THE FAMILY OPILIOACARIDAE (ACARI: PARASITIFORMES) IN NORTH AND CENTRAL AMERICA, WITH DESCRIPTION OF FOUR NEW SPECIES

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OPILIOACARIDA
OPILIOACARUS

SUMMARY: A number of new collections of Opilioacaridae from Mexico, USA, and Central America allowed a revision of the family in this region. Because current classifications are hampered by incomplete descriptions and the use of unreliable characters, we present a brief review of characters used in distinguishing taxa within the Opilioacaridae. Characters such as the number of leaf-like setae on the palp tibiotarsus appear quite reliable, but setal numbers in the sterno-genital region show considerable intraspecific variability. Potentially valuable new characters were found in the morphology of the ovipositor. Based on the revised character set, we describe four new species from Mexico and Nicaragua, and redescribe *O. texanus*. A review of collection data for New World Opilioacaridae suggests the need for a re-evaluation of current ideas on habitat preference in the family.

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RÉSUMÉ : Les nouvelles collections du Mexique, des USA, et d'Amérique centrale ont permis une révision de la famille dans cette région. Une brève révision des caractères utilisés pour la distinction des espèces est donnée en raison des lacunes des précédentes études basées sur des descriptions incomplètes. Le nombre de soies en forme de feuilles du tibiotarse du palpe apparaît comme un caractère fiable mais le nombre de soies de la région sternogénitale montre une variablité intraspécifique importante. Des nouveaux caractères potentiellement utilisables sont fondés sur la morphologie de l'ovopositeur. Sur la base des nouveaux caractères, quatre nouvelles espèces sont décrites du Mexique et du Nicaragua, et *O. texanus* est redéfini. Une compilation des données sur les Opilioacaridae du Nouveau Monde suggère la nécessaire réevaluation des idées reçues sur les habitats préférentiels de la famille.

INTRODUCTION

The family Opilioacaridae is widely distributed throughout the tropical and warm temperate zones of the world. Despite the relatively large size of its representatives, they are rarely collected, and so far only 19 species in 8 different genera have been described. Most of this diversity has been reported from the

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Old World. Seven out of eight genera, *Adenacarus* Van der Hammen 1977 (1 described species), *Panchaetus* Naudo 1963 (2), *Paracarus* Chamberlin and Mulaik 1942 (1), *Phalangiacarus* Coineau and Van der Hammen 1977 (1), *Salfacarus* Van der Hammen 1977 (5), *Siamacarus* Leclerc 1989 (2), and *Vanderhammenacarus* Leclerc 1989 (1), are all restricted to the Old World. Only the type genus, *Opilioacarus* With 1904, has been reported from both the Old (2 described species) and New World (5-6). The status of an undescribed opilioacarid from Australia (WALTER & PROCTOR, 1998) is still unclear. However, this suggestion of a broad geographical range for *Opilioacarus* might be misleading. The New World species appear to form a monophyletic group, defined by the reduction in the number of setae on the penultimate segment from 5 or 7 in the Old World *Opilioacarus* to 3 in the New World forms. The name *Neocarus* Chamberlain and Mulaik 1942 is available for this lineage, and has been used at both the generic (KAISER & ALBERTI, 1991) and subgeneric (KLOMPEN, 2000) level. Until a comprehensive analysis of relationships in the family can be conducted, we prefer to use this name at the subgeneric level, to avoid further proliferation of generic names.

The first species described from the New World was *O. platensis*, collected in Uruguay and Argentina (SILVESTRI, 1905). This species was redescribed by VAN DER HAMMEN (1969) based on material from Southeastern Brazil. The first North American species to be described were *O. texanus* (Chamberlin and Mulaik 1942) and *O. arizonensis* (Chamberlin and Mulaik 1942), but *O. arizonensis* was later synonymized with *O. texanus* (VAN DER HAMMEN, 1966). CAMIN *et al.* (1958) mentioned an opilioacarid collected on Puerto Rico, but this material was never described. A survey of cave fauna in Cuba resulted in the description of two additional species, *O. orghidani* and *O. vanderhammeni,* collected under stones in caves and at cave entrances (JUVARA-BALS & BALTAC, 1977). The final described species is *O. ojastii* described by LEHTINEN (1980) from Venezuela.

A number of additional records have helped to flesh out the distribution pattern of Opilioacaridae in the New World. HOFFMANN and VÁZQUEZ (1986) reported Opilioacaridae from the state of Baja California Sur in Mexico, and PALACIOS-VARGAS and VÁZQUEZ (1988) reported them from Nicaragua, while KAISER and ALBERTI (1991) and KLOMPEN (2000) recollected *O. texanus* from Central Texas. All of these records taken together suggest that Opilioacaridae are wide-spread in the America's.

Given the slowly increasing number of described species and records it is especially unfortunate to note that current descriptions are often incomplete. Different authors emphasize different, and barely overlapping, sets of characters, making appropriate cross comparisons nearly impossible. Neither has there been a thorough evaluation of the variability within the character systems used. As a result, it has become quite difficult to make reliable species identifications.

During this study we acquired additional material from the states of Quintana Roo and Baja California Sur (Mexico) and Texas (USA), and from Belize, Nicaragua, and Brazil. This additional material allowed a comparative study of Opilioacaridae from North and Central America with two basic goals. First, to re-evaluate the characters used in previous descriptions of New World Opilioacaridae, and, where possible, propose additional ones. Second, using this improved character set, to describe four new species from Mexico and Nicaragua, and to add to the description of *O. texanus*. Finally we will briefly discuss the implications of the new records in terms of geographical distribution and habitat selection for these mites.

MATERIAL AND METHODS

The majority of specimens was obtained during surveys of the microarthropod fauna in Baja California and Quintana Roo (e.g. PRIETO TRUEBA *et al.*, 1999). Most specimens were extracted from litter using Berlese funnels. Additional specimens were obtained by manual collecting from under rocks and the loose bark of fallen logs. All material from Texas and Nicaragua was collected by hand.

Most material was studied as slide mounted specimens, although some were examined using temporary preparations in cavity slides. The current study is limited to adult specimens, immatures, and the problems associated with identifying instars, will be the subject of a future study.

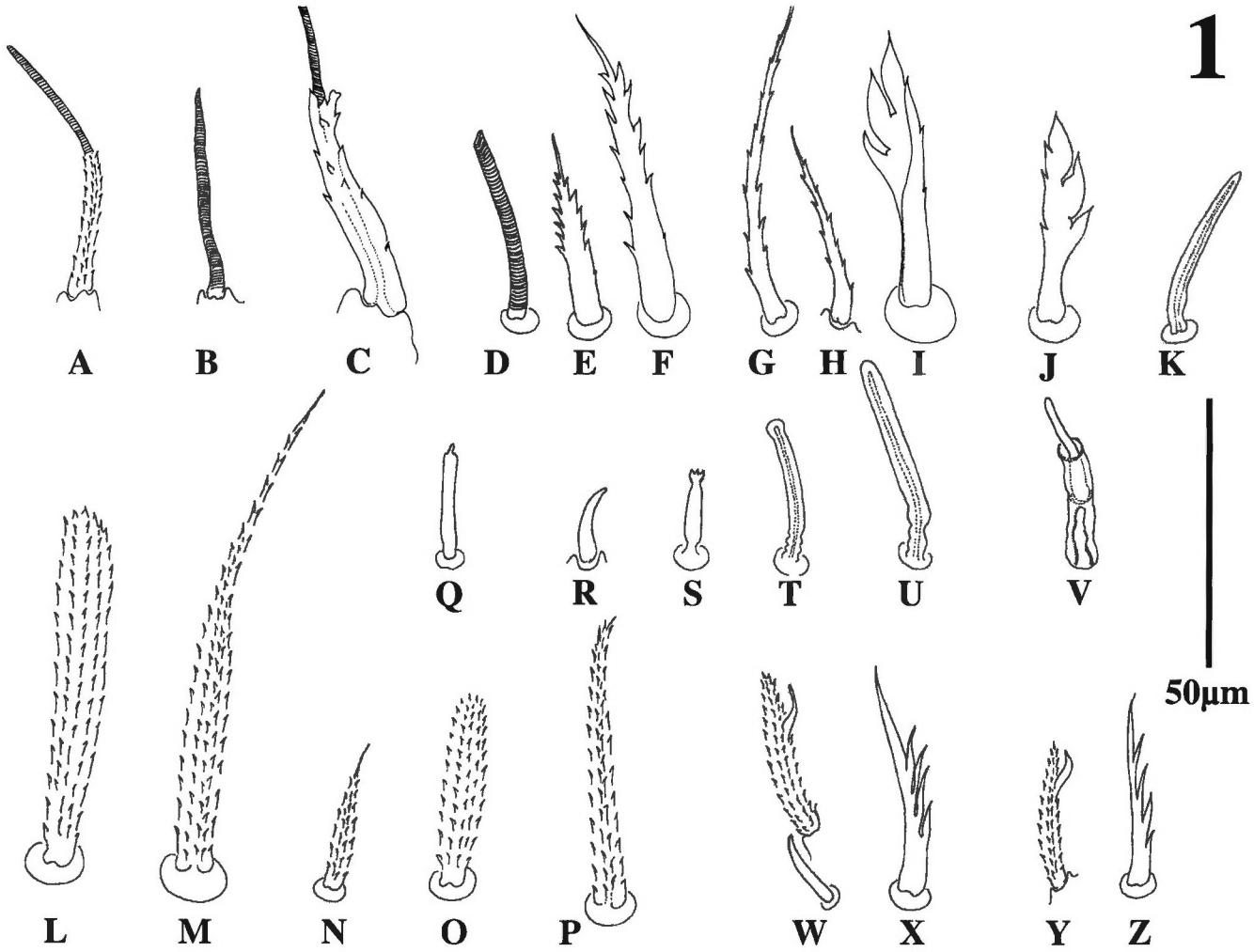

FIG. 1: Some of the different types of setae found on the palp (A-K), sterno-genital region (L-P), tarsi I (Q-V), and tarsi II (W-Z) of adult Opilioacaridae. A: type *sm1*; B: type *sm2*; C: type *sm3*; D: type *ch*; E, F: type *v1*; G, H: type *v2*; I, J: type *d*; K: type *s*; L: stout ribbed seta on the lid of the pregenital capsule; M: barbed, tapering seta on the lid of the pregenital capsule; N: fine, tapering type of male genital setae; O: stout ribbed type of male genital setae; P: sternal setae; Q-U: setal types in sensory region of tarsi I; V: "Haller's organ" on tarsi I; W, Y: forked dorsal seta on tarsi II; X, Z: strongly toothed distal ventral setae on tarsi II. A, C, D, K, Y, Z: *O. nohbecanus*, male; B: *O. siankaanensis*, female; E, G, J: *O. nicaraguensis*, male; F, H, I, W, X: *O. bajacalifornicus*, female; L, M, O, P: *O. bajacalifornicus*, male; Q-V: *O. texanus*, female; N: *O. texanus*, male.

Measurements are based on slide mounted specimens. These measurements are therefore biased, but can still be used to compare among the species in this study. Given the small number of available specimens, drawings are representative of individual specimens, not species. Therefore some structures may not be depicted even though they are considered present in the species. Such differences will be noted in the descriptions.

Abbreviations for collections: OSAL: Acarology Laboratory, Ohio State University, Columbus, Ohio, U.S.A.; TMMC: Texas Memorial Museum, Austin, Texas; UNAM: Acarology Collection of the Universidad Nacional Autónoma de Mexico, Mexico City, Mexico; UQRoo: University of Quintana Roo, Chetumal, Mexico.

CHARACTER EVALUATION.

In these character evaluations, the focus is on comparisons among the taxa examined and between new

Site	N	*v1*	*v2*	*s*	*d*	*ch*	*sm1*	*sm2*	*sm3*
O. nohbecanus	2F	4-5	3	3	4	17-19	5-7	3	0
	2M	4	2	3	4	12	5	3	2 3
O. siankaanensis	4	5	3	3	5	14-15	5	3	0
O. nicaraguensis	7	5	2-3 (4)	3	4-6	18-22	3-8	3 (4-5)	0
O. bajacalifornicus	8 (2[a])	5	3	3	5	14-18 (21)	5-9 (9-12)	3	0
O. texanus	5 (1[a])	5	3	3	5	14 (21)	3 (5)	3	0
O. platensis[b]	M	5	3	?	5-6	14	5-8	3	0
O. orghidani[c]	F	5		3	4	20-24	9		0
	M	5		3	4	20-24	9		1
O. vanderhammeni[c]	F	6	6	3	10	32	9-10		0
	M	6	6	3	12	32	9-10		0

Data on palp setation for *O. ojastii* were not available.
[a] number of "super" adults: adults with distinctly higher numbers of setae in all areas of the body
[b] data for 2 males from Brazil, tentatively identified as *O. platensis*
[c] data for *O. orghidani* and *O. vanderhammeni* from Juvara-Bals and Baltac (1977)

TABLE 1: Comparative setal pattern for the palp tibiotarsus of adult New World Opilioacaridae

and previously described New World Opilioacaridae. Unfortunately, the level of detail presented in the description of *O. ojastii*, and to a lesser degree *O. platensis*, precludes comparative discussions for some character systems. They are discussed only where available information makes this possible. More wide-ranging comparisons, involving other genera of Opilioacaridae, are made only where indicated.

