembles those of Xenotarsonemus viridis Ewing, but are distinguished by the length of the flange on femur I and the long thin pharynx. Furthermore, setae 3a is 1 1/3 longer than 3b in X. gordoni spec. nov.

MALE: Unknown.

FEMALE: (Figs. 43-45) Length 200 $\pm$ 12.37, width 138.75. Gnathosoma; length $\bar{X}$ 20.72, width $\bar{X}$ 19.24; with anterolateral and ventral setae, being simple, small and

slender. Palpi approximate, short, directed anteriorly. Cheliceral stylets short. Pharynx long and thin, with muscular sclerotized walls.

Idiosoma, body oval, finely punctated. Prodorsal shields subtriangular, covering gnathosoma. Bothridial setae capitate, slightly granulate (16.28 ± 0.32). Setae v_1 slender, Sc_2 slightly longer than v_1. Setae c_1 is 2/3 as long as setae c_2; base of setae c_1 not on horizontal plane with c_2, situated below base of c_2. Setae d, e, f and h slender, about same length, setae c_1 slightly longer than d. Tergites D, EF and H with pores. Anteromedian apodeme extending posteriorly to apodemes II, uniting with transverse apodeme. Posteromedian apodeme present. Apodeme IV uniting posteromedian apodeme. Ventrocaudal lobe between legs IV slender, long, and triangular (19.24 ± 1.10). Coxal setae 1a slender about 2/3 length of setae 2a. Coxal setae 3a 1 1/3 longer than 3b. Coxal setae 3b about same length to 2a.

Leg I slightly longer than leg II; leg III longer than legs I and II. Ta a_ω present on leg I, long and rodlike (16.87 ± 0.03). Ta v of tarsi I-III very small, spinelike. Setae a_ω of femur I long, slender, serrate, located near two long spinelike flanges. Femur II with large subtriangular flange as figured. Setation respectively on femur, genu, tibia and tarsus of leg I: 4-4-6(2) + 9 (1); leg II: 3-3-4-5(2); leg III: 1 + 3-4-5. Tibiotarsus I with tibial cluster of 2 sensilla. Leg IV slender about as long as combined

length of femorogenu and tibia III, not reaching to posterolateral edge of idiosoma; femorogenu 3x as long as tibiotarsus, subterminal seta of tibiotarsus same length of movable part of leg IV; terminal seta slightly longer than subterminal seta.

HOST AND LOCALITY: Holotype female, 2 paratypes females were collected at CATIE, Turrialba, Cartago (Coll. R. Faerron, 1971), on Acalypha macrostachya Jacq. Holotype and paratype: deposited in the Collection of Lab. Acarología, Facultad de Agronomía, Universidad de Costa Rica, San José, Costa Rica; paratype female (N°CR-R0025) deposited in the U.S. National Museum Collection, Acari Collection, at Beltsville, MD. 20705.

ETYMOLOGY: This species is named in honor of Ing. Román Gordón M.Sc., Instituto de Investigación Agropecuaria de Panamá (IDIAP), for his dedication and studies in phytoparasitic mites in Panamá.

Xenotarsonemus camarae spec. nov.

DIAGNOSIS: Species of X. camarae resembles that of X. uliginosis (Willmann), but are distinguished by the length of the pharynx and by the setae j on femur II. The pharynx is long in X. camarae and short in X. uliginosis.

MALE: Unknown.

FEMALE: (Figs. 46-48) Length 180, width 146.25. Gnathosoma, length 26.25, width 27; dorsal anterolateral setae indiscerable, ventral seta short and simple. Palpi

short and elongate; chelicerae short, needle-like or styletiform. Pharyngeal structure strong with stout muscular walls, almost extending from anterior gnathosoma to posterior margin of gnathosoma.

Idiosoma oval; dorsal shields smooth, as on ventral surface. Prodorsal shield subtriangular. Bothridial setae capitate, sparsely spiculated (12.7 ± 1.03). Setae v_1 about 1/2 as long as setae Sc_2. Setae c_1 and c_2 slender, setae c_2 1/3 longer than c_1; base of setae c_1 not on horizontal plane with c_2, situated below base of c_2. Setae d, e, f about equal in length, setae h about 1/3 longer than d, e and f. Tergite EF with pores. Pores on tergites D and H indiscernable. Anteromedian apodeme extending posteriorly beyond apodemes II, not uniting with transverse apodeme. Transverse apodeme ligthly sclerotized. Posteromedian apodeme present, barely visible. Apodemes III and IV barely visible. Ventrocaudal lobe between legs IV triangular, long, slender, pointed distally (13.32). Coxal setae 1a slender about 1/2 length of setae 2a. Coxal setae 3a slender and lightly serrate. Coxal setae 3b equal in length to 2a and 3a.

Leg III slightly longer than legs I and II. Ta ω present on leg I-III, small spinelike. Setae ω_1 of femur I long, serrate, located near to small spinelike flange. Femur II with large elongate flange as figured. Setae $\mathcal{J}$ on femur II spatulate, pilose. Setation respectively on femur, genu, tibia and tarsus of leg I: 4-4-6(2) + 8(1); leg II: 3-

3-4-5(2); leg III: 1 + 3-4-5. Tibiotarsus I with tibial cluster of 2 sensilla. Leg IV slender and short, about same length of femorogenu of leg III, not reaching to posterolateral edge of idiosoma; femorogenu 4x as long as tibiotarsus, subterminal seta of tibiotarsus about same length of movable part of leg IV; terminal seta slightly longer than subterminal seta.

HOST AND LOCALITY: Holotype female was collected at Carretera Nacional N°10, Paraíso, Cartago (Colls. L.A.Salas, G.Ulate, F.Freitez 1971) on Lantama camara L. Holotype deposited in the Collection of Lab. Acarología, Facult. Agronomía, Universidad de Costa Rica, San José, Costa Rica.

ETYMOLOGY: This species is named for its host, Lantama camara L.

REMARKS: Mites of the genus Tydeus sp. (Tydeidae) were found with this species. X. camarae present 2 solenidia on tarsus II, proximally and medially.

Xenotarsonemus vargasi spec. nov.

DIAGNOSIS: The male of X. vargasi resembles that of X. denmarki Beer, but are distinguished by having setae Sc_1 3x longer than Sc_2, and solenidion on tarsus II thicker and longer than that of tarsus I. X. denmarki has setae Sc_1 and Sc_2 about same size and solenidion on tarsus I and II, about same size.

MALE: (Figs. 49-50) Length 121.87, width 67.5. Gnathosoma, length 19.87, width 19.5; with anterolateral

simple setae about 1 1/2 as long as ventral setae. Palpi small, directed anteriorly, nearly parallel. Cheliceral stylets short, with 3 inconspicuous processes distally. Pharynx long with finely sclerotized walls.

Idiosoma; body pyriform; broadest in anterior region of hysterosoma. Prodorsal shield subrectangular. Setae v_2 slender, pilose, 2/3 as long as setae v_1; Sc_1 about 3x as long as Sc_2; v_2 about same length as Sc_2. Hysterosoma with setae c_2 smooth, attenuate and slender, about equal in length as c_1; base of setae Sc_1 nearly on horizontal plane with Sc_2. Setae d and c_1 pilose, about same size. Pores or cupules present, not easily seen. Ventral region smooth. Anteromedian apodeme extending posteriorly behind apodemes II, uniting with transverse apodeme. Apodeme II curving inward, uniting with anteromedian apodeme. Apodeme III not uniting with apodeme IV. Posteromedian apodeme present. Coxal setae 1a and 2a slender, about same size. Coxal setae 3a and 3b slender, about same size; setae 3a (13.32 $\pm$ 0.2) 2x as long as 1a and 2a.

Leg III slightly longer than legs I, II and IV; leg I about same size as leg II. Ta ω present on tarsi I-III, small, spinelike. Setation respectively on femur, genu, tibia and tarsus of leg I: 4-4-5(3) - 8(1); leg II: 3-3-4-5(2); leg III: 1 - 3-4-4. Tibia I with cluster of 3 sensilla comprised of short clavate solenidion (Ti ω), with finely stalked, thinly capitate solenidion and setiform seta. Tarsus II with solenidion Ta ω (5.18 $\pm$ 0.1) 1/3

longer and thicker than that of tarsus I. Leg IV short (33.75 ± 0.35), with setae on trochanter, femorogenu as figured; with rodlike solenidion adjacent to tactile (29.6 ± 0.4) on tibiotarsus IV. Tarsal claws slender, slightly curved.

FEMALE: Unknown.

HOST AND LOCALITY: Holotype male was collected at La Rita, Guápiles-Limón (Coll. M. Dormond, 1983) on Bactris gasipaes H.B.K. Holotype deposited in the Collection of Lab. Acarología, Facultad de Agronomía, Universidad de Costa Rica, San José, Costa Rica.

ETYMOLOGY: This species is named in honor of Dr. Mario Vargas-Vargas, Facultad de Microbiología, Universidad de Costa Rica, for his dedication to the Medical Acarology in Costa Rica.

REMARKS: This mite was found on leaves of Bactris gasipaes with about 30 spores of the fungus Cladosporium sp. adhered to its body.

DISCUSSION AND CONCLUSIONS

The main purpose of this study was the taxonomic identification to species of members of the Family Tarsonemidae (white mites) found in Costa Rica, list their hosts and describe the symptomology of damage they produce.

A detailed study of members of the family was carried out starting with the first specimen collected in 1970 to the last which was registered in the Reference Collections of the MIP/Catie project and the Lab. Acarologia, Escuela de Fitotecnica, University of Costa Rica in 1989.

Since 1962, when the University of Costa Rica's Acarology Course started, to the present, different specimens have been sampled, observed and collected from a variety of hosts including forestry, ornamental, medicinal and fruit species, traditional crops and weeds. Processing of collected material was increased since 1970.

With the aid of specialized literature and support received, many species were identified including two new genera, one new sub-genus and new species whose descriptions and illustrations are presented for the first time in this work.

Diagnostic information related to hosts and damage is presented for use in the field as a first approximation in identification of the pest.