Palp tibiotarsus. The distribution of sensilla on the palps shows some potentially species-specific characters. The palp tarsus is remarkable for the number and diversity of sensilla (Figs 1A-K, 2). Terminology for these sensilla follows GRANDJEAN (1936) with minor modifications. Much of GRANDJEAN'S comments for the palp of *O. segmentatus* With 1904 are valid for our material, but we noticed even more diversity in sensillar shapes. Type *v* setae are found mostly on the ventral side of the tarsus. These setae are barbed, with tapering tips, strongly resembling "standard" mechanoreceptors. We could distinguish two types based on the number of barbs and overall shape, designated *v1* and *v2* (Figs 1E-H). Their numbers are quite constant among all material examined, with the possible exception of the specimens from Noh Bec, which usually carry only 4, instead of 5, *v1* type setae, and in the males only 2, instead of 3, *v2* setae (Figs 2A-C, Table 1). Type *s* sensilla resemble solenidia, but lack the transverse striation (Figs 1K, 2C, 2F). A total of three sensilla of this type are inserted antiaxial. Both their number and position are constant among the material examined.

The number of foliate setae, type *d* of Grandjean (Figs 1I, J), has been used to distinguish species. For example, *O. vanderhammeni* is unusual in carrying 10-12 setae of this type. Although most of the specimens examined carried 5 type *d* setae, all specimens from Noh Bec carried only 4 (Figs 2A, B, Table 1), a character shared with *O. orghidani* Juvara-Bals and Baltac 1977. The type *ch* sensilla are smooth and show "cut-off" tips (Fig. 1D). Grandjean reported observing very faint transverse striations, a characteristic that was also noted in our study. Given their gross morphology, these setae may be terminal-pore receptors (terminology following ALTNER & PRILLINGER, 1980). Their numbers are quite variable both among and within populations. The number reported by GRANDJEAN for *O. segmentatus*, 14, is commonly found in specimens from Texas, Sian Ka'an, Lol Beh, and Brazil, but most specimens from Baja California Sur and Nicaragua, as well as females from Noh Bec, show generally higher, numbers (Table 1). Whether these differences can be used as effective characters is still unclear. Given the observed intra-population variability such an assessment would require examination of much higher numbers of specimens.

Sensilla of type *sm* appear to be composites, with a basal part resembling setae of type *v*, and a distal part that is smooth, shows distinct transverse striation, and has a rounded tip. "True" type *sm* sensilla, type

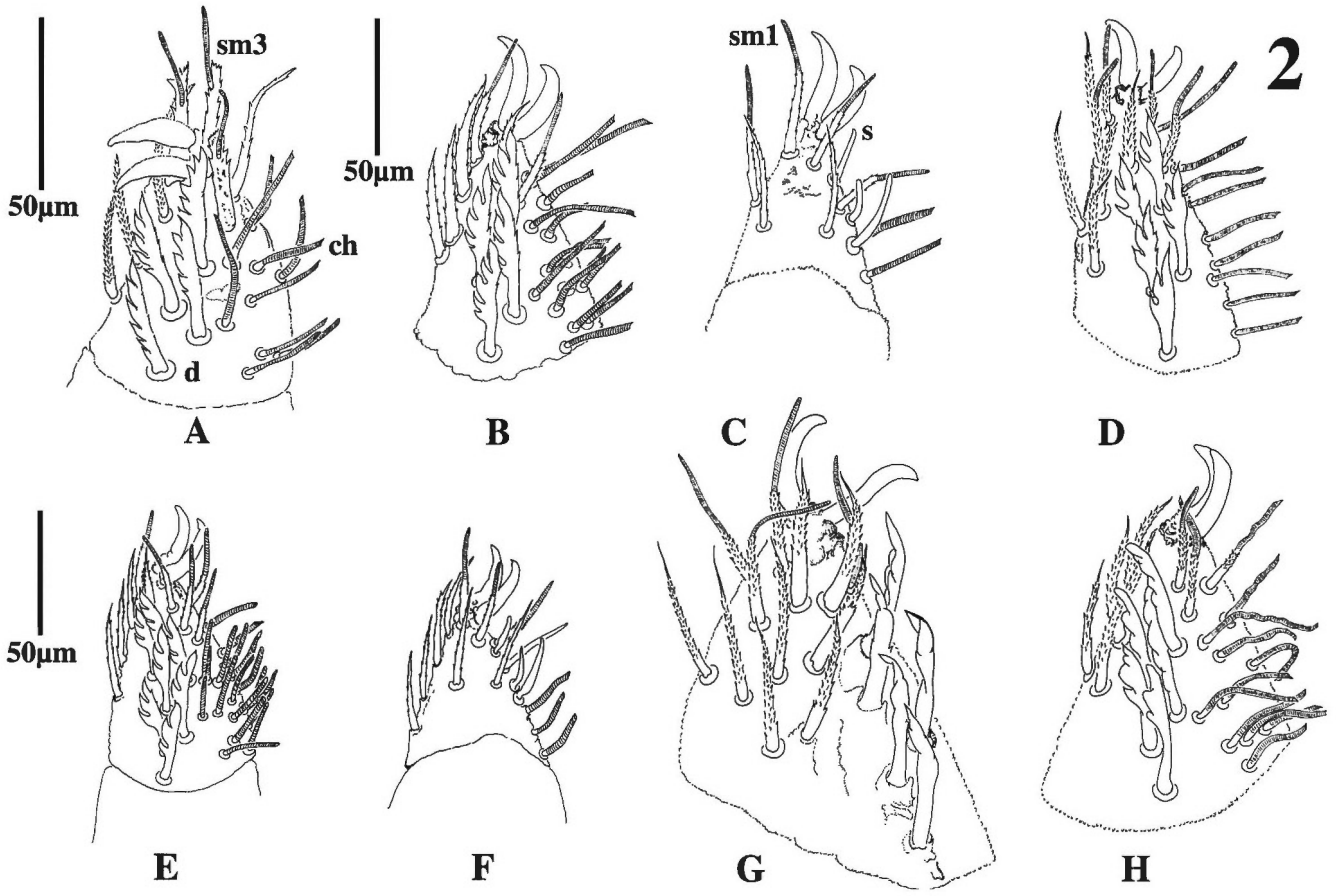

FIG. 2: Palp tibiotarsus. A-C: *O. nohbecanus*, A: male, ventral view, B, C: female ventral and dorsal view; D: *O. siankaanensis*, male, ventral view; E, F: *O. nicaraguensis*, male, ventral and dorsal view; G: *O. bajacalifornicus*, male, ventral view; H: *O. texanus*, male, ventral view. Some setal types indicated. Scales refer to, respectively, Figs A and H, B-C, and E-G.

sm1 (Fig. 1A), occur in quite variable numbers, from 3 (most specimens from Texas) to 8, 9, or even 12 (in some specimens from Baja California Sur). Notably, higher numbers of type *sm1* sensilla often correlate with high numbers of *ch* sensilla. A modified version of the *sm* sensilla shows no obvious signs of the barbed basal part. Nearly all specimens examined carried three of these type *sm2* sensilla (Fig. 1B). Finally, males from Noh Bec were remarkable in showing yet another variant, designated type *sm3* (Figs 1C, 2A). Superficially resembling type *sm1*, the basal part of these sensilla is wide and flat with less barbs than standard type *sm1* sensilla, but the distal part is highly similar: round, smooth, with transverse striation, and with a rounded tip. A single one of these sensilla has been reported on the palps of male *O. orghidani* (JUVARA-BALS & BALTAC, 1977), while males from Noh Bec carry 2 or 3.

Notably, in material from Baja California and Texas some adults, "super" adults, have distinctly larger numbers of all variable types of setae, not only on the palps (*ch*, *sm1*), but also in other body regions. While this might represent simple individual variation, it is possible that it results from adult molts, a phenomenon known to occur in Opilioacaridae (NAUDO, 1963, COINEAU & LEGENDRE, 1975, KLOMPEN, 2000). Only rearing experiments will allow a distinction among these two possibilities.

In summary, species specific characters can be drawn from the number of type *d* sensilla and the presence of type *sm3* sensilla. The numbers of type *v1*, *ch*, and *sm1* sensilla are variable, but their utility may be limited due to high levels of intra-populational variability.

Subcapitulum. The general shape of the gnathosoma, including shape and position of the labrum

and lateral lips has been described quite well by Grandjean (1936) and Van der Hammen (1966), and will not be repeated here. We found no appreciable variability among out material. The bulk of the variability appears to be in the setae.

Among these, the morphologically most diverse group is formed by the paralabials (sensu VAN DER HAMMEN, 1966) (Figs 3, 4). All of the material studied showed four structures in this series. Paralabial setae *pl1* are distinct, ventrally inserted, spines, partially covered by the lateral lips (Fig. 3A). With's organ (*pl2*) shows some variability in its morphology, but this is hard to quantify due to the membranous nature of this seta. Two general structures of With's organ have been recognized in Opilioacaridae: either a forked seta (as in *Paracarus* and *Siamacarus*) or a hypertrophied membranous and disc-shaped structure (as in all other genera) (VAN DER HAMMEN, 1970). The two states may not be very different. Although all of our specimens have the "membranous" condition, the membrane is supported by a structure highly reminiscent of the "forked" condition. One branch of this fork retains the short fringe found in the "forked" condition, while the other supports the broader membranous flap stretching from the first branch through the second (Fig. 3F). This membranous flap also has a fimbriate edge. Although the development of the branches and the joint basal part is clearly weaker than that for "normal" setae, the basic structure is identical. The number of teeth on the third pair of paralabials, the rutella (*pl3*), has been used by VAN DER HAMMEN as a species specific character. This idea seems untenable when comparing the rutella of larger numbers of individuals. There is some intra-populational variability but most importantly, the rutella in many specimens show two rows of teeth. One row has relatively small teeth that are rounded at the tip, while the other has longer teeth that are pointed (Figs 3A-E). The resulting three-dimensional structure makes consistent interpretation of this character quite difficult. We therefore agree with LEHTINEN (1980) that this character may have only very limited value. The smallest of the paralabial setae is a small spine positioned dorso-laterally on the subcapitulum. Described as ε by GRANDJEAN (1936) and *pl4* by Van der Hammen (1966), it was reported as absent for *O. texanus* (VAN DER HAMMEN, 1966), but detailed examination of our material showed it to be present (Fig. 3F).

Site	N	*pl*	*cb*	*Vm*	*lvm*	*ldm*	*vp*	*lvp*
O. nohbecanus	2F	4	4	1-2[a]	1	2	4-5	1
	2M	4	4	2(1[a])	1	1	4	1
O. siankaanensis	2	4	4	1	1	1	4	1
O. nicaraguensis	7	4	4	2(1[a])	1	1	3	1
O. bajacalifornicus	5F	4	4	3(1[a])	1	1	6	1
	4M	4	4	3(1[a])	1	1(0)	4	1
O texanus	4	4	4	1[a]	1	1	2	1
O. platensis[b]	F	?	4	2-4	1	1	1-5	1
	M	?	4	1-3	1	1	3-5	1
O. orghidani[b]	F	?	4	4	1	1	3	1
	M	?	4	3(1)	1	1	2(3)	1
O. vanderhammeni[b]	F	4	4	4	1	1	4	1
	M	4	4	8(3)	1(2)	1	6(9)	1(2)

If not specified, data for males and females are lumped. Data for *O. ojastii* were not available. Setal designations follow Van der Hammen (1966).
[a] circumbuccal-type setae
[b] data for *O. platensis* from Van der Hammen (1969), for *O. orghidani* and *O. vanderhammeni* from Juvara-Bals and Baltac (1977).

TABLE 2: Comparative setal pattern for the subcapitulum of adult New World Opilioacaridae.

Among the remaining subcapitular setae, the distinction made by Van der Hammen (1966) between the circumbuccal and the median and posterior setae is more complex in our material. The circumbuccal setae have a characteristic shape, long, smooth and with a "cut-off" or lightly bifid tip (Fig. 3A cb).