Species found were Acarapis woodi (Rennie), Daidalotarsonemus deleoni (Smiley), Daidalotarsonemus

limonensis spec. nov., Daidalotarsoenemus ternifoliae spec. nov., Dendroptus irregularis spec. nov., Floridotarsonemus edule spec. nov., Fungitarsonemus cocosi (DeLeon), Fungitarsonemus lodici (DeLeon), Fungitarsonemus peregrinus (Beer), Neodendroptus perseae spec. nov., Phytonemus pallidus (Banks), Polyphagotarsonemus latus (Banks), Spinatarsonemus alajuelensis spec. nov., Spinatarsonemus costarricensis spec. nov., Spinatarsonemus parsoni spec. nov., Steneotarsonemus comosus spec. nov., Steneotarsonemus kruseae spec. nov., Tarsonemella (Paratarsonemella) ramirezi spec. nov., Tarsonemus bakeri Ewing, Tarsonemus floridanus (Attiah), Tarsonemus fusarii Cooreman, Tarsonemus solengrandis spec. nov., Tarsonemus inornatus (Attiah), Tarsonemus minutos (Attiah), Tarsonemus pseudokennedyi spec. nov., Tarsonemus randsi Ewing, Tarsonemus scaurus Ewing, Tarsonemus simplex Ewing, Tarsonemus waitei Banks, Tarsonemus spp. (p?), Xenotarsonemus gordoni spec. nov., Xenotarsonemus camarae spec. nov. and Xenotarsonemus vargasi spec. nov.

Acarapis woodi was found affecting the tracheal system of Apis mellifera in several hives. This could become an important economic pest in Costa Rica due to its effects on honey production. Evaluation of different hives in the country has been recommended (Calvo & Vargas).

The species most commonly found were Phytonemus pallidus, Polyphagotarsonemus latus, Tarsonemus fusarii, Tarsonemus inornatus, Tarsonememus minutus, Tarsonemus

scaurus and Tarsonemus waitei. P. latus feeding causes a wide range of symptoms on different hosts: Upward leaf curl, on Glycine max, downward leaf curl, on Capsicum annuum, Lycopersicon esculentum, Impatiens spp., Solanum tuberosum, Citrus aurantium and Citrus reticulata, leaf bending and reduction of leaf surface, on Solanum melongena, Schefflera sp. and Phaseolus vulgaris, flower and leaf fall on Capsicum annuum, fine cracking of the fruit and carpel epidermis, on Solanum melongena, poor development and dwarfism of the plant, on Capsicum annuum, changes in the color of the lower surface of the leaf to dull brown and reddish, on Schefflera sp. and Citrus spp., and death as seen for Lycopersicon esculentum. P. latus can be considered the most important phytoparasitic representative of the Tarsonemidae in Costa Rica and Central America.

This study determined that P. pallidus causes epidermal cracking and leaf necrosis, on Saintpaulia spp. and Gloxinia sp., poor plant development on Fragaria sp., leaf deformation, reverse leaf curling and dwarfism of Capsicum annuum. Depending on the host, this mite causes varying percentages of damage, indicating a possible difference in its development or aggressiveness.

Some mites were found to interact with other pest organisms, such as Neodendroptus perseae with the fungus Sphaceloma sp. on Persea americana and P. latus with the insect Bemisia on Capsicum annuum.

Damage caused by P. pallidus and P. latus in some

hosts, has been confused with virus, fungus, bacteries and nutritional deficiency.

Tarsonemids transport fungus, in specialized structures as sporothecas (Moser), or use the folds and sutures of the body and the legs, as small baskets.

Steneotarsonemus comosus was found on Ananas comosus causing a multiple crown of the fruit because of abnormal leaf growth. Steneotarsonemus kruseae was found on Pennisetum clandestinum causing a proliferation of leaf buds in the form of a fan, reducing the length of the leaves. Symptoms caused by Steneotarsonemus furcatus DeLeon like those mentioned by Freitez (1979) on Cocos nucifera, were observed in Costa Rica, but mites were not found.

Daidalotarsonemus deleoni, Daidalotarsonemus limonensis spec. nov., Fungitarsonemus lodici, Fungitarsonemus peregrinus, Polyphagotarsonemus latus, Tarsonemus fusarii, Tarsonemus inornatus, Tarsonemus scaurus, Tarsonemus sp., Tarsonemus pseudokennedyi spec. nov., Tarsonemus waitei and Xenotarsonemus vargasi were collected with fungus spores on their bodies, suggesting that mites disperse fungi on which they may or may not feed. Future investigation of the role of tarsonemids in the desimination of fungi on other tropical plants is needed to clarify their importance.

The appearance of new species, subgenera and genera in the collected material indicates how little this family, along with others in the Costa Rican and Central American tropics and sub-tropics, has been studied.

The genera Neodendroptus, Spinatarsonemus and sub-genus Paratarsonemella are mentioned since, according to Lindquist's key (1986b), they do not exhibit all the characteristics for the described genera. Neodendroptus is similar to Dendroptus and Phytonemus, Spinatarsonemus resembles Heterotarsonemus and Hemitarsonemus, while the sub-genus Paratarsonemella has retractible quelicerae like Tarsonemella, but posesses bothridial and 3c setae. It is probable that Paratarsonemella can be elevated to genus level as Neodendroptus and Spinatarsonemus can be reduced to sub-genus level.

Finally, it should not be discounted that as samples continue to be taken, the appearance of new representatives will reinforce or change the current classification of the Tarsonemidae family. There is, therefore, a need for keys and drawings at the species level for the different genera, to assist in recognition and ordering of the specimens.

RESUMEN: Se describen e ilustran nuevos géneros, subgénero y especies de la Familia Tarsonemidae: Daidalotarsonemus limonensis spec. nov., Daidalotarsoenemus ternifoliae spec. nov., Dendroptus irregularis spec. nov., Floridotarsonemus edule spec. nov., Neodendroptus genus nov., Neodendroptus perseae spec. nov., Spinatarsonemus genus nov., Spinatarsonemus alajuelensis spec. nov., Spinatarsonemus costarricensis spec. nov., Spinatarsonemus parsoni spec. nov., Tarsonemella (Paratarsonemella) ramirezi

subgenus nov. spec. nov., Tarsonemus solengrandis spec. nov., Tarsonemus pseudokennedyi spec. nov., Steneotarsonemus comosus spec. nov., Steneotarsonemus kruseae spec. nov., Xenotarsonemus gordoni spec. nov., Xenotarsonemus camarae spec. nov. and Xenotarsonemus vargasi spec. nov. Se mencionan notas sobre caracteristicas de campo, sintomatología en sus plantas hospederas e interrelaciones con otros patógenos. Se presentan claves de los géneros, y especies de Tarsonemus encontradas en Costa Rica.

HOSTS: MITES

Apis mellifera L.	HYMENOPTERA: Apidae
Acarapis woodi (Rennie)	
Acalypha macrostachya Jacq.	EUPHORBIACEAE
Xenotarsonemus gordoni spec. nov	
Acnistus arborescens Schlecht	SOLANACEAE
Tarsonemus fusarii Cooreman	
Tarsonemus minutus (Attiah)	
Anacardium occidentale L.	ANACARDIACEAE
Tarsonemus inornatus (Attiah)	
Tarsonemus minutus (Attiah)	
Ananas comosus (L.) Mell.	BROMELIACEAE
Steneotarsonemus comosus spec. nov.	
Annona cherimolia Mill.	ANNONACEAE
Polyphagotarsonemus latus Banks	
Annona muricata L.	ANNONACEAE
Daidalotarsonemus limonensis spec. nov.	
Bactris gasipaes H.B.K.	PALMAE
Tarsonemus floridanus (Attiah)	
Tarsonemus solengrandis spec. nov.	
Tarsonemus inornatus (Attiah)	
Tarsonemus pseudokennedyi spec. nov.	
Xenotarsonemus vargasi spec. nov.	
Byrsonima crassifolia L.	MALPIGHIACEAE
Tarsonemus minutus (Attiah)	
Capsicum sp.	SOLANACEAE
Polyphagotarsonemus latus (Banks)	
Capsicum annuum L.	SOLANACEAE
Phytonemus pallidus (Banks)	
Polyphagotarsonemus latus (Banks)	
Tarsonemus inornatus (Attiah)	
Carica papaya L.	CARICACEAE
Tarsonemus minutus (Attiah)	
Citrus sp.	RUTACEAE
Tarsonemus sp.	
Citrus aurantium L.	RUTACEAE
Polyphagotarsonemus latus (Banks)	

Citrus paradisi Macf.	RUTACEAE
Spinatarsonemus alajuelensis spec. nov.	
Citrus reticulata Blanco	RUTACEAE
Polyphagotarsonemus latus (Banks)	
Citrus sinensis (L.) Osbeck	RUTACEAE
Tarsonemus floridanus (Attiah)	
Tarsonemus fusarii Cooreman	
Cleome spp.	CAPPARIDACEAE
Tarsonemus bakeri Ewing	
Cocos nucifera L.	PALMAE
Fungitarsonemus cocosi (DeLeon)	
Tarsonemus simplex Ewing	
Codiaeum variegatum Blume	EUPHORBIACEAE
Polyphagotarsonemus latus (Banks)	
Coffea arabica L.	RUBIACEAE
Tarsonemus waitei Banks	
Cupressus sp.	CUPRESSACEAE
Daidalotarsonemus deleoni (Smiley)	
Dendroptus irregularis spec. nov.	
Polyphagotarsonemus latus (Banks)	
Datura arborea L.	SOLANACEAE
Polyphagotarsonemus latus (Banks)	
Datura stramonium L.	SOLANACEAE
Polyphagotarsonemus latus (Banks)	
Ficus hemsleyana Stand.	MORACEAE
Tarsonemella (P.) ramirezi spec. nov.	
Fragaria sp.	ROSACEAE
Phytonemus pallidus (Banks)	
Glycine max (L.) Mell	PAPILIONACEAE
Polyphagotarsonemus latus (Banks)	
Impatiens spp.	BALSAMINACEAE
Polyphagotarsonemus latus (Banks)	
Lantana camara L.	VERBENACEAE
Tarsonemus inornatus (Attiah)	
Tarsonemus scaurus Ewing	
Xenotarsonemus camarae spec. nov.	
Limonium sp.	PLUMBAGINACEAE
Tarsonemus randsi Ewing	

Lycopersicon esculentum Mill.	SOLANACEAE
Polyphagotarsonemus latus (Banks)	
Macadamia ternifolia F.	PROTEACEAE
Fungitarsonemus lodici (DeLeon)	
Daidalotarsonemus ternifoliae spec. nov.	
Mangifera indica L.	ANACARDIACEAE
Polyphagotarsonemus latus (Banks)	
Musa sp.	MUSACEAE
Tarsonemus minutus (Attiah)	
Tarsonemus scaurus Ewing	
Myristica sp.	MYRISTICACEAE
Tarsonemus scaurus Ewing	
Phaseolus vulgaris L.	LEGUMINOSAE
Polyphagotarsonemus latus (Banks)	
Pennisetum clandestinum Hoechts	GRAMINEAE
Steneotarsonemus kruseae spec. nov.	
Tarsonemus scaurus Ewing	
Persea americana Mill.	LAURACEAE
Daidalotarsonemus ternifoliae spec. nov.	
Neodendroptus perseae spec. nov.	
Spinatarsonemus parsoni spec. nov.	
Tarsonemus fusarii Cooreman	
Prunus persica (L.) Zieb. & Zucc.	ROSACEAE
Tarsonemus sp.	
Tarsonemus waitei Banks	
Rosa sp.	ROSACEAE
Tarsonemus fusarii Cooreman	
Rubus sp.	ROSACEAE
Spinatarsonemus costarricensis spec. nov.	
Saccharum officinarum L.	GRAMINEAE
Fungitarsonemus peregrinus (Beer)	
Saintpaulia sp.	GESNERIACEAE
Phytonemus pallidus (Banks)	
Saintpaulia ionantha Wendl.	GESNERIACEAE
Phytonemus pallidus (Banks)	
Schefflera sp.	ARALIACEAE
Polyphagotarsonemus latus (Banks)	

Sechium edule (Jacq.) Sw.	CUCURBITACEAE
Floridotarsonemus edule spec. nov	
Tarsonemus inornatus (Attiah)	
Sinningia speciosa Benth. & Hook.	GESNERIACEAE
Phytonemus pallidus (Banks)	
Solanum tuberosum L.	SOLANACEAE
Polyphagotarsonemus latus (Banks)	
Spondias purpurea L.	ANACARDIACEAE
Tarsonemus sp.	
Vitis vinifera L.	VIOLACEAE
Tarsonemus inornatus (Attiah)	

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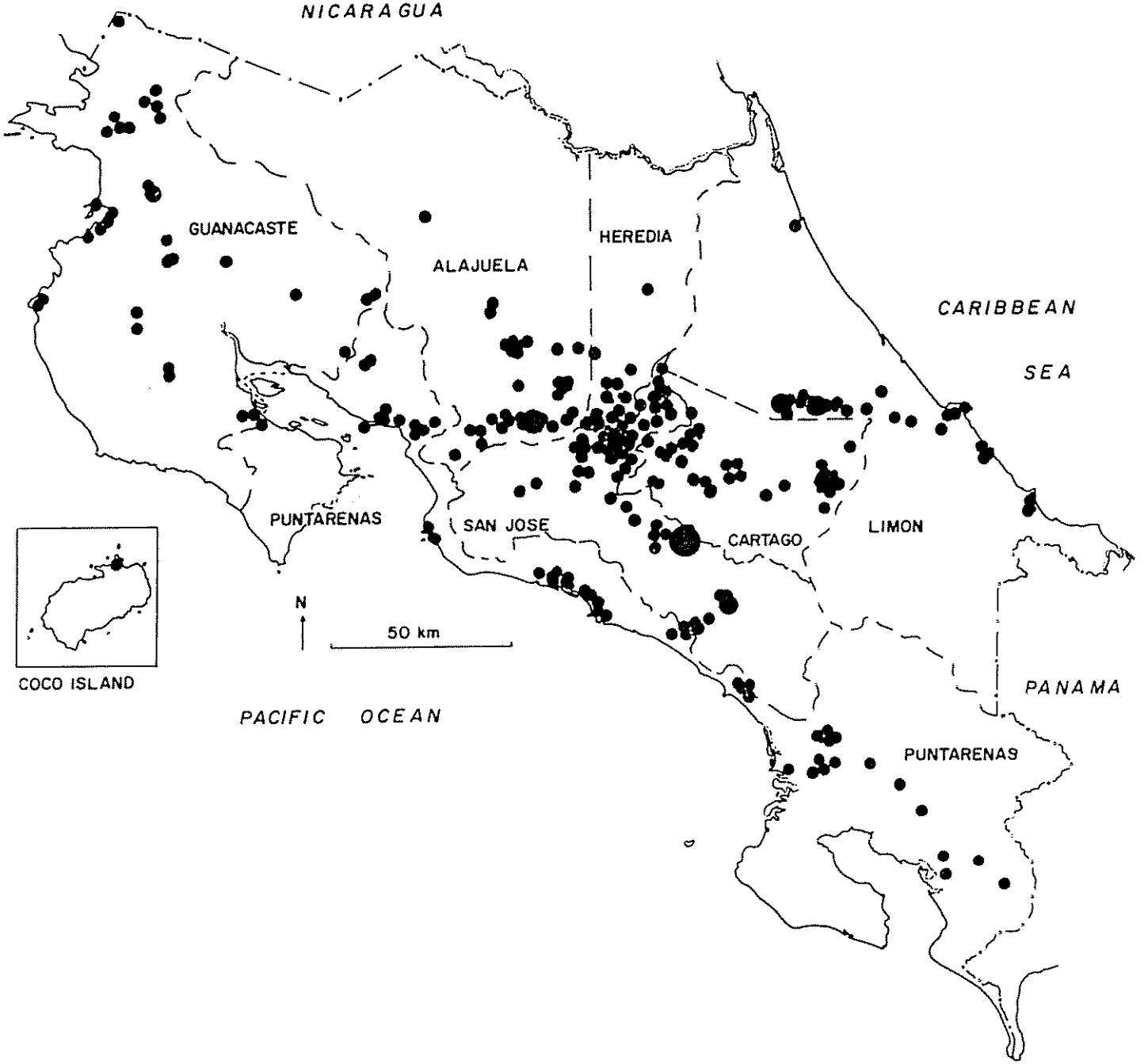
NICARAGUA
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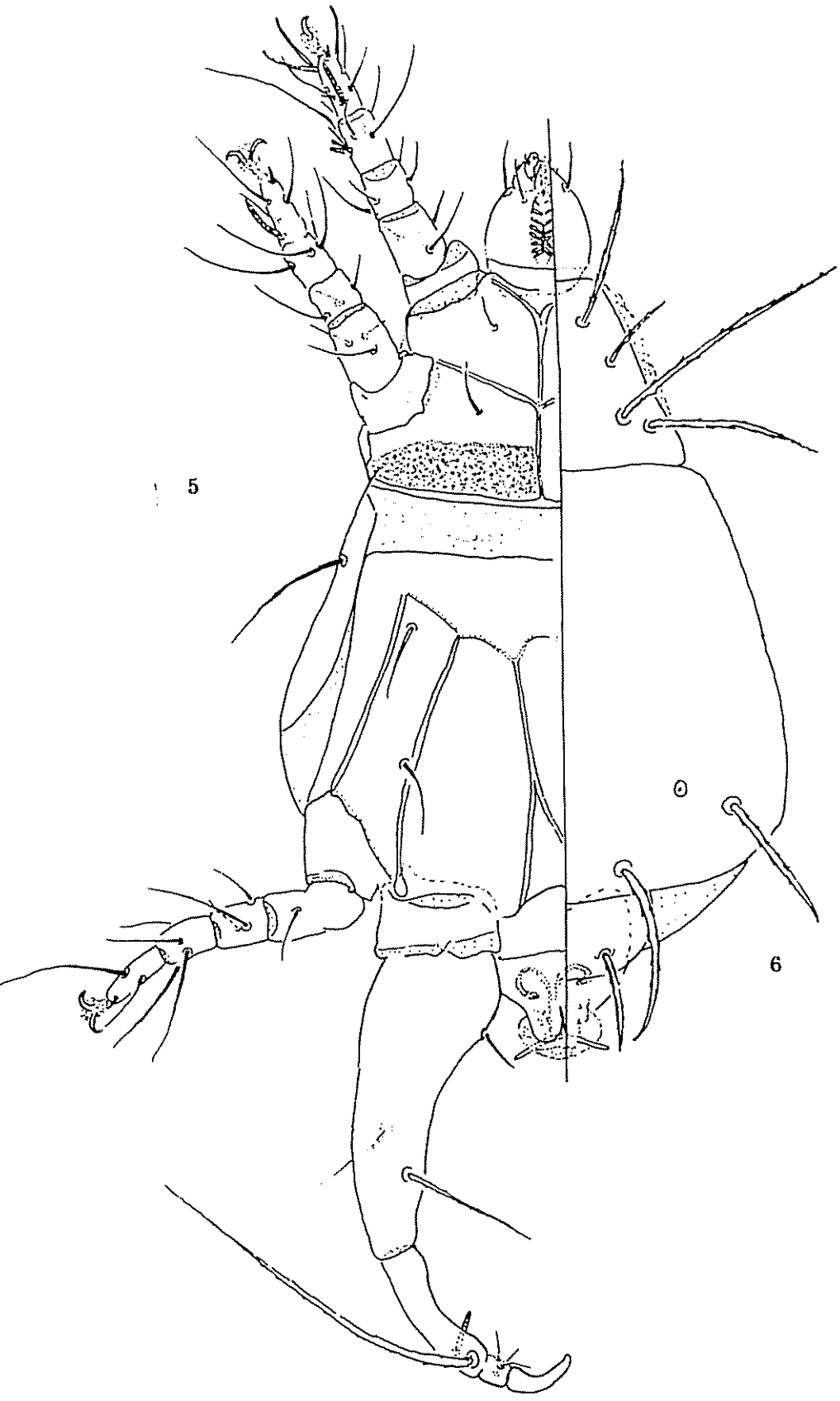
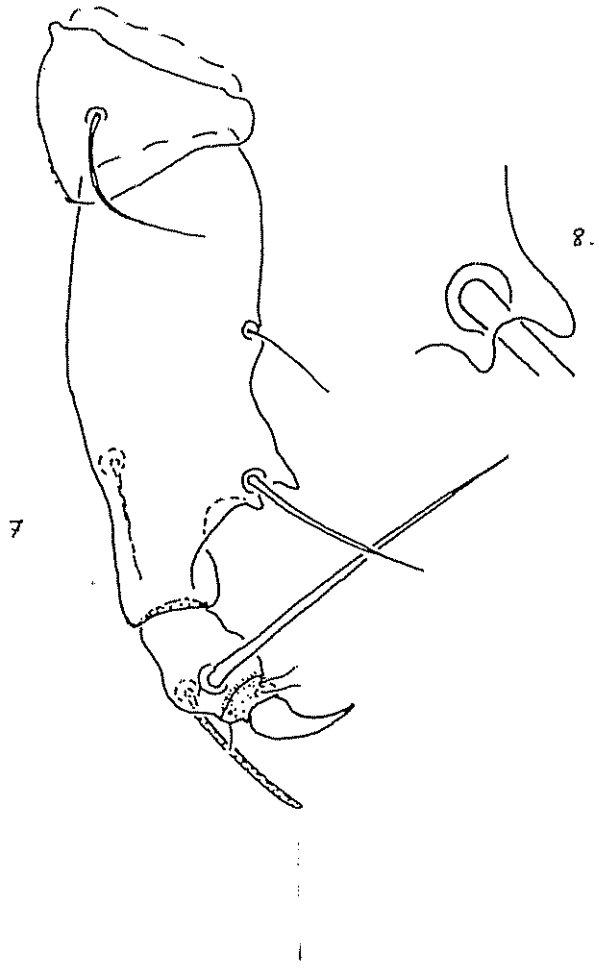
COCO ISLAND
PACIFIC OCEAN
PANAMA
PUNTARENAS