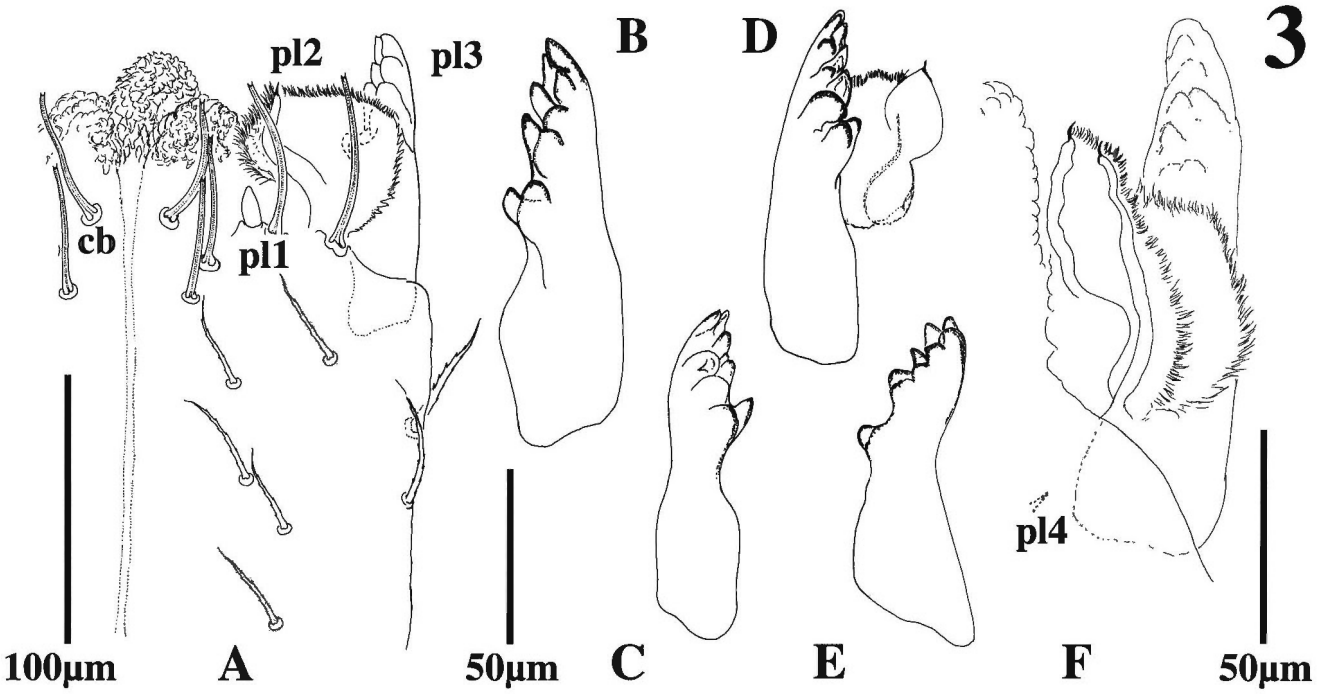

FIG. 3: Paralabial setae: With's organ, *pl2* (A, F) and rutellum, *pl3* (B-E). A: *O. nicaraguensis*, male, ventral view subcapitulum; B: *O. bajacalifornicus*, female; C. *O. texanus*, male; D: *O. nohbecanus*, male; E: *O. siankaanensis*, female; F: *O. texanus*, female, ventral view. Abbreviations: cb: circumbuccal type setae; *pl1-4*: paralabial setae.

Positionally, they bend over the paralabial setae and lateral lips, and probably function in connection with these structures. In contrast, the remaining subcapitular setae may be smooth or barbed but are always tapering. Material from Sian Ka'an and Texas showed 4 pairs of circumbuccal-type setae (as in VAN DER HAMMEN's (1966) description of *O. texanus*), but the remaining specimens have 5 pairs (6 in one female from Noh Bec). This suggests that either some of VAN DER HAMMEN's (1966) median setae, specifically setae *vm1* (and occasionally the *vm2*), are functionally included with his circumbuccal setae, or, that the number of circumbuccal setae is not fixed at 4. To retain continuity with previous studies, we have chosen the first interpretation. This is not the first study to report shape identity between the circumbuccal and *vm1* setae. Based on published illustrations, it is also found in *O. vanderhammeni* (JUVARA-BALS & BALTAC, 1977). Published drawings for *O. orghidani* and *O. platensis* do not allow a clear answer to this question.

The number of median and posterior subcapitular setae in males appears to be smaller than in females in most of our material, although there tends to be some overlap (e.g. Table 2, Baja California Sur material). This contrasts with the condition for *O. vanderhammeni*, in which males have more subcapitular setae than females (JUVARA-BALS & BALTAC, 1977).

Sternal and genital area. The setation pattern of the sterno-genital area has been used extensively in descriptions of Opilioacaridae. For all our material we examined the number and type of setae on the sternal verrucae (sv) and on the lids of the pregenital capsules (pc), in the area between the sternal verrucae and the pregenital capsules, in the pregenital area (pg), and in the genital (g) area (see Fig. 5 for terminology).

The sternal verrucae in adults may carry 2-5 setae each, all of which are of the barbed, tapering type, sometimes with a much thinner tip ("composite setae" of VAN DER HAMMEN; Fig. 1M). One of these setae tends to be more strongly developed. Setal numbers are slightly variable within populations and occasionally between left and right sides of the body (variable in 6/16 individuals for males, 4/15 for females). Overall, the numbers are highly overlapping

	N	sternal verrucae	region between sternal verrucae and genital capsules		genital capsule	pre-genital region	genital region	
		stout setae	stout setae	tapering setae	stout setae	number setae	number setae	shape setae
FEMALE								
O. nohbecanus	2	3	6-7	1	4-5	0	0	
O. siankaanensis	3	3-4	5-6	1	3-5	0	0	
O. nicaraguensis	4	4	5-8	1-2	3-6	2 (5)	0	
O. bajacalifornicus	4	3-4	6-7	2	3-5	2	0	
O. texanus	3	4-5	6	2	5-6	2	0	
O. platensis		?	?	?	5-6	0-2	6-9	
O. orghidani		3	6	2	3-4	0	0	
O. vanderhammeni		3	5	1	4	0	5	
MALE								
O. nohbecanus	2	2 3	5-6	1-2	3-4	4-5	5-7	stout
O. siankaanensis	1	3	6	1	3	2	4	stout
O. nicaraguensis	5	3-5	4-8	1-2	4-5	2-7	3-6	stout
O. bajacalifornicus	3	3 4	5-7	2	4	5-8 (13[a])	7-8 (11[a])	stout
O. texanus	2	3 4	4-6	2	3-5	4-5	8-9	fine
O. platensis		4	15-18		4-6	8-10	7	fine
O. orghidani		3	6-7	2	4-5	6-9	13	stout
O. vanderhammeni		4	4	1	4	8	7	stout

[a] numbers for "super" adults: adults showing distinctly higher numbers of setae in all areas of the body.

TABLE 3: Comparative setal pattern for the sterno-genital region of adult New World Opilioacaridae.

(Table 3). In addition to setae, the sternal verrucae carry one enlarged lyrifissure.

The area between the sternal verrucae and the pregenital capsules carries variable numbers of barbed and tapering, and stout and ribbed setae (Fig. 1L) plus another pair of enlarged lyrifissures. The number of pairs of stout ribbed setae (usually 5-7 pairs, occasionally 4 or 8) is again variable within individuals (8/16 for males, 5/15 for females) and populations, with nearly complete overlap among populations (Table 3). The number of barbed, tapering setae is slightly more promising (Fig. 5). Adults from Texas and Baja California Sur always carry two pairs, but females from Noh Bec, Lol Beh, and Sian Ka'an carry only one pair. Males from those areas and all adults from Nicaragua are variable for this character (Table 3).

The pregenital capsules also carry one barbed tapering and 3-5 (occasionally 6) stout ribbed setae each (Figs 1L, M). Intraspecific (5/16 for males, 5/15 for females), and intra-populational differences once again obscure most inter-populational differences (Table 3). The only notable difference is that females from Texas tend to be on the high side of the curve (5 or 6). Each of the pregenital capsules also carries a small lyrifissure (GRANDJEAN, 1936, VAN DER HAMMEN, 1966), but this structure is often difficult to see.

The number and shape of the pregenital and genital setae may provide some species specific information. Most females carry one pair of pregenital setae (Fig. 7D), but these setae are absent in all females from Quintana Roo (Fig. 7B). An unusual modification was found in one female from Nicaragua, which appears to carry 4-5 pregenital setae (Fig. 6A). Variability in the males is much larger. The number of pregenital and genital setae may vary from, respectively, 2-13 and 3-11, and is highly variable within populations. A useful and consistent difference may derive from the shape of the genital setae. In most males examined the genital setae are similar to the

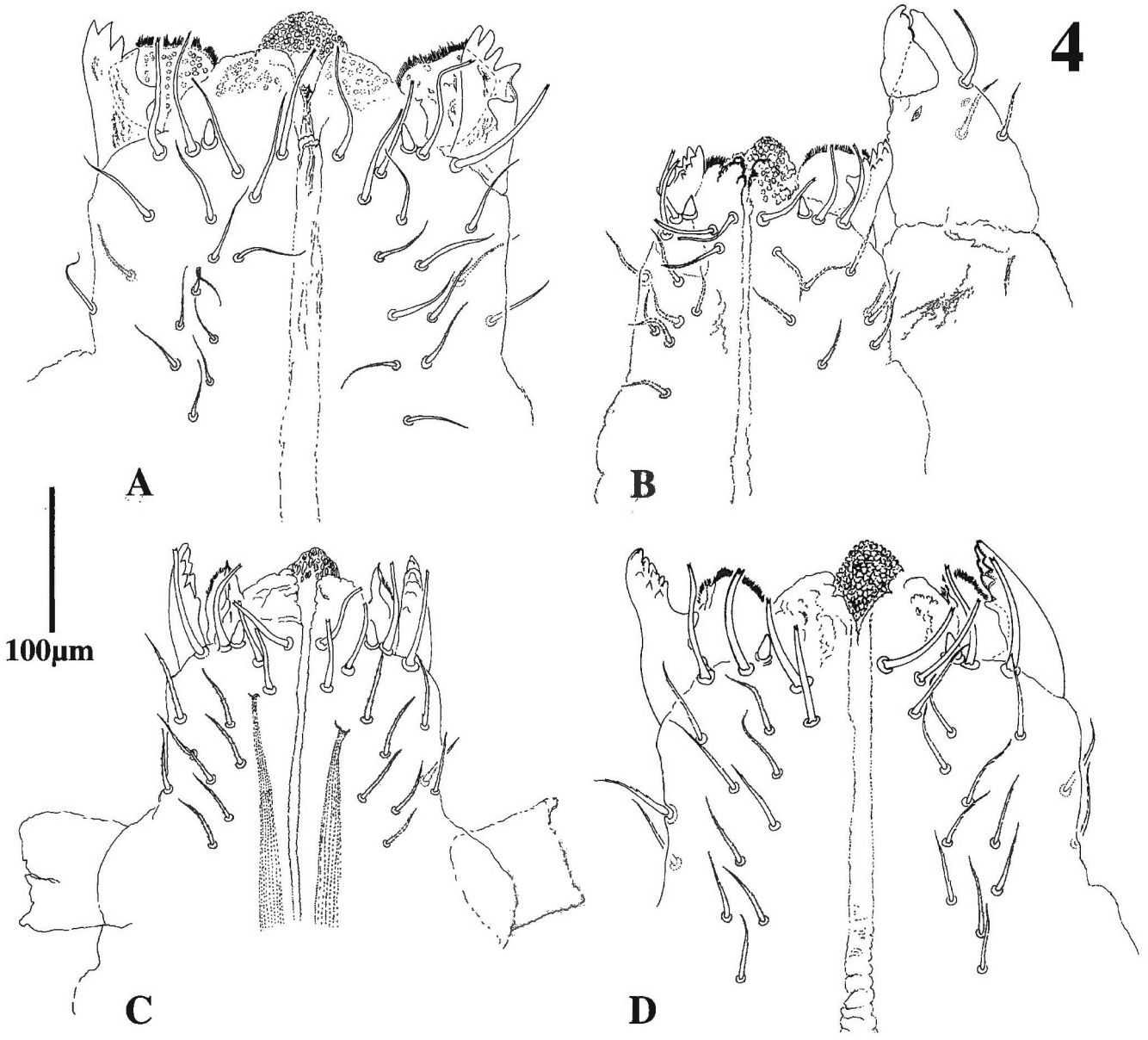

FIG. 4: Subcapitulum, ventral view. A: *O. bajacalifornicus*, female; B: *O. siankaanensis*, female; C: *O. nohbecanus*, male; D: *O. texanus*, female. With's organ is not drawn for the parts overlapping the rutellum. Its shape is indicated by dashed lines.

pregenital setae, stout and ribbed (Figs 1O, 5A, C-D). This condition was also observed for *O. orghidani* and *O. vanderhammeni* (JUVARA-BALS & BALTAC, 1977). However, in *O. platensis* (VAN DER HAMMEN, 1969), *O. texanus*, and in two males from Brazil (possibly *O. platensis*) these setae are of the barbed and tapering type (Figs 1N, 5B).