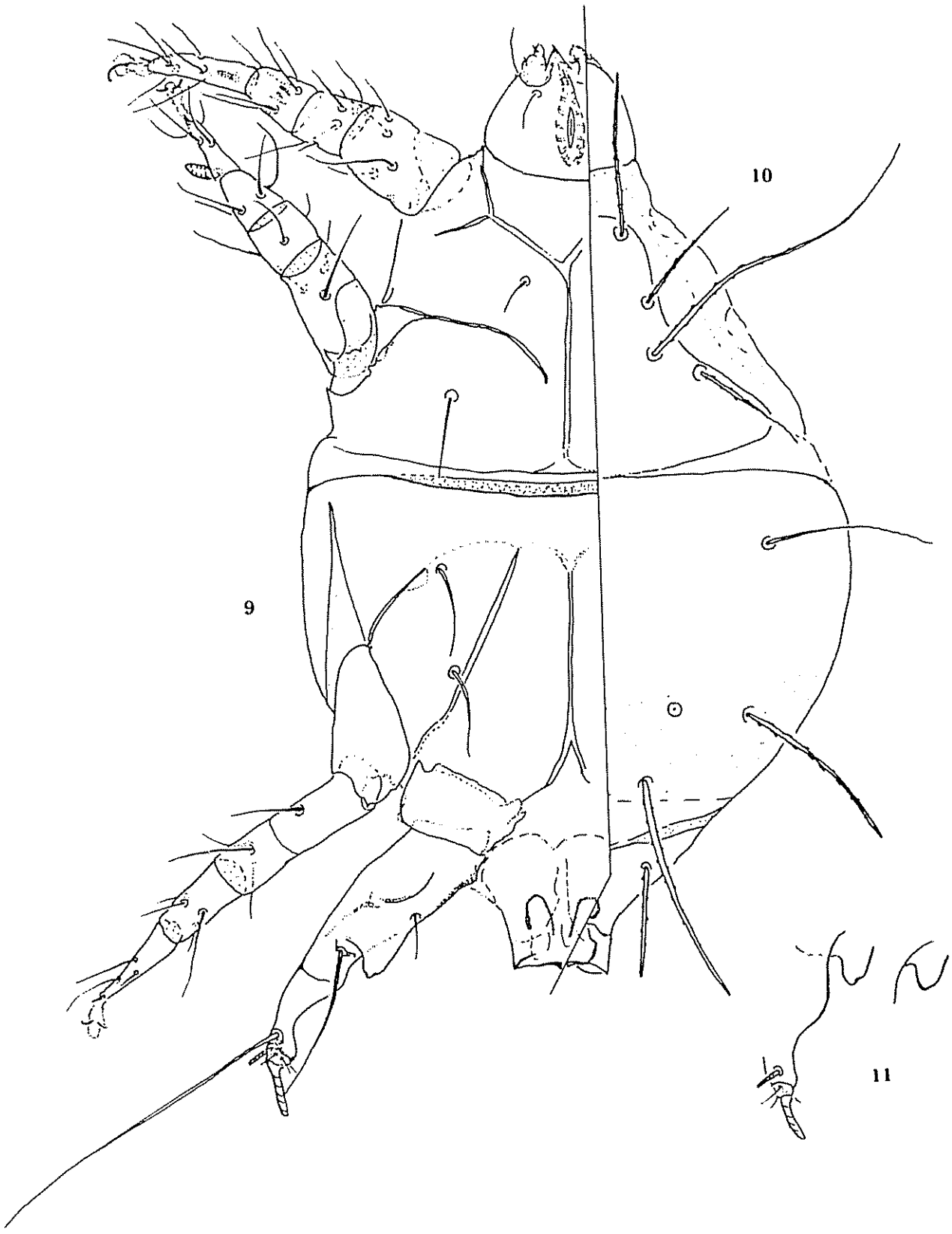
Figs. 2-4. Daidalotarsonemus limonensis spec.nov. female-2. ventral aspect, 3. dorsal aspect, 4. leg IV.



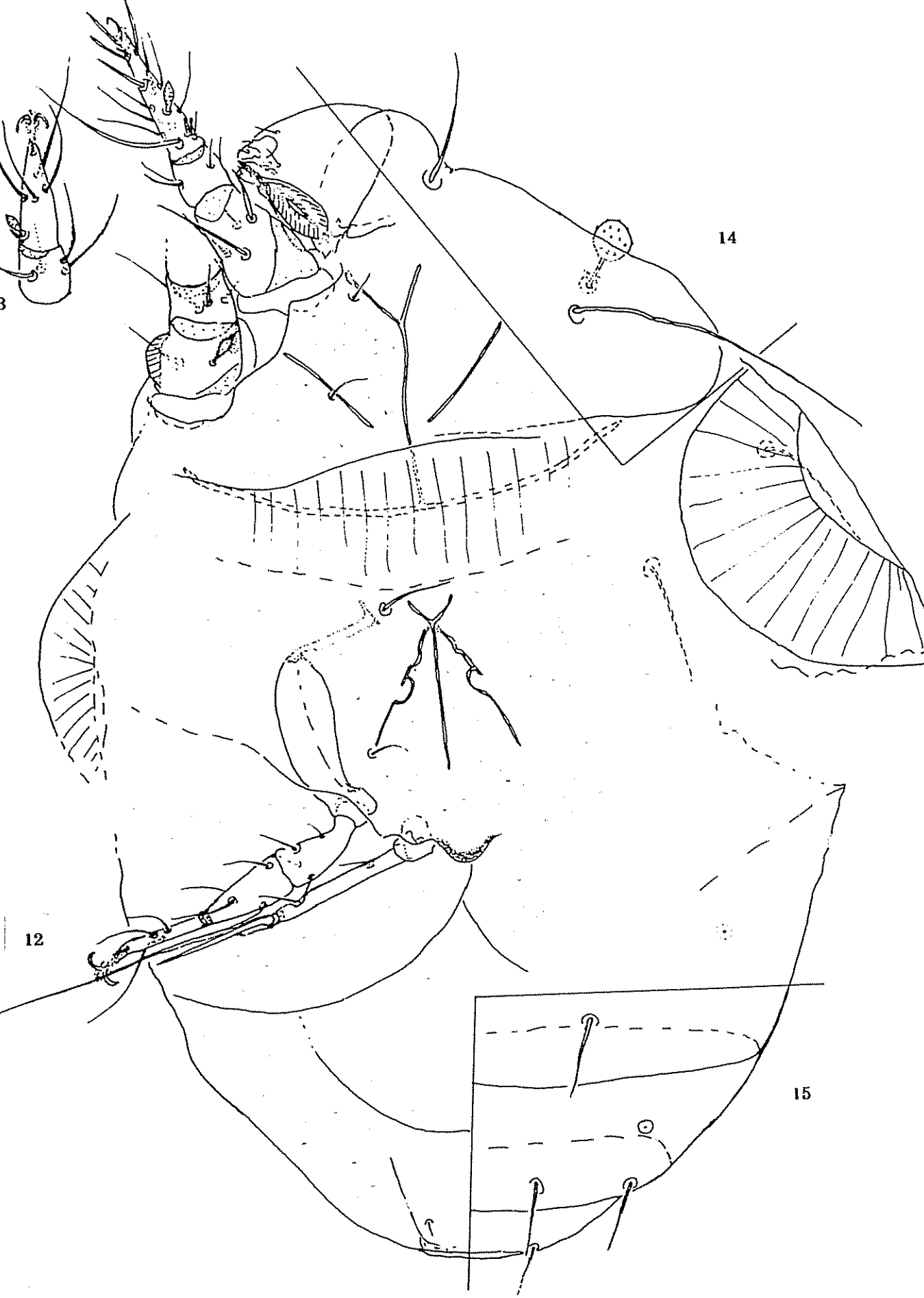
Figs. 5-6. Daidalotarsonemus ternifoliae spec.nov. male-5. ventral aspect, 6. dorsal aspect.



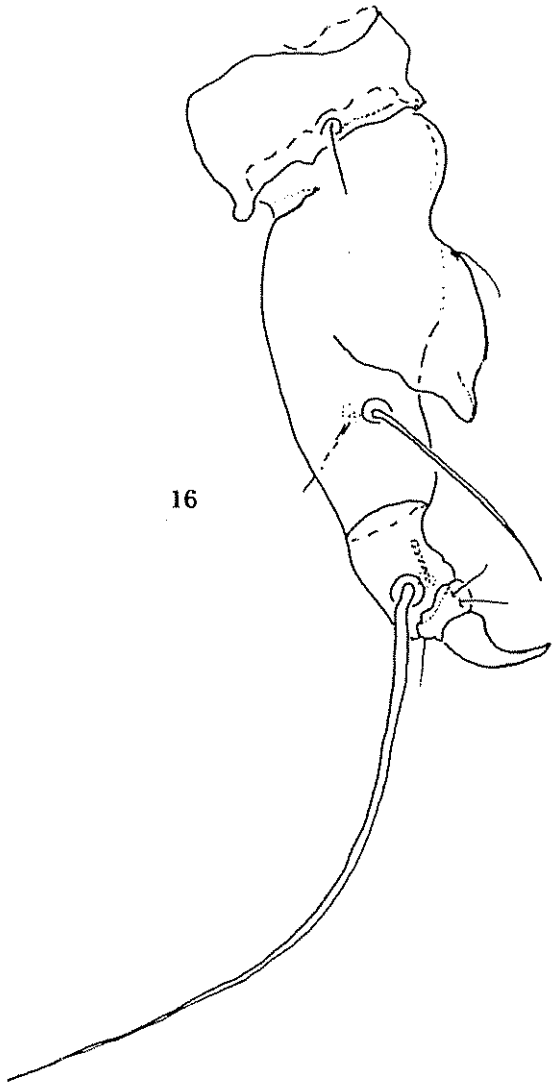
Figs. 7-8. Dendrotus irregularis spec.nov. male-7. leg IV, 8. flange aspect.



Figs. 9-11. Floridotarsonemus edule spec.nov. male-9. ventral aspect, 10. dorsal aspect, 11. flanges aspects of leg IV.



Figs. 12-15. Floridotarsonemus edule spec.nov. female-12. ventral aspect, IV, tibia and tarsus of leg II, 14.



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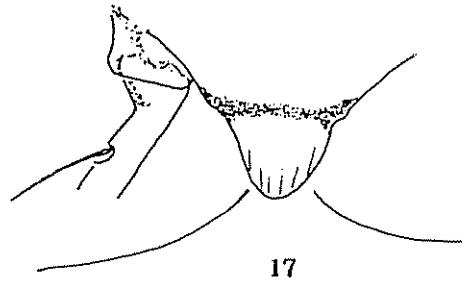

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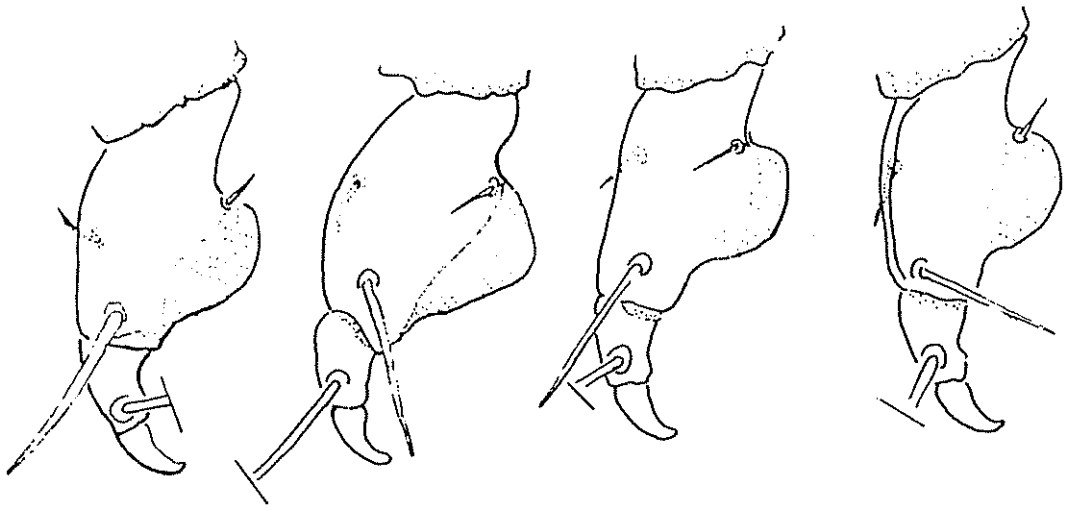
Figs. 16-17. Neodendroptus perseae spec.nov.-16. leg IV of male, 17. ventrocaudal lobe of female.



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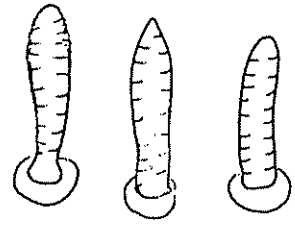

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Figs. 18-19. Phytonemus pallidus (Banks) male-18. variations of leg IV, 19. variations of solenidion of tarsus II.

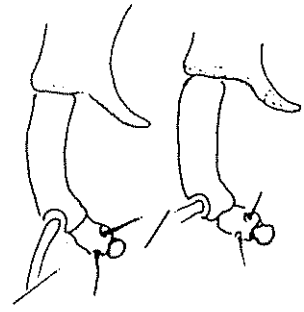

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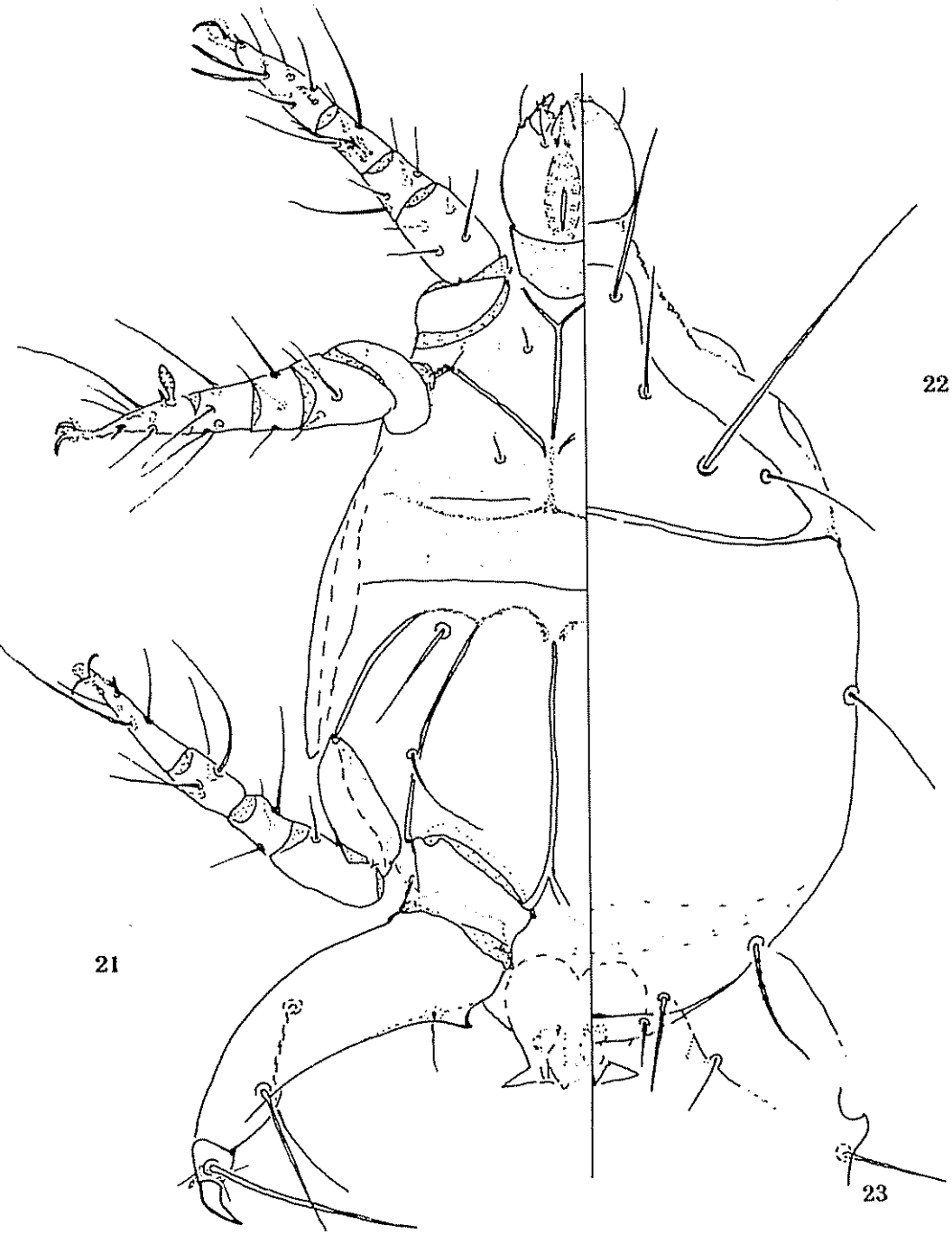
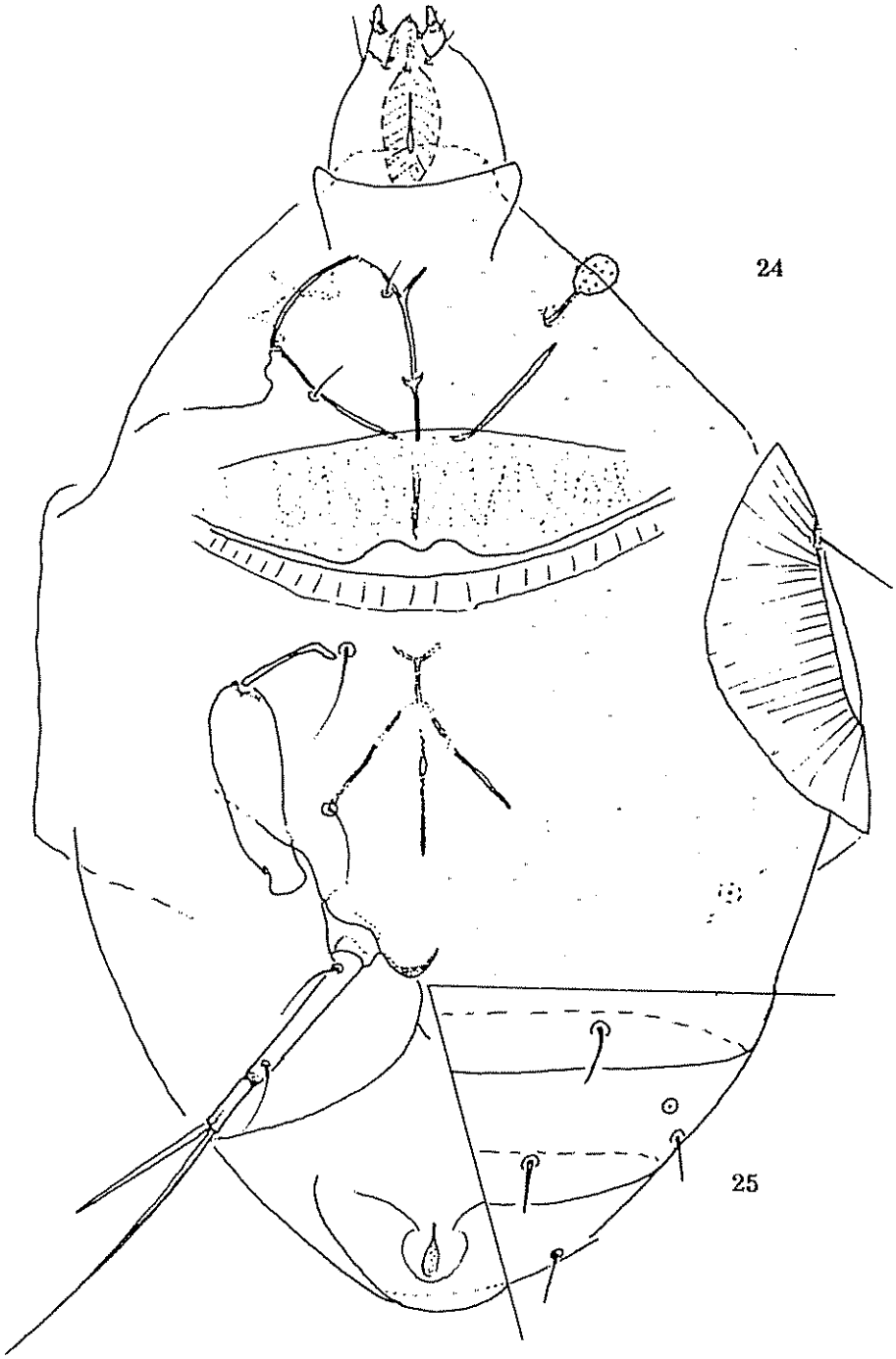
Fig. 20. Polyphagotarsonemus latus (Banks) male- variations of buttonlike claw of leg IV.