A second potentially informative difference involves the presence or absence of genital setae in the females. Genital setae in this context refers only to setae posterior to the genital opening and between the pregenital capsules, excluding setae on the ovipositor (see below). Van der Hammen (1969) described and illustrated such setae for females of *O. platensis*, and Juvara-Bals and Baltac (1977) reported genital setae for *O. vanderhammeni*. VAN DER HAMMEN (1966) also reported genital setae for *O. texanus*, but based on our observations we concur with his later assertion

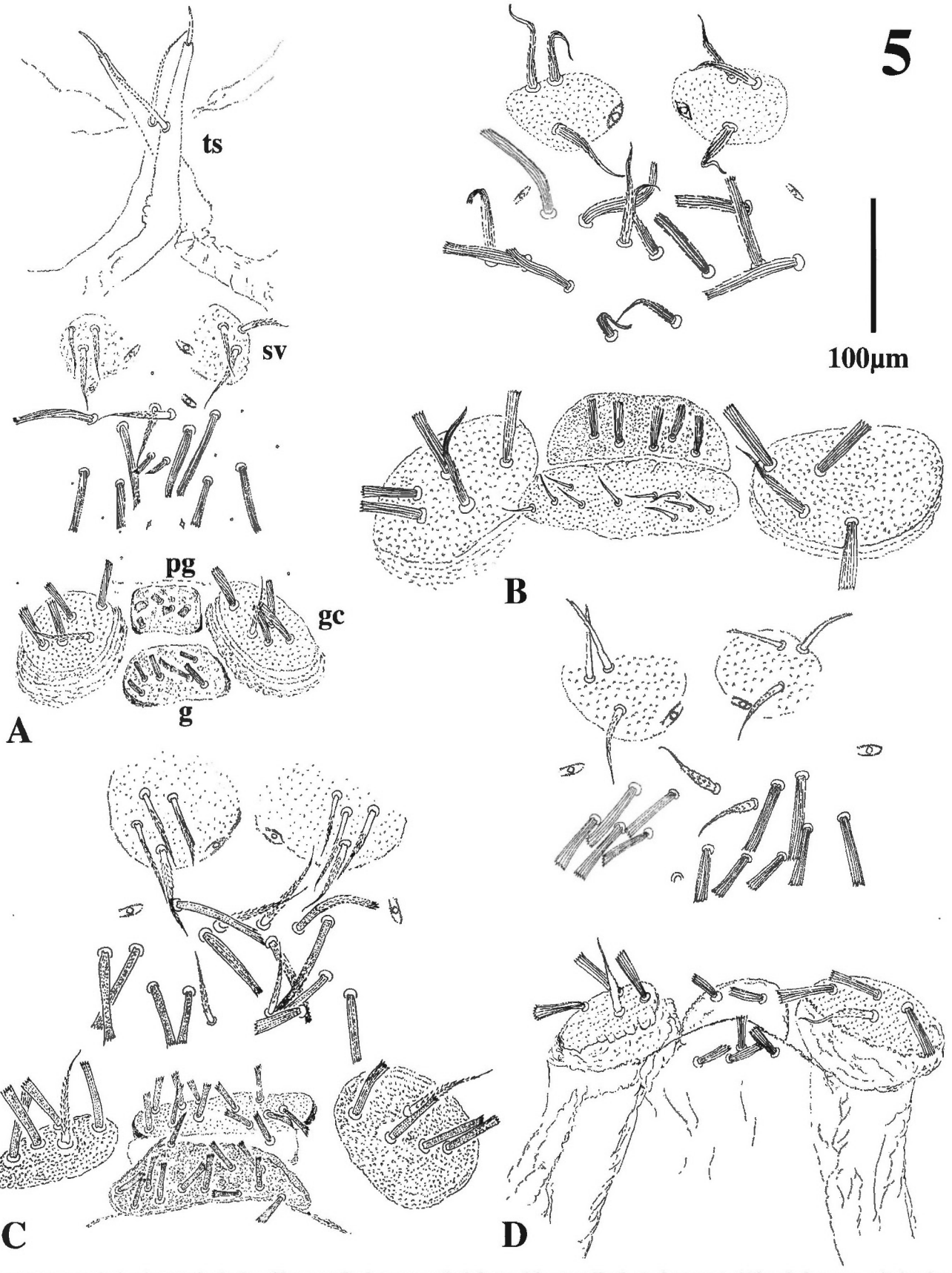

FIG. 5: Sterno-genital region, male. A: *O. nohbecanus*; B: *O. texanus*; C: *O. bajacalifornicus*; D: *O. siankaanensis*. Abbreviations: g: genital region; pc: pregenital capsule; pg: pregenital region; sv: sternal verrucae; ts: tritosternum.

(VAN DER HAMMEN, 1969) that the specimen he examined was not a female. Genital setae in the female are absent in all our material (including *O. texanus*) and in *O. orghidani* (JUVARA-BALS & BALTAC, 1977). This condition appears to be unusual within Opilioacaridae, as genital setae have been reported for females of *Panchaetes*, *Salfacarus*, and possibly *Paracarus* (NAUDO, 1963, VAN DER HAMMEN, 1968, 1977). Data for *Siamacarus*, *Vanderhammenacarus*, *Adenacarus*, or the Old World *Opilioacarus* are unfortunately not available.

In summary, the presence or absence of female pregenital and genital setae and the shape of the male genital setae are likely to be informative at the species level. The number of barbed tapering setae in the region between the sternal verrucae and the pregenital capsules may also be informative. All other characters, especially those dealing with numbers of setae, are unlikely to be informative at or above the species level.

Ovipositor. The morphology of the ovipositor has not received much attention in previous descriptions of Opilioacaridae, but we found considerable differentiation in this structure. The most dramatic difference is the presence or absence of long terminal (= eugenital?) setae near the tip of the ovipositor (Figs 6B, 7A, C). When present, these setae are very distinct, whether the ovipositor is withdrawn into the body or evaginated. They are arranged in several clusters lateral and posterior to the ovipore (Figs 6B, 7C). Long setae on the ovipositor are present in all females from Baja California Sur and Noh Bec, but absent in all other specimens examined. Neither have they been reported for any other species of Opilioacaridae. The absence of records in the literature is interpreted as absence of these setae. The structures are very distinct and would not be missed in even a cursory examination.

A second characteristic concerns the presence of small, paired structures slightly proximal to the ovipore. These can appear as bean-shaped non-protruding structures (Figs 7B-D) or as two small curved and blunt-tipped setae (Figs 6A, 7A). Homology of the two types is suggested by the strong similarity in position and overall size, and the absence of any instance in which both types were found in a single individual. More detailed study of the morphology of especially the bean-shaped structures would be indicated. Unlike the presence of the longer setae near the ovipositor, presence of these structures may be overlooked quite easily. Conclusions on the distribution of these structures in other species of *Opilioacarus (Neocarus)* or even other Opilioacaridae are deferred until actual specimens can be examined. As a final note, our observations suggest that the ovipositor is three-lobed as is the ovipositor of primitive Acariformes, and not bilobed as reported for some African Opilioacaridae (VAN DER HAMMEN, 1977).

The internal glandular structure is usually poorly visible, but in one female from Noh Bec such structures were visible (Fig. 7A). A pair of fairly large sac-like glands is clearly connected to the genital atrium via long narrow ducts, a condition similar to that described for *O. texanus* by ALBERTI & COONS (1999).

Stigmata. The relative arrangement of the stigmata has been used by LEHTINEN (1980) in diagnosing *O. ojastii*. In *O. ojastii* stigma 4 is inserted more towards the body axis than stigma 3, but in *O. texanus* it is inserted at approximately the same level as stigma 3 (VAN DER HAMMEN, 1966) (Fig. 8D). In *O. platensis* (VAN DER HAMMEN, 1969), and in other material examined during this study, stigma 4 is inserted further from the body axis than stigma 3 (Figs 8A-C). While these results are promising, we defer judgment on the value of this character until larger series of specimens of a variety of species can be examined specifically for this character. There is a great potential for artifacts in establishing the state of this character using slide mounted specimens, especially given the relatively small positional shifts involved.

Legs. Legs I in Opilioacaridae are thin and very long, up to 3 times the length of the body. Opilioacarids use these legs like the antennae of insects. Although the tips of legs I may rest on the substrate, these legs are not used for walking. The tarsi of legs I include a large and diverse assemblage of sensilla, showing potential interspecific variability (Figs 1Q-U, 9A-B). We did investigate some of this variability, but the available material was insufficient to properly evaluate variability in this character set for all relevant taxa. In general, the distal sensillar field of the female includes 2 broad sensilla with a nipple-like tip (Fig. 1Q; more than 2 setae of this type in many males),

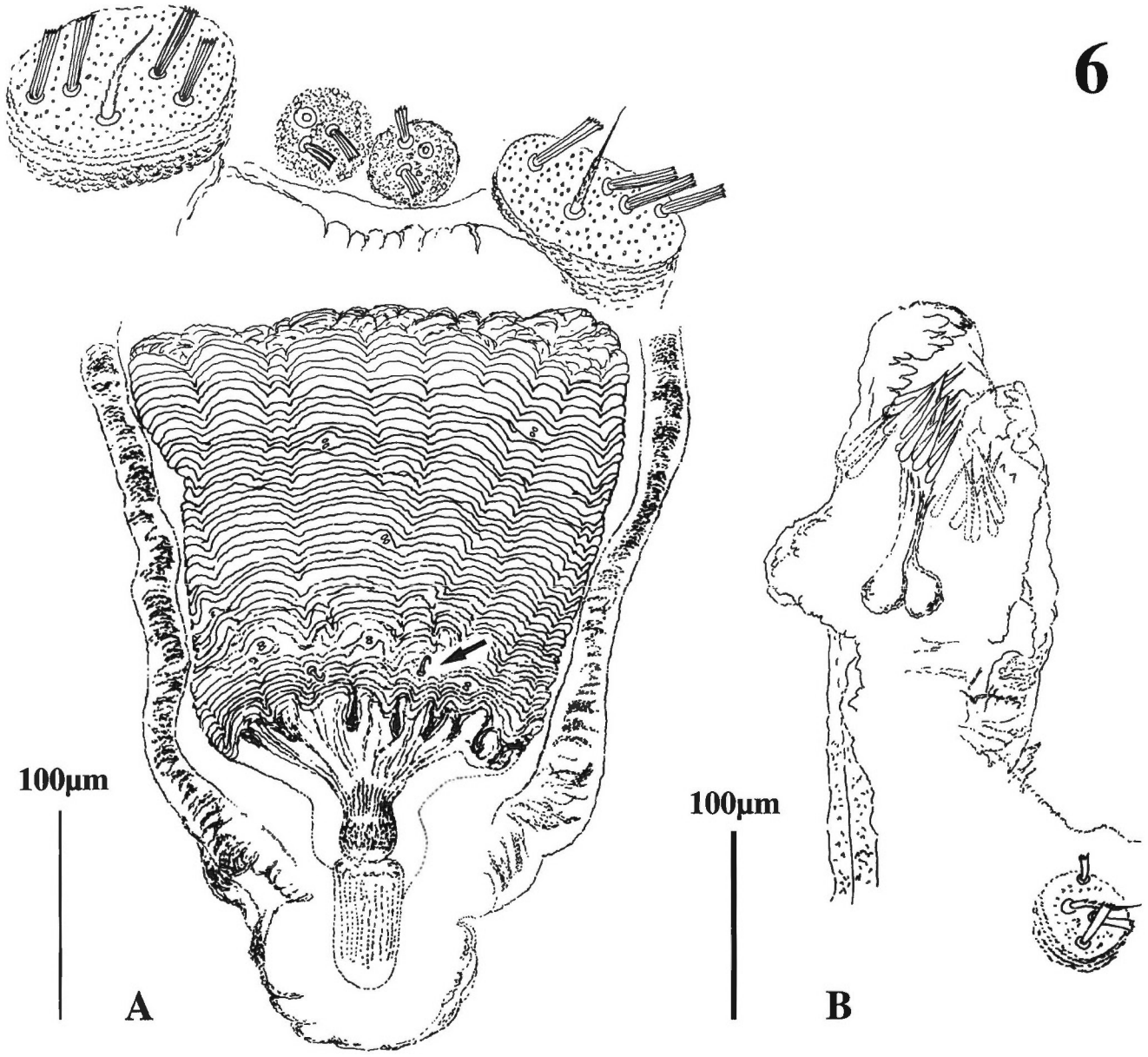

FIG. 6: Ovipositor and genital region female. A: *O. nicaraguensis*, genital area and invaginated ovipositor (internal); arrow points to small curved seta on ovipositor; B. *O. bajacalifornicus*, evaginated ovipositor, lateral view.

1 small spine-like sensillum (Fig. 1R), a highly modified broad sensillum with a "crown-like" tip (Fig. 1S), one or two broad and membranous sensilla with curvy sides (Fig. 1T), a number of broad, blade-shaped and slightly membranous sensilla of varying length (Fig. 1U), and a number of long sensilla with a bifurcate tip and weak indications of transverse striation (Figs 9A-B). More basal on tarsi I is a dorsal pit with one completely hidden, and one partially protruding (porose?) sensillum (Figs 1V, 9A). Pretarsi I carry a pair of well-developed claws, but no setae.