Figs. 21-23. Spinatarsonemus alajuelensis spec.nov. male- 21. ventral aspect, 22. dorsal aspect, 23. flange aspect of leg IV.



Figs. 24-25. Spinatarsonemus alajuelensis spec.nov. female- 24. ventral aspect, 25. dorsum opisthosomal aspect.

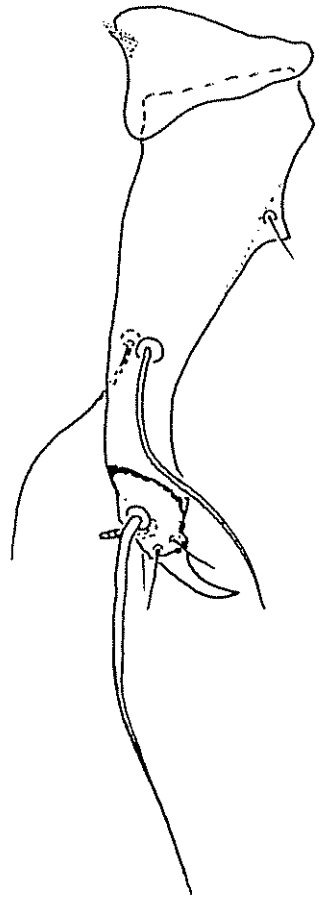
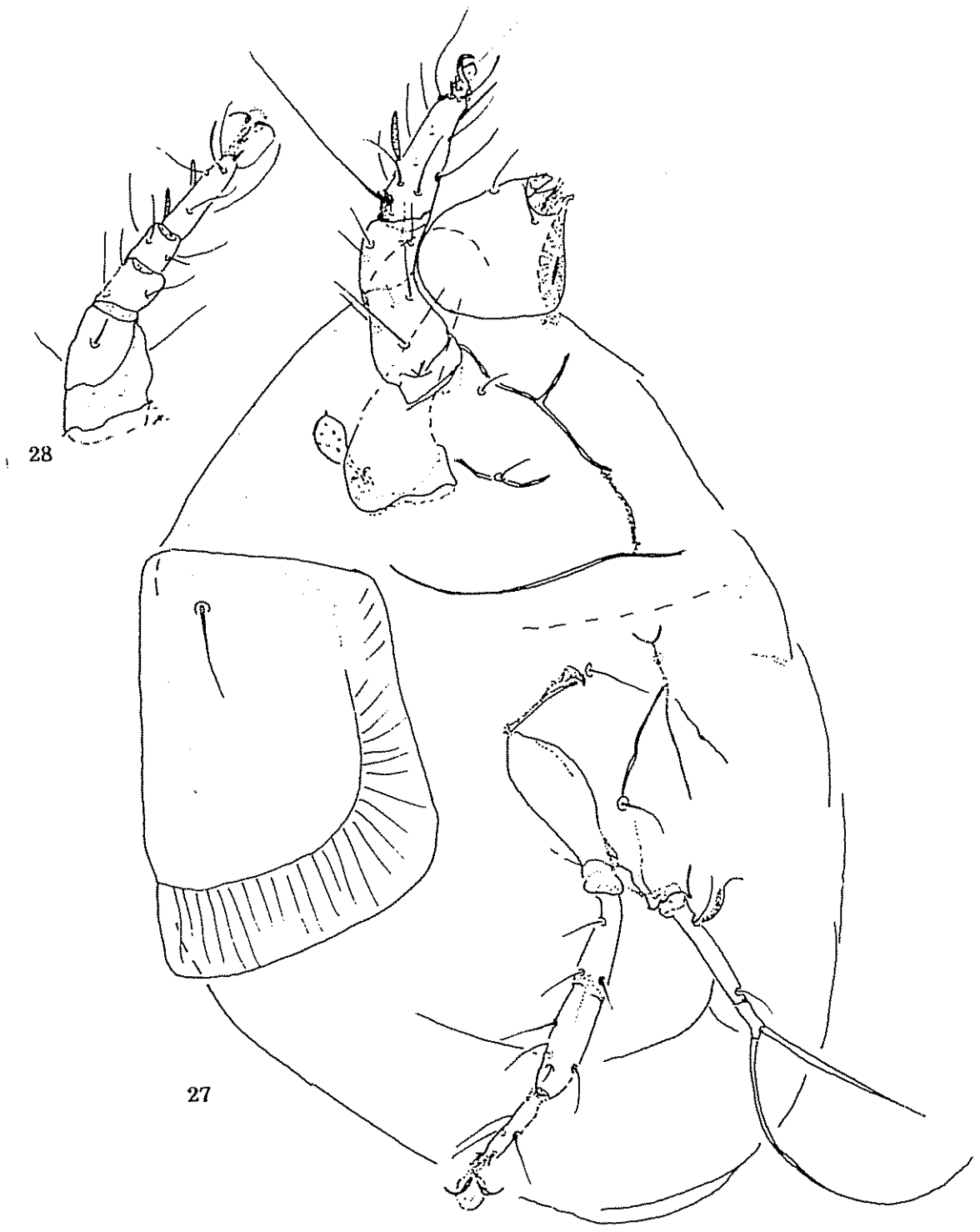


Fig. 26. Spinatarsonemus costarricensis spec.nov. male- leg IV.



Figs. 27-28. Spinatarsonemus costarricensis spec.nov. female- 27. ventral aspect, 28. leg II.

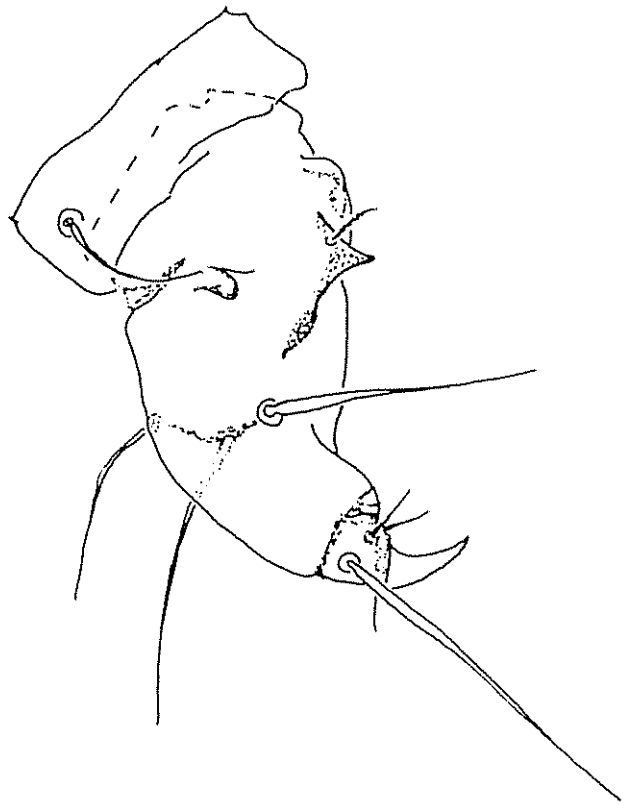


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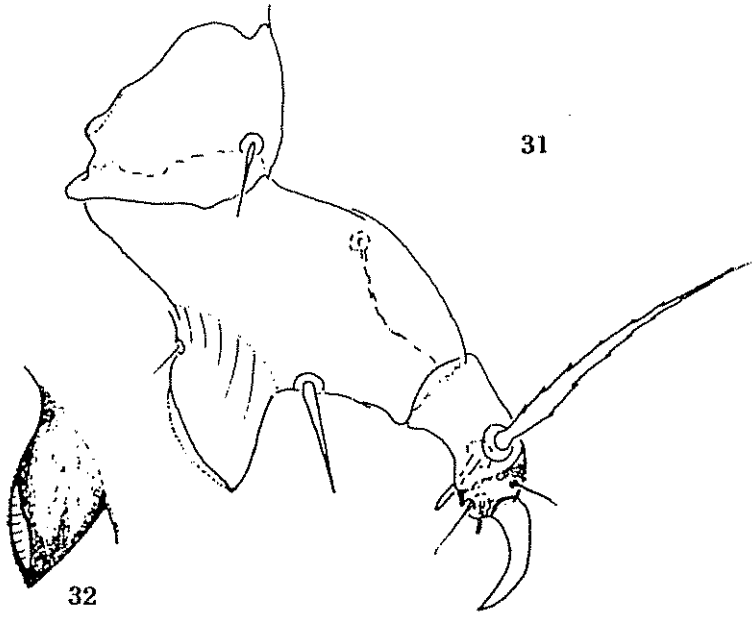
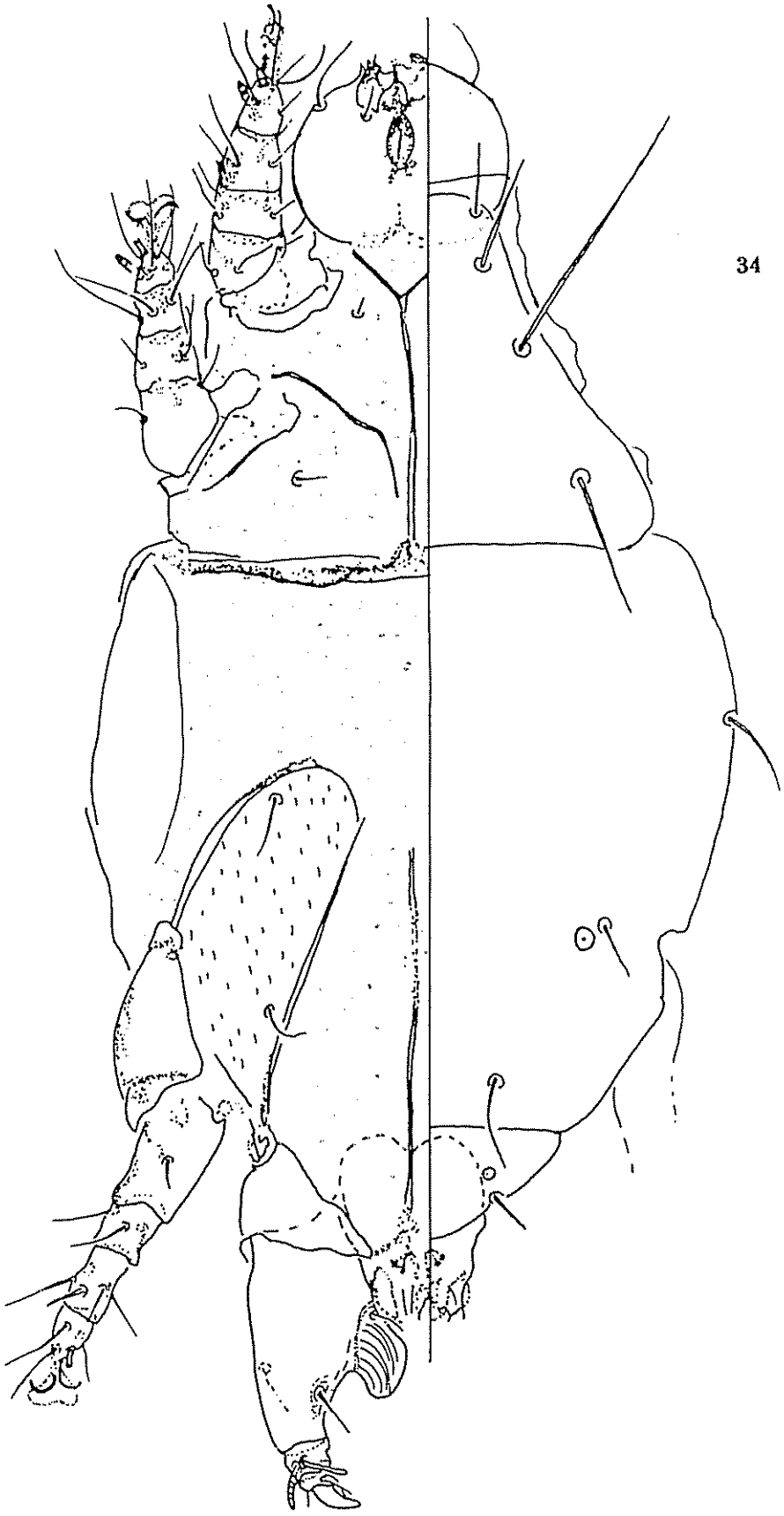
Fig. 29. Spinatarsonemus parsoni spec.nov. male- leg IV.

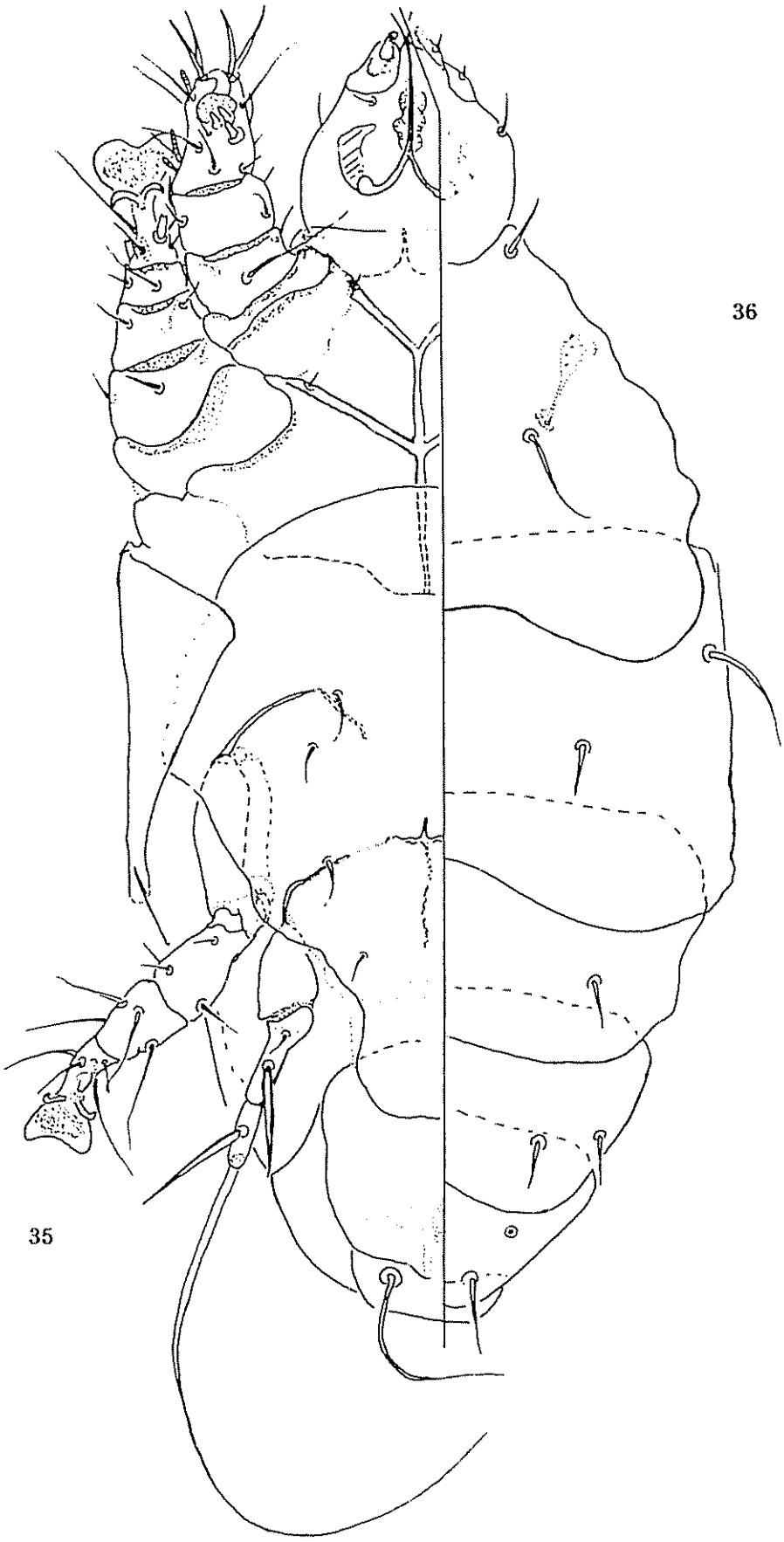
Fig. 30. Spinatarsonemus parsoni spec.nov. female- ventral aspect.



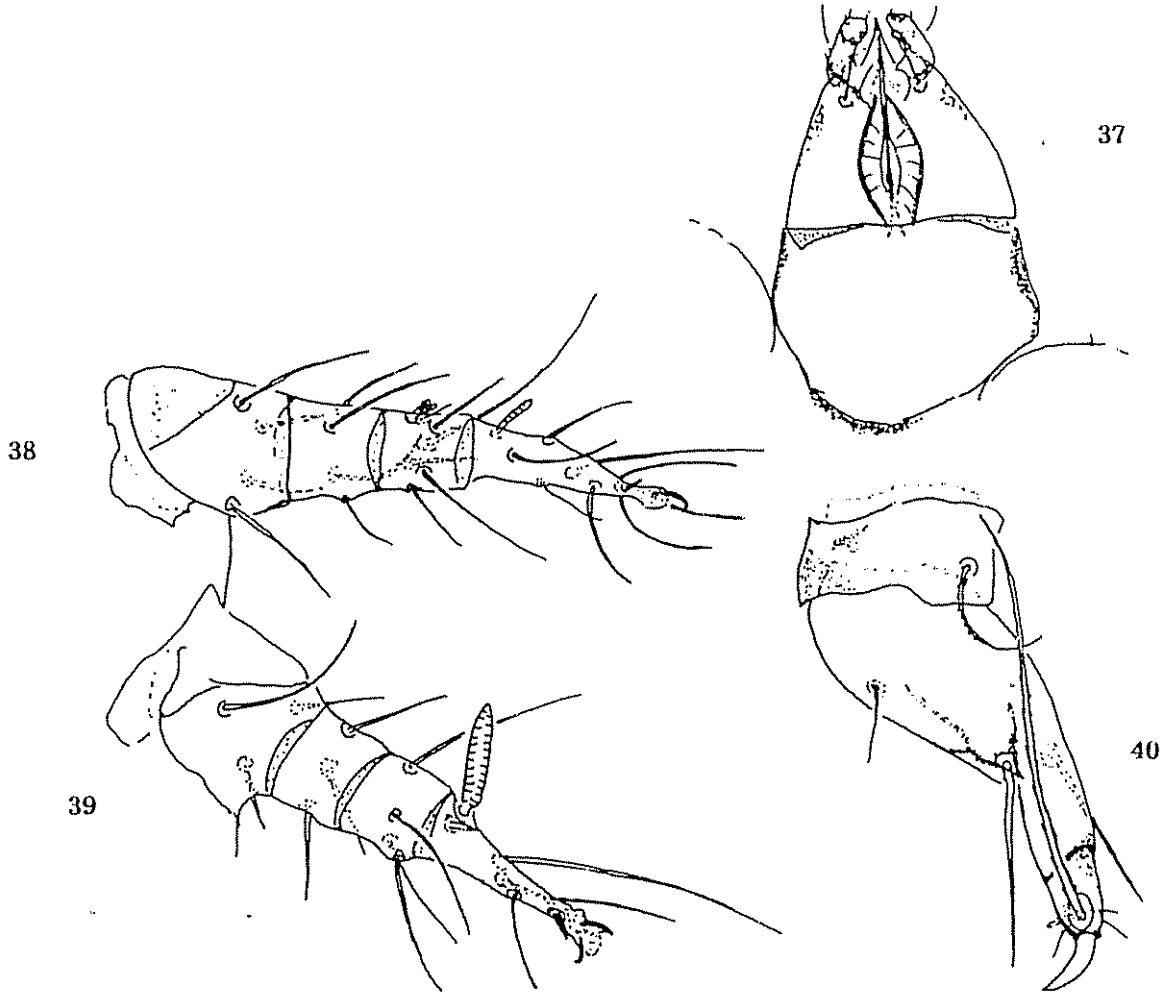
Figs. 31-32. Steneotarsonemus comosus spec.nov. male-31. leg IV, 32. flange aspect.



Figs. 33-34. Steneotarsonemus kruseae spec.nov. male- 33. ventral aspect, 34. dorsal aspect.



Figs. 35-36. Tarsonemella (P.) ramirezi spec.nov. female-
35. ventral aspect, 36. dorsal aspect.



Figs. 37–40. Tarsonemus solengrandis spec.nov. male–37. gnathosoma, 38. leg I, 39. leg II, 40. leg IV.