The sensillar complement of tarsi II is far less complex than that of tarsi I. In all taxa tarsi II carry a barbed, bifurcate setae and two sensilla resembling solenidia in a dorsal position (Figs 1W, Y, 9C-D). The dorsal setae are generally barbed, often in the ribbed

pattern found in many idiosomal setae, but most ventral setae are either lightly barbed or smooth. One exception is the distal ventral pair of setae which tends to be more markedly barbed/incised than the remaining setae (Figs 1X, Z, 9C-D). Pretarsi with two pairs of setae showing one fringed edge, and a pair of well developed claws. Neither one of these characteristics proved useful as species specific characters in our study. Similarly, we did not record any distinguishing species-specific characteristics for the remaining parts of legs I-II or legs III. Segmentation and setation patterns for these legs have been discussed in detail by VAN DER HAMMEN (1966).

DESCRIPTIONS

Opilioacarus (Neocarus) nohbecanus n. sp.

(Figs 1A, C, D, K, Y, Z, 2A-C, 3D, 4C, 5A, 7A, 8A, 9A-B, 10D, 11B)

DIAGNOSIS: Palp tibiotarsus of the males with 2-3 *sm3* type setae; only 4 leaf-like setae (*d* type) on the palp tibiotarsus of both adults; pregenital setae in the female absent; setae on the female ovipositor present; genital setae of the male of the stout ribbed type.

The palp characteristics are shared by *O. orghidani*, but that species does not share the distinct morphology of the ovipositor.

Color: Females with a combination of pale blue and light brown color on the idiosoma, blue and purple on the legs, and more bright blue on the palps. Males more brownish in all parts of the body. Juveniles generally showing a more pale blue color on all parts of the body.

Gnathosoma and palps (Figs 1A, C, D, K, 2A-C, 3D, 4C, 10D): Palp tibiotarsus with only 4 leaf-like setae (*d* type) in the adults, and 2-3 *sm3* type setae in the males. In addition, only 4 (not the more common 5) *v1* setae in most adults (Figs 2A-C, Table 1). Palpal claws of the males very strong and curved, inserted slightly lateral.

Subcapitulum (Fig. 4C): general morphology as in other *Opilioacarus* (GRANDJEAN, 1936, VAN DER HAMMEN, 1966). All 4 pairs of paralabial setae present, *pl4* very small and inserted dorso-laterally on the subcapitulum. Rutella well developed, with 5 large teeth in the prominent row, and 4-5 smaller ones in the secondary row (Fig. 3D). Total of 5 (one female with 6) circumbuccal-type setae. Remaining subcapitular setae barbed. Female with slightly more subcapitular setae than male (Table 2).

Chelicera (Fig. 10D): Basal segment with one seta, movable digit with 3 lightly barbed additional setae. Dorsal and antiaxial lyrifissures well developed. Fixed digit with 2-3 strong teeth. Movable digit extending slightly beyond fixed digit; with 5-6 teeth (visible in paraxial view, partially hidden in antiaxial view) and a well developed terminal hook.

Idiosoma (Figs 5A, 7A, 8A, 11B): Female: size (N=2), 1420 × 1020 and 1450 × 1000 μm; male: size (N= 2), 1570 × 1230 and 1770 × 1190 μm.

Dorsum: Propodosoma with approximately 100 setae, all of the stout ribbed type (Fig. 11B). Most setae relatively short, with only some anterior setae slightly longer. Two pairs of eyes present. Lyrifissures absent. Hysterosoma largely without setae but with large numbers of serially arranged lyrifissures. Segment XVIII with one dorsal, and 2 lateroventral setae. Anal plates of both females and males each with 8 to 9 stout ribbed setae. Stigmata 4 inserted further from body axis than stigmata 3 (Fig. 8A).

Sterno-genital region (Fig. 5A): Sternal verrucae each with three setae of the barbed, tapering type and 1 lyrifissure. Rest of sternal area with 5-7 pairs of stout ribbed and 1 (occasionally 2 in males) pair of barbed, tapering setae. Pregenital capsules each with 4 (3-5) stout ribbed and one barbed, tapering seta.

Pregenital and genital areas with, respectively, 4-5 and 5-7 stout ribbed setae in the male, but without setae in the female. Ovipositor with 7-12 long, lightly barbed setae around the ovipore, and 1 pair of very small curved setae slightly basal to the ovipore (Fig. 6A).

Arrangement of the male accessory glands could not be established in the cleared specimens.

Legs: Length of legs I (N=2) 3610 and 4040 μm, length legs IV(N=2) 2940 and 2850 μm. The length ratio of legs I relative to the idiosoma 2.3 or 2.8, the same ratio for legs IV is 1.9 and 2.0. Legs II and III

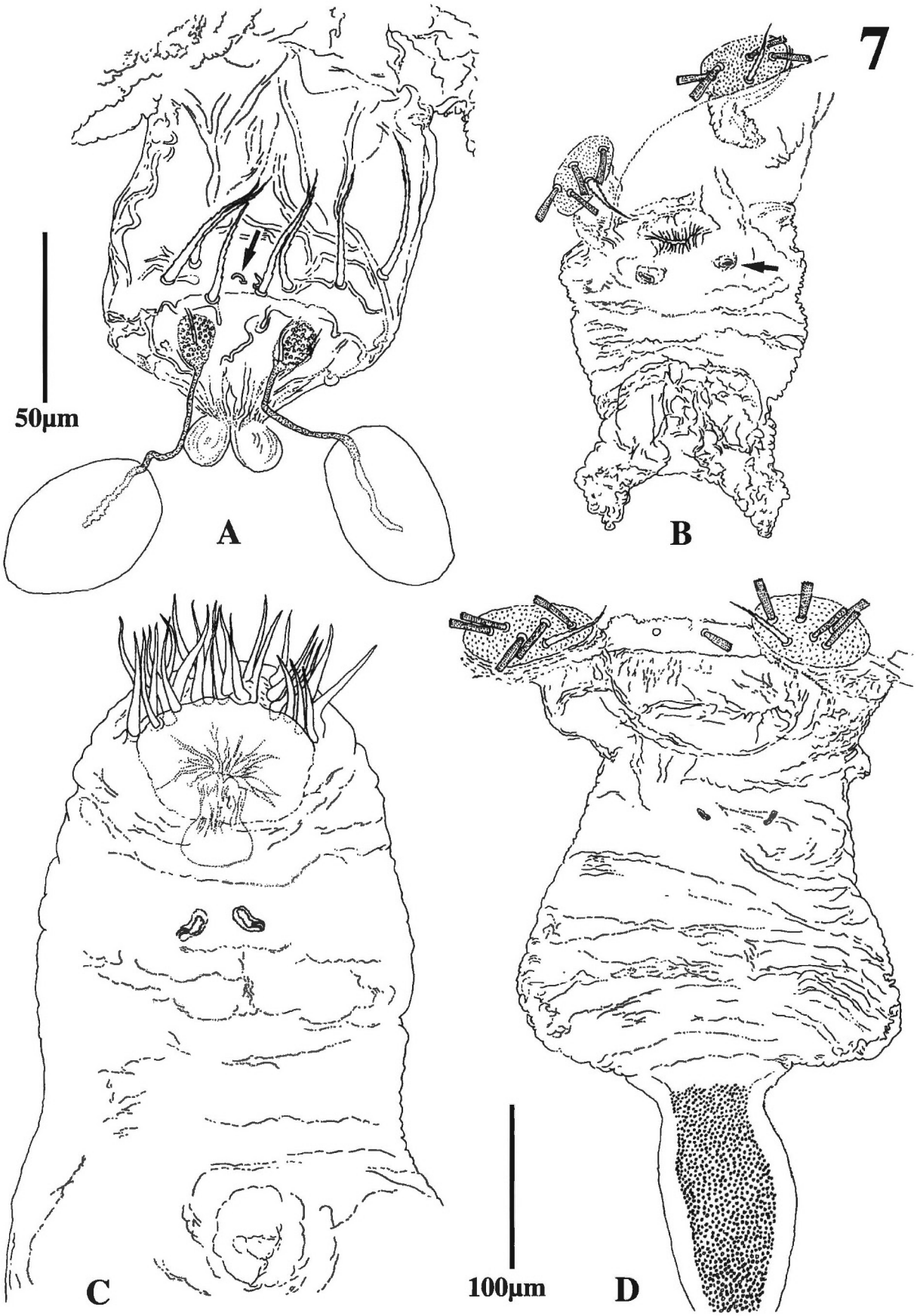

FIG. 7: Ovipositor and genital region female. A: *O. nohbecanus*, invaginated ovipositor with associated glands; B: *O. siankaanensis*, invaginated ovipositor; C: *O. bajacalifornicus*, evaginated ovipositor; D: *O. texanus*, genital area and invaginated ovipositor. Arrows point to small curved seta (A) or bean-shaped structures (B) on ovipositor.

are relatively shorter. Sensillar complement of legs I as figured (Figs 9A-B). Several ventral setae of tarsi II with distinct barbs (Figs 1Y, Z).

ETYMOLOGY: named after the Reserva Forestal in which this material was collected.

MATERIAL EXAMINED: MEXICO: Quintana Roo, Ejido de Noh Bec, Reserva Forestal, 19°7'24"N 88°20'20"W, ex litter at the base of overgrown ruins of a Mayan pyramid, coll. R.C. Chargoy, 12 Feb 2000 (F Holotype), AL5944; same site, colls. M.M. Vázquez and H. Klompen, 19 Jun 1999, AL5724 (M Allotype, 1M paratype, 3PN); same site, coll. M.M. Vázquez, 11 Feb 1997, AL5902 (1F paratype, 1TN, 2PN, 1L).

DEPOSITION SPECIMENS: Holotype female (specimen number OSAL000550) and allotype male (OSAL000551) deposited at UNAM. Paratypes at UQRoo (1F, 1TN, 3PN, 1L) and OSAL (1M, 2PN; OSAL000553, 558-559).

Opilioacarus (Neocarus) siankaanensis n. sp.

(Figs 1B, 2D, 3E, 4B, 5D, 7B, 8B, 9D, 10B, 11C)

DIAGNOSIS: Palp tibiotarsus of the male lacking *sm3* type setae; 5 leaf-like (*d* type) setae on the palp tibiotarsus; pregenital setae in the female absent; setae on the female ovipositor absent; genital setae of the male of the stout ribbed type.

The above combination of characters is not matched by any of the other species considered, but it remains to be investigated whether any of these characteristics is derived.

Color: Mostly a light, pale-blue, with some patches of purple and white. Among the most pale species examined.

Gnathosoma and palps (Figs 1B, 2D, 3E, 4B, 10B): Palp tibiotarsus with 5 leaf-like setae (*d* type) in the adults, and without *sm3* setae in the males. Number of setae smaller than in *O. nohbecanus*, especially for the *ch* type. Five *vl* setae in the adults (Fig. 2D, Table 1).

Subcapitulum (Fig. 4B): general morphology as in *O. nohbecanus*. Rutella well developed, with 5 large teeth in the row of large teeth and up to 5 smaller ones in a second row (Fig. 3E). Four circumbuccal-type setae. Median and posterior subcapitular setae barbed. Total number subequal to, or less than, that in *O. nohbecanus* (Table 2).

Chelicera (Fig. 10B): Setation pattern and lyrifissures as in *O. nohbecanus*, although dorsal lyrifissure often difficult to detect. Dentition in a female from Sian Ka'an with 2 large teeth on the fixed digit, and one large tooth on the movable digit (Fig. 10B). In contrast, a male from Sian Ka'an did show the large tooth (plus several smaller ones) on the fixed digit, but the movable digit has multiple small, instead of two large, teeth (Fig. 10C). This might indicate sexual dimorphism, but a female from Lol Beh showed an intermediate form of dentition on the movable digit. Until more specimens become available for study, we cannot exclude the possibility that all differences noted are related to the angle at which the chelicera were observed. Finally, some specimens show a small spur ventrally on the movable digit.

Idiosoma (Figs 5D, 7B, 8B, 11C): Female: size (N=3), 1250 × 822, 1450 × 1000, and 1420 × 1000 μm (specimen from Lol Beh); male: size (N= 1) 1550 × 935 μm.

Dorsum: Propodosoma with 85-90 setae (Fig. 11C). Average shape of setae more broad than in *O. nohbecanus*. Eyes, dorsal lyrifissure, and dorsal setal patterns as in *O. nohbecanus*. Anal plates of both females and males each with 7 to 9 stout ribbed setae.

Sterno-genital region (Fig. 5D): Sternal verrucae each with three (occasionally four) setae of the barbed, tapering type (Fig. 1J) and one lyrifissure. Rest of sternal area with 5-6 pairs of stout ribbed (Fig. 1K) and 1 pair of barbed, tapering setae. Pregenital capsules each with 3 (rarely 4 or 5) stout ribbed and one barbed, tapering seta. Pregenital and genital areas with, respectively, 2 and 4 stout ribbed setae in the male (Fig. 5D); without setae in the female. Ovipositor relatively simple, without long setae around the ovipore, and with a pair of small bean-shaped structures basal to the ovipore (Fig. 7B; see above). Arrangement of the male accessory glands could not be established in the cleared specimens.

Legs: Length of legs I (N=2) 3050 and 3780 μm, length legs IV(N=2) 2520 and 2910 μm. Length ratio of legs I relative to the idiosoma 2.1 and 2.4, same

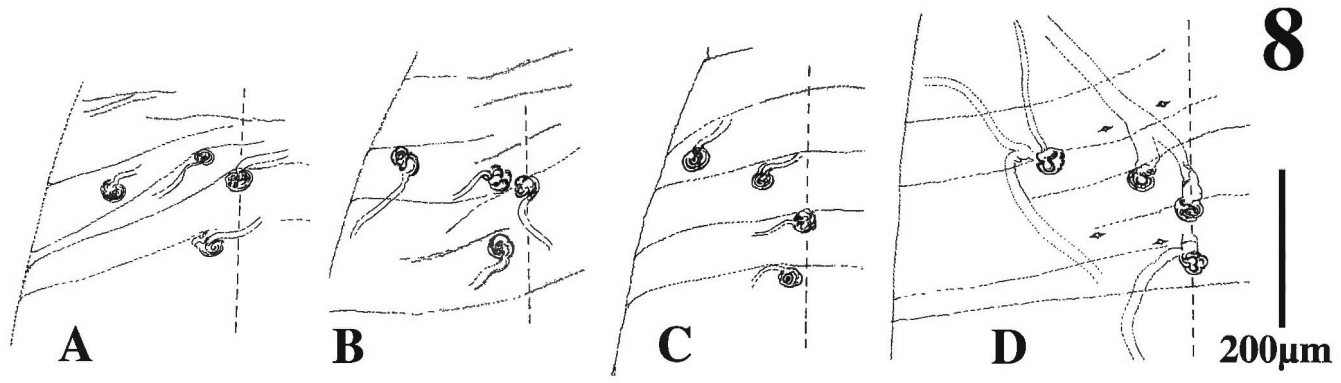

FIG. 8: Stigmata, position relative to each other: A: *O. nohbecanus*, female; B: *O. siankaanensis*, female; C: *O. nicaraguensis*, male; D: *O. texanus*, female. Dashed line runs parallel to the body axis.

ratio for legs IV 1.7 and 1.9. Sensillar complement for tarsi largely as noted for *O. nohbecanus*. Tarsi II as figured (Figs. 9C-D). With the exception of the distal ventral pair, all ventral setae smooth.

ETYMOLOGY: named after the Biosphere Reserve in which the original material was collected.

MATERIAL EXAMINED: MEXICO: Quintana Roo, Sian Ka'an Biosphere Res., 19°43'N 87°49'W, ex litter of *Bucida buceras* and *Dalbergia glabra*, coll. M.M. Vázquez, 8 Mar 1995, AL5881 (F Holotype); same site, coll. M.M. Vázquez, 5 Jul 1995, AL5880 (1F); ex litter and under stones, colls. M.M. Vázquez and H. Klompen, 16 Jun 1999, AL5702 (M Allotype); MEXICO: Quintana Roo, Lol Beh restaurant, on road from Tulum to Cobá, 20°25'N 87°39'W, ex litter, coll. J.A. Rodriguez, 10 Jun 1999, AL5700, (1PN); same site, ex litter and under stones, colls. M.M. Vázquez and H. Klompen, 17 Jun 1999, AL5720 (1F, 2TN, 3 DN), colls. M.M. Vázquez and H. Klompen, 24 Jun 1999, AL5733 (1F, 2DN).

DEPOSITION SPECIMENS: Holotype female (OSAL000561) and allotype male (OSAL000562) deposited at UNAM. Paratypes at UQRoo (1F, 1TN, 4DN, 1PN) and OSAL (2F, 1TN, 2DN, 1PN; OSAL000563, 565, 567, 570, 572-573).

Opilioacarus (Neocarus) nicaraguensis n. sp.

(Figs 1E, G, J, 2E-F, 3A, 6A, 8C, 10A, 11A, 12)

DIAGNOSIS: Palp tibiotarsus of the male without *sm3* type setae; 5 (occasionally 4 or 6) leaf-like setae (*d* type) on the palp tibiotarsus in the adults; at least 1 pair of pregenital setae in the female; long setae on the ovipositor absent, but ovipositor with 1 pair of small, curved setae, and several gland-like structures; genital setae of the male of the stout ribbed type.

This species resembles *O. siankaanensis* in the absence of long setae on the ovipositor, and the absence of *sm3* type setae on the male palp, but differs from this species by the presence of pregenital setae in the female.

Color: Two different coloration pattern were observed, some dark blue and purple over most of the body, others more brown and orange with less blue on the legs and palps and with conspicuous separation of body segments by bands of light color .

Gnathosoma and palps (Figs 1E, G, J, 2E-F, 3A, 10A): palp tibiotarsus with 4-6 (usually 5) leaf-like setae (*d* type) in the adults, and without *sm3* setae in the males. Number of setae higher than in *O. siankaanensis*, especially the number of *ch* type setae (Table 1). By far the most variable species in terms of numbers of palp setae, with considerable variability in numbers for *v2*, *sm1*, and *sm2* setae, in addition to variability in numbers of *d* and *ch* setae.

Subcapitulum: general morphology as in *O. nohbecanus*. Rutella well developed, with 5 large teeth in the row of large teeth and 4-5 smaller ones in a second row. With's organ in this species displays a distinct forked structure in addition to the usual membranous disc. Five circumbuccal-type setae. Remaining median and posterior subcapitular setae barbed. Total number subequal to that in *O. siankaanensis* (Table 2).

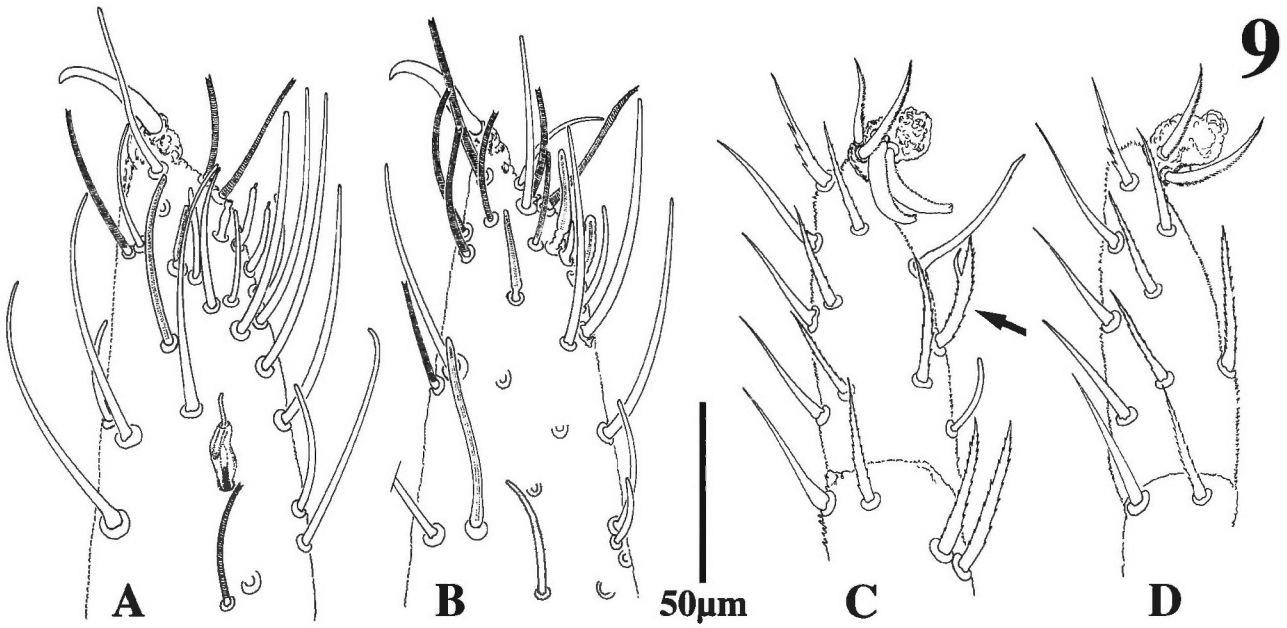

FIG. 9: Tarsus: A, B: *O. nohbecanus*, female, tarsus I, antero-and posterolateral views; C, D: *O. siankaanensis*, female, tarsus II, antero-and posterolateral view; arrow points to forked dorsal seta.

Chelicera (Fig. 10A): Setation pattern and lyrifissures as in *O. nohbecanus*, but dorsal lyrifissure poorly visible. One male appears to have 4 setae on the fixed digit (one side of the body only), but this specimen is in poor condition. Dentition strong, with 3 large teeth on the fixed digit, and two large and two smaller teeth on the movable digit. Ventral spur on the movable digit well developed.

Idiosoma (Figs 6A, 8C, 11A, 12): Female: size (N=2), 2350 × 1490 and 1940 × 1300 µm; male: size (N= 2), 1790 × 1490 and 2030 × 1040 µm.

Dorsum: Propodosoma with approximately 100 short setae, all of the stout ribbed type (Fig. 11A). Most setae relatively short, with only some anterior ones slightly longer. Eyes, dorsal lyrifissure, and dorsal setal patterns as in *O. nohbecanus*. Anal plates of both females and males each with 10 to 12, usually 11, stout, ribbed setae. Stigmata 4 further away from body axis than stigmata 3.

Sterno-genital region: sternal verrucae each with 3 barbed, tapering setae and one lyrifissure. Remaining sternal region with 6-7 pairs of large stout ribbed setae and one pair of barbed, tapering setae. Pregenital capsules each with 4 (rarely 5) stout ribbed, and one barbed, tapering setae.

Pregenital and genital areas of the males with, respectively, 4-7 and 4-6 stout ribbed setae (2-4 and 0-3 for males from Hervideros de San Jacinto). Females with 2 pregenital (5 in one individual) setae positioned on small tubercles, and no genital setae. Ovipositor differs in shape from those in the other species (Fig. 6A). Both invaginated and evaginated ovipositors with a characteristic transverse folding pattern resulting in a striated appearance. A pair of small, curved setae (as in *O. nohbecanus*) just basal to the ovipore; slightly more basal, 3-6 additional small structures in 2 rows. Morphologically, these structures appear to have two small valves, suggesting gland openings. The striations around these structures are slightly more spaced. Both the regular striate pattern and the presence of these "gland-like" structures are unique among the material studied. When invaginated the ovipositor appears to lie in a small cavity delineated by distinct (muscle?) walls.

Accessory glands in one male include a pair of large median glands, and a pair of large lateral glands (Fig. 12), as described by Lehtinen (1980) for *O. ojastii*.