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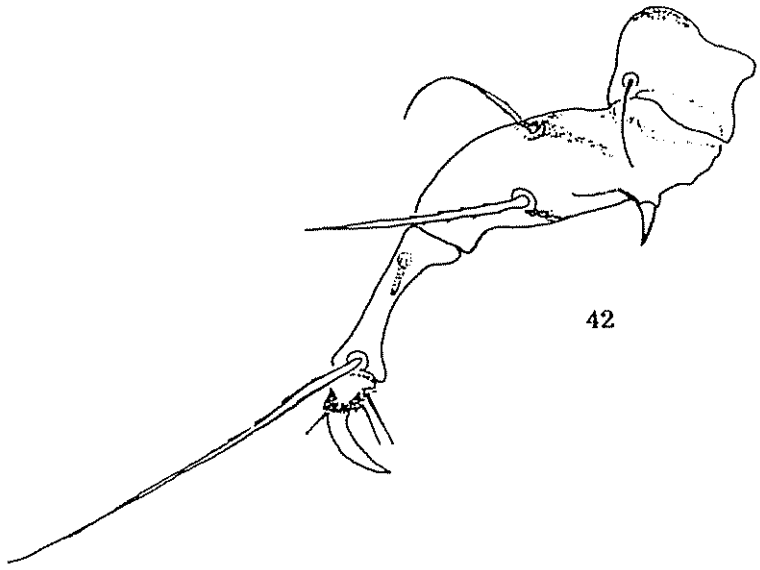

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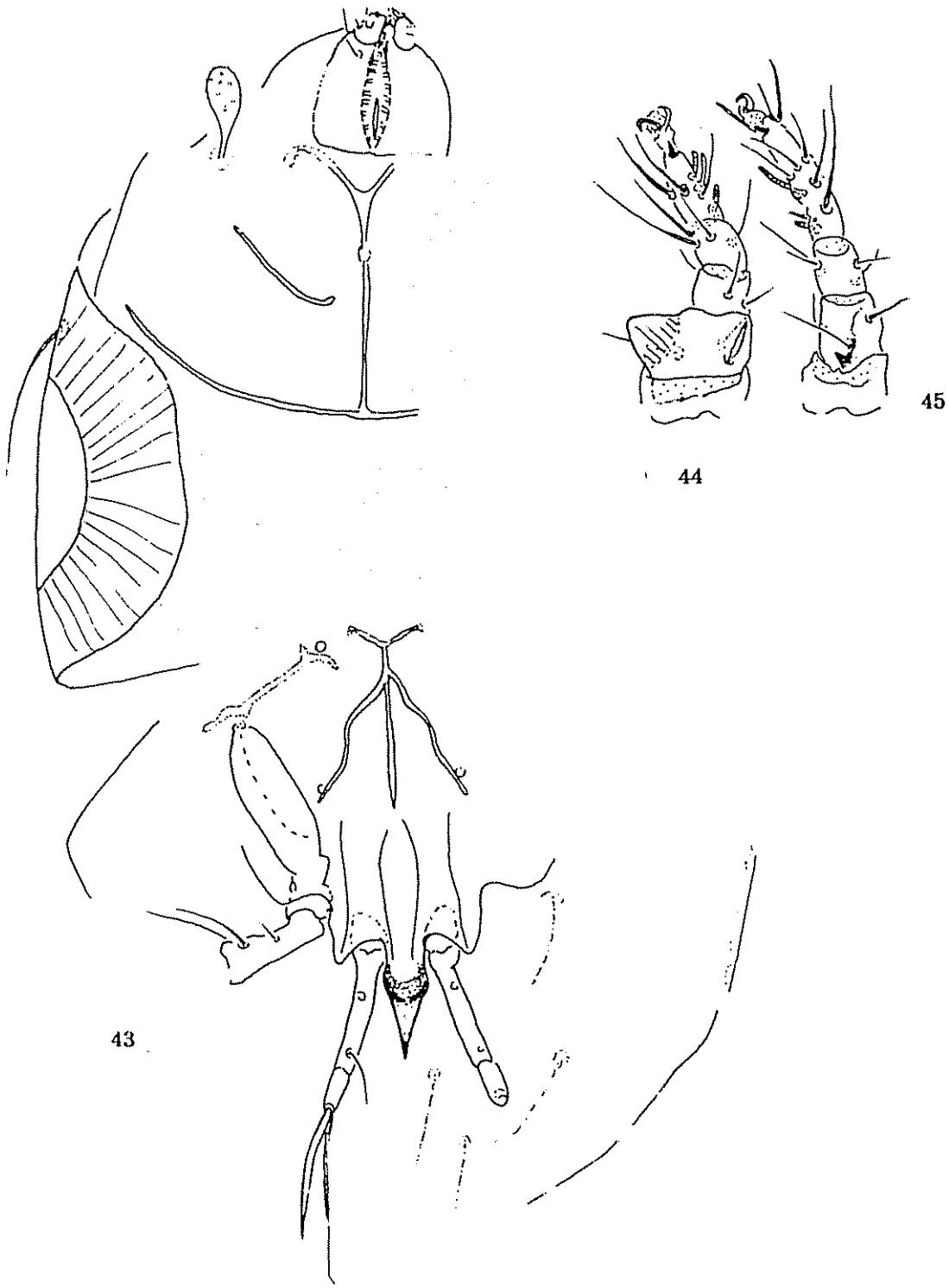
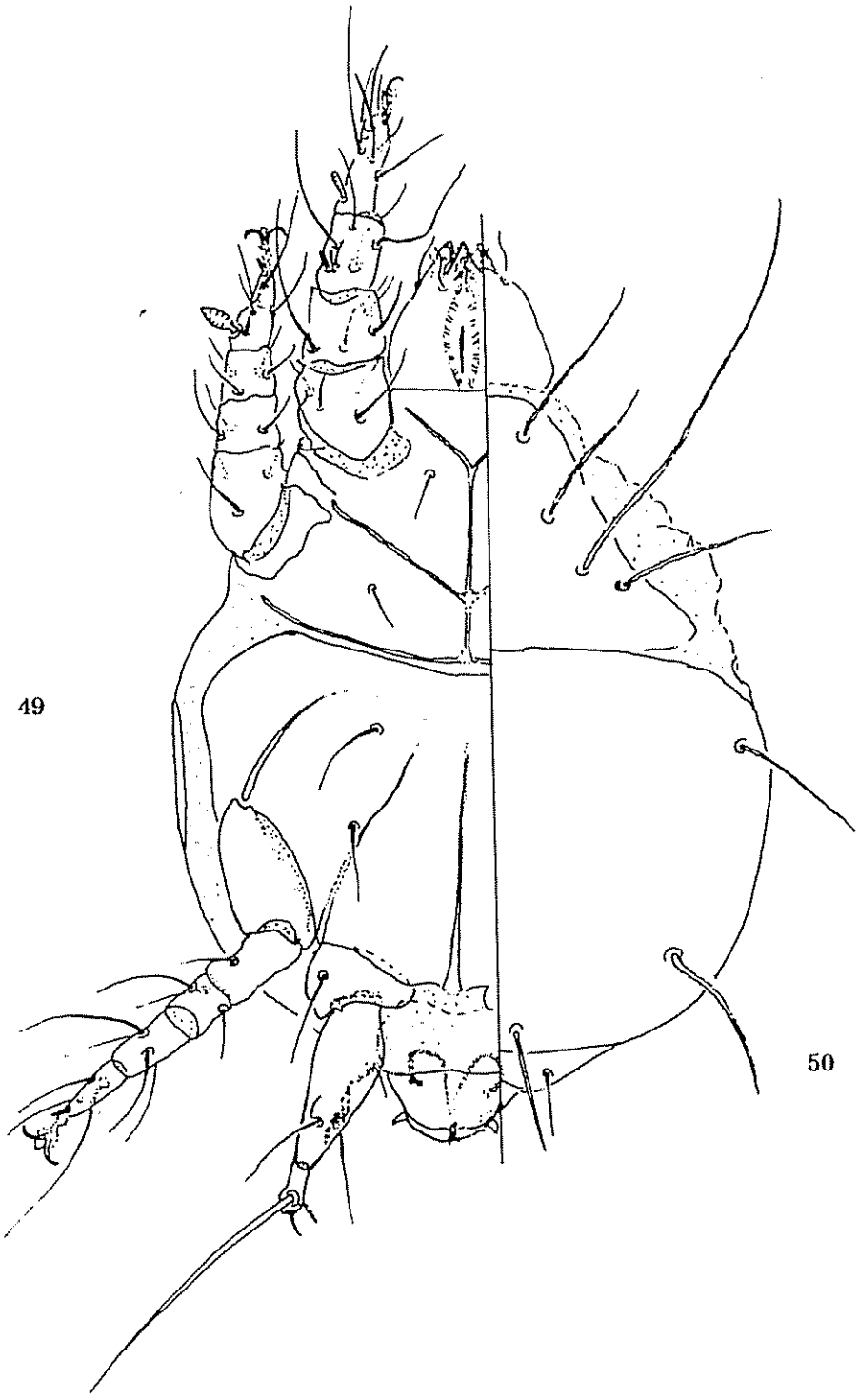
Figs. 41-42. Tarsonemus pseudokennedyi spec.nov. male- 41. tarsus of leg III, 42. leg IV.



Figs. 43-45. Xenotarsonemus gordoni spec.nov. female-43. ventral aspect, 44. leg II, 45. leg I.

Figs. 46-48. Xenotarsonemus camarae spec.nov. female-46. ventral aspect, 47. dorsal aspect, 48. flange of femur I.



Figs. 49-50. Xenotarsonemus vargasi spec.nov. male- 49. ventral aspect, 50. dorsal aspect.

Ochoa , R. 1989. Review of the family Tarsonemidae in Costa Rica (ACARI: Heterostigmata). Thesis M. Sc., Turrialba, Costa Rica, CATIE. 125 p.

Daidalotarsonemus limonensis Ochoa, Smiley & Saunders spec. nov.,
Daidalotarsonemus ternifoliae Ochoa, Smiley & Saunders spec. nov.,
Dendroptus irregularis Ochoa, Smiley & Saunders spec. nov.,
Floridotarsonemus edule Ochoa, Smiley & Saunders spec. nov.,
Neodendroptus Ochoa, Smiley & Saunders genus nov.,
Neodendroptus perseae Ochoa, Smiley & Saunders spec. nov.,
Spinatarsonemus Ochoa, Smiley & Saunders genus nov.,
Spinatarsonemus alajuelensis Ochoa, Smiley & Saunders spec. nov.,
Spinatarsonemus costarricensis Ochoa, Smiley & Saunders spec. nov.,
Spinatarsonemus parsoni Ochoa, Smiley & Saunders spec. nov.,
Tarsonemella (Paratarsonemella) ramirezi Ochoa, Smiley & Saunders subgenus nov. spec. nov.,
Tarsonemus solengrandis Ochoa, Smiley & Saunders spec. nov.,
Tarsonemus pseudokennedyi Ochoa, Smiley & Saunders spec. nov.,
Steneotarsonemus comosus Ochoa, Smiley & Saunders spec. nov.,
Steneotarsonemus kruseae Ochoa, Smiley & Saunders spec. nov.,
Xenotarsonemus gordoni Ochoa, Smiley & Saunders spec. nov.,
Xenotarsonemus camarae Ochoa, Smiley & Saunders spec. nov.,
Xenotarsonemus vargasi Ochoa, Smiley & Saunders spec. nov.