Legs: Length of legs I (N=1) 3250 µm, length legs IV(N=2) 3100 µm. Length ratio of legs I relative to

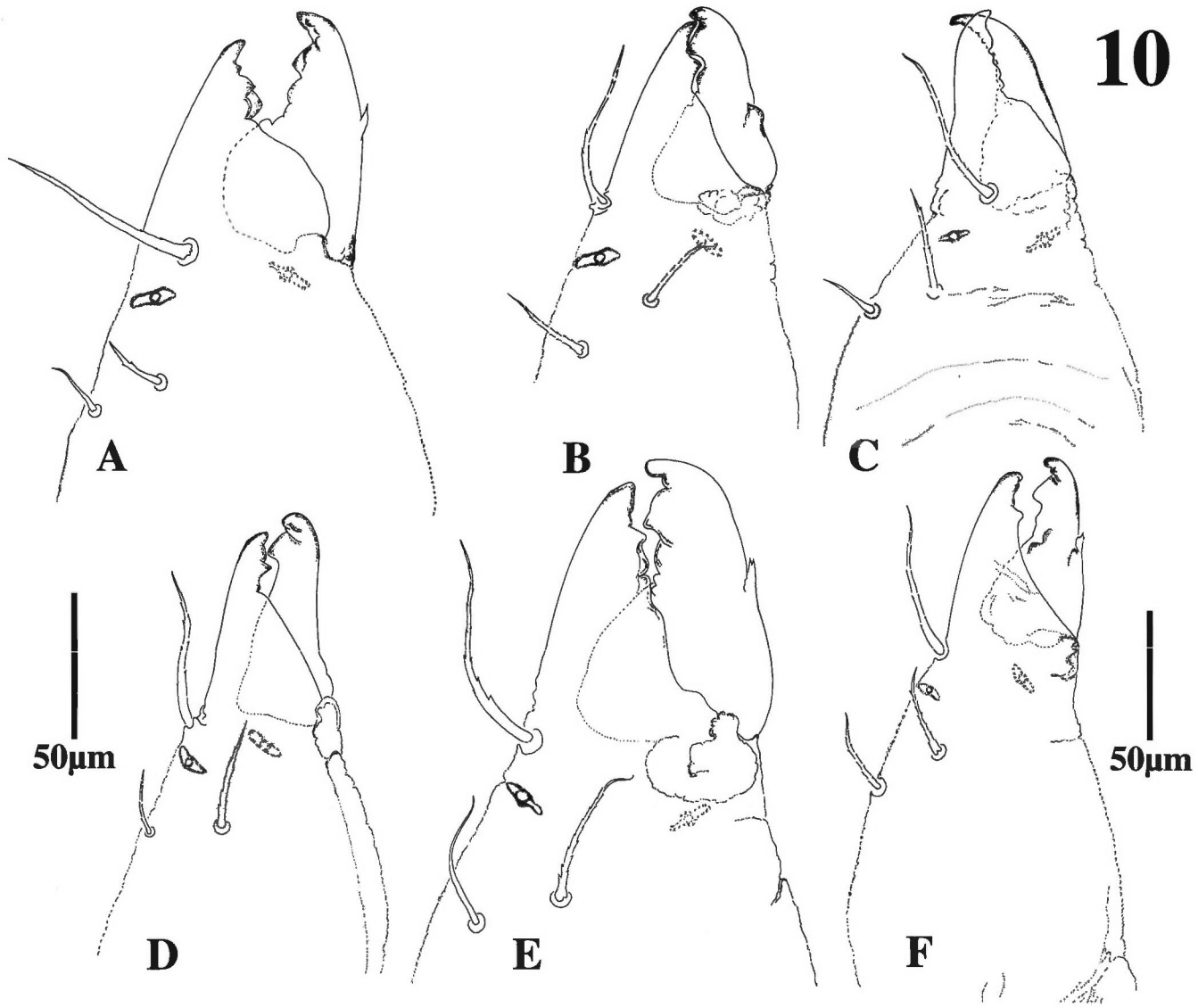

FIG. 10: Chelicera: A: *O. nicaraguensis*, male; B: *O. siankaanensis*, female; C: *O. siankaanensis*, male; D: *O. nohbecanus*; E: *O. bajacalifornicus*; F: *O. texanus*.

the idiosoma 2.2, ratio for legs IV 1.8. Sensillar complement for tarsi largely as noted for *O. nohbecanus*. Tarsi II with most ventral setae smooth, as in *O. siankaanensis*. Legs IV generally very large and well developed.

ETYMOLOGY: named after the country in which the material was collected.

MATERIAL EXAMINED: NICARAGUA: León, Comarca, Los Cocos, near Volcano Telica, 12°35′N 86°50′W, coll. J.M. Maes and L. de Armas, 8 Aug 1995, ex under stones, AL5947 (1M Holotype, 3M paratypes, 2TN); León, base of Volcano Momotombo, 12°28′N 186°31′W, coll. J.M. Maes and L. de Armas, 5 Aug 1995, ex under stones, AL5945 (1F); León, Hervideros de San Jacinto, 12°34′N 86°44′W, coll. J.G. Palacios-Vargas and J.M. Maes, 4 Sep 1987, ex under stones, AL5949 (1M); NICARAGUA: Managua, Laguna Xiloa, coll. Maes, Armas and Goodwin, 13 Aug 1995, ex under stones, AL5946 (3F); NICARAGUA: Matagalpa, road Telica to San Isidro, km 167, coll. J.G. Palacios-Vargas and J.M. Maes, 21 Aug 1998, ex under stones, AL5948 (1TN); NICARAGUA: Madriz, San José de Cuzmapa, coll.

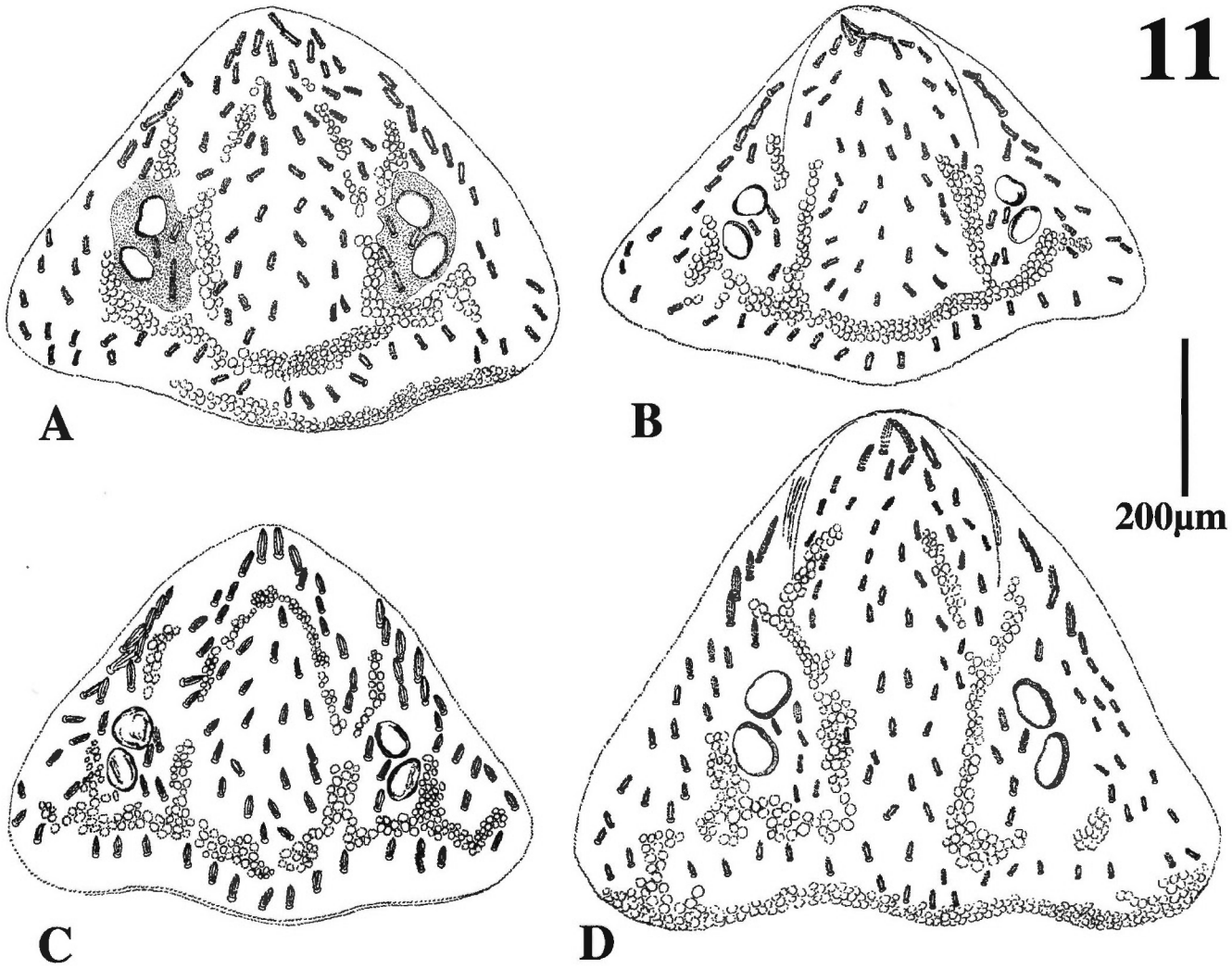

FIG. 11: Propodosoma: A: *O. nicaraguensis*, male; B: *O. nohbecanus*, female; C: *O. siankaanensis*, female; D: *O. texanus*, female.

J.G. Palacios-Vargas and J.M. Maes, 22 Sep 1987, ex under stones in temperate forest of *Pinus oocarpa*, AL5950 (2M)

DEPOSITION SPECIMENS: Holotype male (OSAL000576) to be deposited in National Acarology Collection in Nicaragua. In the absence of a dedicated acarology collection, the primary type is temporarily housed in OSAL labelled "property of Nicaragua". Paratypes at Museo Entomologico, León, Nicaragua (1F, 1M, 1TN), UQRoo (1F, 2M, 1TN), and OSAL (1F, 2M, 1TN; OSAL000578-581).

Opilioacarus (Neocarus) bajacalifornicus n. sp.

(Figs 1F, H, I, L, M, O, P, W, X, 2G, 3B, 4A, 5C, 6B, 7C, 10E)

DIAGNOSIS: Palp tibiotarsus of the male lacking *sm3* type setae; 5 leaf-like setae (*d* type) on the palp tibiotarsus in all adults; 1 pair of pregenital setae in the female; long setae on the ovipositor present; genital setae of the male of the stout ribbed type.

The presence of long setae on the ovipositor is shared with *O. nohbecanus*, but that species has *sm3*

type setae on the palps of the male, and 4 leaf-like setae on the palps of the adults.

Color: Generally dark blue mixed with purple. A few light spots on the legs and the ventral part of the propodosoma. Overall a dark species.

Gnathosoma and palps (Figs 1F, H, I, 2G, 3B, 4A, 10E): Palp tibiotarsus with 5 leaf-like (*d* type) setae (occasionally 4 or 6) (Figs 1I, 2G). Generally setation more variable than in the other species (possibly these specimens represent more than one species).

Subcapitulum (Fig. 4A): general morphology as in *O. nohbecanus*. Rutella with 5 large teeth in the main row, and 4-5 in the smaller row (Fig. 3B). Total of 5 circumbuccal-type setae. Median and posterior setae smooth or very weakly barbed. On average, females with slightly more setae than males (Table 2).

Chelicera (10E): Setation pattern and lyrifissures as in *O. nohbecanus*. Fixed digit with 1-2 large teeth, movable digit with 2 large teeth. Ventral spur on the movable digit well developed.

Idiosoma (Figs 1L, M, O, P, 5C, 6B, 7C): Female: size (N=2), 2350 × 1530 and 2030 × 1270 μm; male: size (N= 2), 2200 × 1510 and 1720 × 1210 μm.

Dorsum: Propodosoma with approximately 130 setae, all of the stout ribbed type. Eyes, dorsal lyrifissure, and dorsal setal patterns as in *O. nohbecanus*. Anal plates of both females and males each with 9 to 12 stout, ribbed setae. Stigmata 4 positioned further away from the body axis than stigmata 3.

Sterno-genital region (Fig. 5C): Sternal verrucae each with 3-4 setae of the barbed, tapering type, and a lyrifissure. Rest of sternal area with 6-7 (occasionally 5) setae of the stout ribbed type, and 2 pairs of the barbed, tapering type. Pregenital capsules each with 3-5 (usually 4) stout ribbed setae and a barbed, tapering seta.

Pregenital and genital areas with, respectively, 5-8 and 7-8 stout ribbed setae in most males, but one individual carried, respectively, 13 and 11 (Fig. 5C). Female with 1 pair of pregenital setae and lacking genital setae. Ovipositor (Figs 6C, 7B) with about 25 long smooth terminal setae around the ovipore, and a pair of bean-shaped structures slightly basal to the ovipore.

Arrangement of the male accessory glands could not be established in the cleared specimens.

Legs: Length of legs I (N=2) 3630 and 4530 μm, length legs IV(N=2) 3610 and 3670 μm. Length ratio of legs I relative to the idiosoma 1.8 and 1.9; for legs IV 1.8 and 1.6. Legs IV are very well developed, especially the femur. Usually this leg is folded close to the body. Jumping has been documented for this species (VÁZQUEZ & PALACIOS-VARGAS, 1988). Sensillar complement for tarsi I similar to that of *O. nohbecanus*. Tarsi II with smooth ventral setae. Distal ventral setae very strongly incised.

ETYMOLOGY: This species is named after the state in Mexico, Baja California Sur, in which the material was collected .

MATERIAL EXAMINED: MEXICO: Baja California Sur, Sierra de La Laguna, 23°28′N 109°54′W, elevation approximately 2000m, coll. M.M. Vázquez, 20 Aug 1986, ex under bark downed tree, AL5951 (1F Holotytpe, 2F paratypes, 2M, 1TN); same site, ex under bark downed *Quercus devia*, coll. M.M. Vázquez, 13 Mar 1985, AL 5953 (1M Allotype); colls. M.M. Vázquez and J. G. Palacios-Vargas, 1 Nov 1986, ex under bark downed log, AL5954 (4F, 2M); coll. B. Roth, 18 Jan 1988, ex under stones, AL5952 (1M).

DEPOSITION SPECIMENS: Holotype female (OSAL000582) and allotype male (OSAL00583) deposited at UNAM. Paratypes at UQRoo (4F, 3M, 1TN) and OSAL (2F, 2M; OSAL000584-587).

Opilioacarus (Neocarus) texanus
(Chamberlin and Mulaik 1942)

(Figs 1N, Q-V, 2H, 3C, 3F, 4D, 5B, 7D, 8D, 10F, 11D)

DIAGNOSIS: Palp tibiotarsus of the male without *sm3* type setae; 5 leaf-like setae (*d* type) on the palp tibiotarsus in all adults; 1 pair of pregenital setae in the female; setae on the ovipositor absent; genital setae of the male of the fine type.

The presence of fine type genital setae in the male clearly separates it from *O. siankaanensis*, which otherwise shares most other characters. It differs from *O. platensis* by the absence of genital setae in the female, and larger numbers of pregenital setae in the male (Table 3).

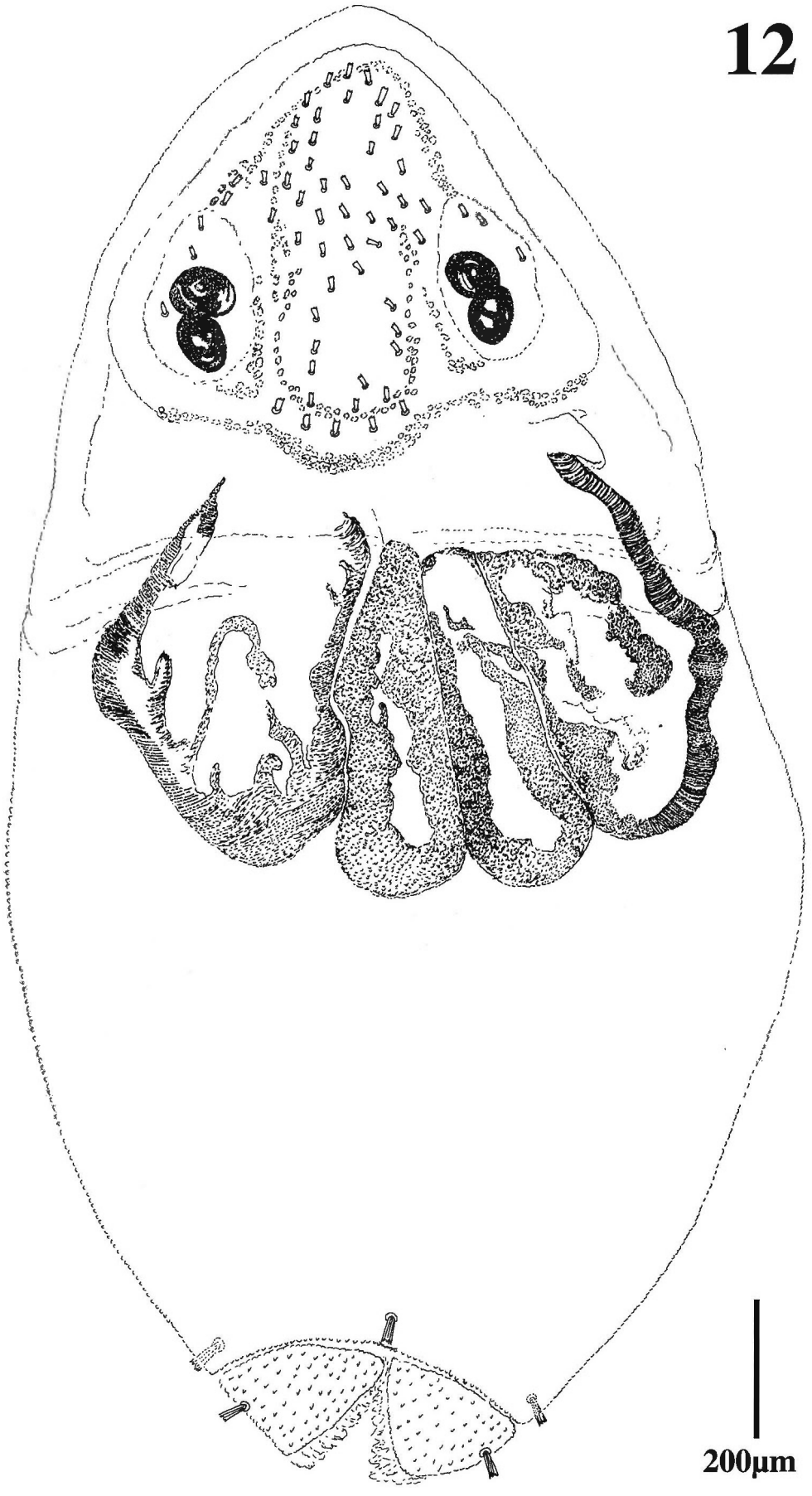

FIG. 12: Idiosoma, arrangement male accessory glands: *O. nicaraguensis*.

Color: Body light brown, contrasting with light blue and purple banding of the legs, palps and parts of the propodosoma.

Gnathosoma and palps (Figs 2H, 3C, 3F, 4D, 10F): Palp tibiotarsus with 5 leaf-like setae (*d* type) and no *sm3* type setae in the males. Generally with the standard complement of setae, but one male with, respectively, 21 and 5 *ch* and *sm1* setae, instead of the usual 14 and 3 (Fig. 2H; Table 1).

Subcapitulum: general morphology as in *O. nohbecanus*. Rutella with 4-5 teeth in the prominent row, and another 4-5 in the secondary row (Fig. 3C). With's organ with distinct internal fork (Fig. 3F). Adults with 5 circumbuccal setae and 6-7 smooth median and posterior setae (Fig. 4D).

Chelicera (Fig. 10F): Setation pattern and lyrifissures as in *O. nohbecanus*. Both fixed and movable digit with a single large tooth, and a number of smaller teeth.

Idiosoma (Figs 1N, 5B, 7D, 8D, 11D): Female: size (N=2), 1980 × 1310 and 2130 × 1270 μm; male: size (N= 2), 1870 × 1270 and 1720 × 1210 μm.
Dorsum: Propodosoma with approximately 120 setae, most short, but some anterior and anterolateral setae distinctly longer (Fig. 11D). Eyes, dorsal lyrifissure, and dorsal setal patterns as in *O. nohbecanus*. Anal plates of both females and males each with 9 to 10 stout ribbed setae. Stigmata 3 and 4 at subequal distance to the body axis (Fig. 8D).

Sterno-genital region (Fig. 5B): Sternal verrucae each with 3-5 barbed, tapering setae. Remaining sternal region with 4-6 pairs of stout ribbed and 2 pairs of barbed, tapering setae. Pregenital capsules each with 5-6 stout ribbed setae in the female, 3-5 in the male, plus a single barbed, tapering seta. Pregenital and genital areas in the male with, respectively, 4-5 stout ribbed and 8-9 fine setae; only one pair of pregenital setae in the female. Ovipositor without setae near the ovipore, but with a pair of the bean-shaped structures (Fig. 7D). Arrangement of the male accessory glands could not be established in the cleared specimens.

Legs: Length of legs I (N=2) 4240 and 5080 μm, length legs IV(N=2) 3570 and 3900 μm. Length ratio of legs I relative to the idiosoma 2.1 and 1.8; for legs IV 1.7 and 1.3. Sensillar complement for tarsi I largely resembling that in *O. nohbecanus*, but striate, notched sensilla generally shorter (Fig. 1Q-V). Tarsi II as in *O. nohbecanus*, but most ventral setae smooth. Distal ventral setae deeply incised, and more leaf-like than in the other species.

MATERIAL EXAMINED: USA: Texas, Brewster Co., Big Bend Nat. Pk., Chisos Mtn., Cat-Tail Canyon, coll. B. Roth-Schroepfer, 20 Mar 1977 (1M); USA: Texas, Kerr Co., W. Ingram, Slippery Ridge Ranch, elevation approximately 600m, 30°02′38″N 99°08′33″W, colls. B.S. Gerdeman and H. Klompen, 24 Apr 1997, AL5185 (3L, 1TN, 2F, 2M); same site, colls. M. Pound and J.E. Keirans, 20 May 1999, AL5694 (1F); USA: Texas, Garza Co., 11.3km ENE Justiceberg, J. Rowland, 13 Oct 1972, TMMC (1F); USA: Texas, Bandera Co., Love Creek Ranch, 17km W. Medina, A.G. Grubbs, 6 Oct 1996, TMMC; USA: Texas, Burnet Co., Burnet Co. Road 404, 8.7km W. Spicewood, A.G. Grubbs, 18 Sep 1994, TMMC; USA: Texas, Travis Co., Hwy 71 and Pedermales River, 37km W. Austin, A.G. Grubbs, 3 Oct 1994, TMMC.

DEPOSITION SPECIMENS: Material from Brewster and Kerr Co. in UQRoo and OSAL, other material in TMMC.

DISCUSSION

Habitat preference for Opilioacaridae is often described as "arid" or "semi-arid" areas. Such a description does fit the collection sites for the Old World *Opilioacarus*, *Adenacarus*, *Paracarus*, the Australian opilioacarid, *O. texanus*, and quite possibly a number of the African Opilioacarids collected from savanna type habitats. Even so, this generalization is clearly overly broad. *Phalangiacarus brossetti* Coineau and Van der Hammen 1977 was collected from tropical forest litter in Gabon, *Vanderhammenacarus deharvengi* Leclerc 1989 from litter in Thailand, and *O. ojastii* from mid-elevation forest in Venezuela. Second, a number of species, e.g. both *Siamacarus* species, *O. orghidani*, and *O. vanderhammeni*, were collected in caves or at the mouth of caves (JUVARA-BALS & BALTAC, 1977, LECLERC, 1989).

The current records expand the range of habitats even more. The Baja California Sur material was collected at an elevation of approximately 2000 m in the Sierra de Laguna near the southern tip of the peninsula. The area is volcanic in origin, with granite rocks found commonly. The area includes many canyons formed by fluvial erosion. The climate in this area is temperate, with a mean annual temperature of 18° C and over 600 mm annual rainfall. Above 1300 m the vegetation is a pine-oak forest dominated by *Pinus cembroides*, *Quercus devia*, *Q. reticulata*, and *Arbutus peninsularis* (madroño). Both the soil and litter layers are thick and very rich in organic matter (PALACIOS-VARGAS & VÁZQUEZ, 1990). Specimens were found under the bark of fallen logs and under stones.

Material from Quintana Roo came from low forest near the coast, secondary forest situated more inland, and mature tropical lowland forest in Noh Bec. While the first two localities have relatively open forest, with some quite dry parts on the soil surface, the Noh Bec sites do not fit the arid model at all. The forest in the Noh Bec Forest Reserve is dominated by large and high mahogany (*Swietenia* spp.) and cedro (*Cedrella odorata*) trees. Temperatures in the area vary from 28° C to 38° C, at often 90-100% humidity. Heavy rainfall is concentrated in the summer (June-August; often influenced by hurricanes), with lighter rains ("equipatas") in winter (November-March). The sun barely reaches the litter and soil layer. Relative to the other collecting localities in Quintana Roo, this forest generally had relatively few exposed rocks, although there were many such rocks near the overgrown Mayan ruins that formed the main collection site. Our specimens were collected from litter and under stones.

The coastal site in the Sian Ka'an Biosphere Reserve is in open, low, and seasonally inundated forest. The area is generally flooded for 4-6 months of the year, with only small islands protruding from the water. Temperatures in the area vary from 28° C to 42° C, with 60-80% humidity. The rainfall regime is similar to that for *O. nohbecanus*. Vegetation is characterized by short to medium trees with small and resinous leafs (especially *Bucida buceras* and *Dalbergia glabra*), often covered with epiphytic bromeliads and orchids. The soil is poor and thin, exposing the underlying calcareous rock. Only a few low-lying sites have a deeper litter and soil layer. The inland site near Cobá does not receive annual floods, but shares with the Sian Ka'an site the absence of large trees, poor and thin soil, and abundance of exposed rocks. Vegetation is more lush and dense than in Sian Ka'an, but overall the forest is still quite open. Specimens at both sites were found in litter and under rocks. All of the localities in Quintana Roo are at approximately sea level.

An undescribed specimen from Belize was collected in litter from a managed pine/treefern forest in the Maya mountains, relatively dry, but strikingly different from the open sites in, for example, Texas. Details about the Nicaragua collecting sites are less clear. All sites are situated close to the Pacific coast of Nicaragua. The climate is warm tropical, with temperatures ranging from 32-38° C, and heavy rains during summer (again, often influenced by hurricanes). Most specimens were recovered under stones in sites with either pine or tropical forest. Most remarkable, specimens from Hervideros de San Jacinto were recovered under rocks near hot springs. Although the rocks and the specimens were not immersed in the springs, these rocks were quite warm to the touch (J.G. PALACIOS-VARGAS, pers. comm.). All specimens in the Nicaragua sites were collected from under stones.

These observations show that not only is there considerable variability in habitat types on a global scale, a similar range of habitat types can be found in Mexico and Central America alone. Combined with the observed variability in characters this suggests that the number of species in the New World may be considerably higher than previously predicted.

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