

REDESCRIPTION OF ADULTS OF *PRASADISEIUS COCYTES* (PRASAD, 1970) (ACARI: OTOPHEIDOMENIDAE)

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ABSTRACT — Females and males of *Prasadiseius cocytes* (Prasad, 1970) (Acari: Otopheidomenidae) are redescribed based on live specimens collected during an expedition to Peru in August 2010. Several idiosomal structures, the dorsal and ventral setal pattern, and some details of gnathosoma are illustrated using photographs. Interspecific variation and presence of seta r5 are also discussed.

KEYWORDS — Otopheidomeninae; taxonomy; chaetotaxy; description; setal pattern; idiosoma; intraspecific variation

INTRODUCTION

Treat (1955) described the first otopheidomenid mite, *Otopheidomenis zalelestes*, based on the specimens that he found in the tympanum of moths (Lepidoptera: Noctuidae) collected in several states of the USA, and erected the new family Otopheidomenidae. Later, Prasad (1968-1987) described several new species from museum-preserved moths of Noctuidae and Sphingidae. These ectoparasitic mites are considered closely related to the Phytoseiidae, a family of predatory mites (Krantz and Khot, 1962; Evans, 1963; Chant, 1965; Chant and Yoshida-Shaul, 1992; Chant and McMurtry, 2007). It is interesting to note that some otopheidomenids have spermatheca similar to the phytoseiids while others do not. The otopheidomenids have the movable digit of chelicera greatly reduced or absent and, with few exceptions (*Katydisseius* and *Orthoptero-seius*), have a terminal anal shield.

Wainstein (1972) proposed a new classification

for the Otopheidomenidae and established a new genus *Prasadiseius* for the mites described from sphingid moths. Zhang (1995) reviewed the systematics and biology of this family, and divided the family into 3 subfamilies: Otopheidomeninae Treat, 1955; Treatiinae Wainstein, 1972; and Katydisseinae Fain and Lukoschus, 1983. The subfamily Otopheidomeninae includes 3 genera: *Noctuisseius* Prasad, 1968; *Otopheidomenis* Treat, 1955; and *Prasadiseius* Wainstein, 1972. Species of *Prasadiseius* infest sphingid moths only and species of *Noctuisseius* and *Otopheidomenis* infest noctuid moths only. Prasad (1970a) described *Otopheidomenis cocytes* from sphingid moths (Lepidoptera: Sphingidae) collected in Loreto, Pucallpa, Peru in 1962 on *Cocytius duponchel* (Poey). Later, it was transferred to *Prasadiseius* by Wainstein (1972). The genus is characterized by the following features: (1) Dorsal shield entire with the lateral margin partially incised, which divides the shield into the podonotal and opisthonotal region; (2) Podonotal region with 8–9 pairs of dorsal se-

tae; (3) j1 pair of setae absent; (4) Only one pair of ventral setae (JV1) present between the genital (in females) or sternogenital shield (in males) and the anal shield; and (5) Parasitic on sphingid moths. This species was found in unusually heavy infestations on museum preserved specimens of *Manduca rustica* (Fab.) (Lepidoptera: Sphingidae) collected in Ecuador (Prasad, 2011b). In addition, it was found to be widely distributed in Neotropical countries including Brazil, Ecuador and Peru in South America and Guatemala in Central America (Prasad, 2011c).

It is interesting to note that the immature stages of most species of Otopheidomenidae have not been described and the adults of these mites have not been described in detail using the system of Lindquist and Evans (1965) adapted in Phytoseiidae by Rowell *et al.* (1978), Chant and Yoshida-Shaul (1989, 1991, 1992), and Chant and McMurtry (2007). Prasad (1970a) did not include a detailed description of *P. cocytes*. His description was based on specimens found on museum preserved moths that had been collected many years before. Mites of this genus had never been observed alive on live hawk moths until August 12, 2010, when they were seen by the author in large numbers on live moths collected in Amazonian forest of Peru (online video, www.indirapublishinghouse.com). The mites were collected, processed and identified as *Prasadiseius cocytes*, which is redescribed herein based on fresh material. A large series of photographs is used to illustrate the species that show many more details of its morphology than in previous works, and uses the current idiosomal chaetotaxy as proposed by Prasad (2011a).

MATERIALS AND METHODS

The details of the materials and methods are given in Prasad *et al.* (2011). After obtaining permit from the Government of Peru, live moths were collected during August 10-18, 2010 and observed. Mites were collected in 70% ethanol and brought to the USA for preparation and identification by the author. Most of the mites were mounted directly in Hoyer's medium. The slide specimens were dried for a week on a slide-warming hot

plate (at 45 – 47°C) and later rung with Glyptal, and labeled. The author identified the mites using an Accu-Scope 3000 phase-contrast microscope (Accu-Scope, New York, USA) under 400x – 1000x magnification. Photographs were taken using a mounted Micrometrics™ camera on the microscope and saved in Photoshop CS2. Measurements were taken directly from the slide-mounted specimens using the Micrometrics system. All measurements are given in micrometers (µm) with the average of the measurements given in brackets. All of the photos of the females and males were taken from specimens collected at the same collection (VP10-36), except for Figs. 21 and 22 (male), which were taken from specimens collected from another collection (VP10-38). Each figure caption has the magnification in which it was taken (200x vs. 400x), followed by the mite collection number (VP10-36 or VP10-38) and the photo number. Voucher specimens will be deposited in the Natural History Museum, Lima, Peru; Museum of Biodiversity, The Ohio State University, 1315 Kinnear Road, Columbus, OH 43212, USA; the US National Museum, Washington, DC, USA; and in the author's collection. The collection data of *Prasadiseius cocytes* on different moths and locations on which this paper is based are as follows: (1) VP10-35, moth #265; (2) VP10-36, moth #275; (3) VP10-37, moth #280; (4) VP10-38, moth #281; and (5) VP10-39, moth #286; Morro Leguia, 2300m, 13°08'35.3", 71°35'08.1", Cusco Province, Peru, 13.VIII.2010, coll. Alberto D. Guanilo, Juan Grados Arauco, Vikram Prasad and Indira Prasad, moth host – *Xylophanes nabuchodonosor* Oberthür, 1904, mites coll. V. Prasad.

FAMILY OTOPHEIDOMENIDAE TREAT, 1955

Subfamily Otopheidomeninae Treat, 1955

Otopheidomeninae Treat, 1955: 556, type genus: *Otopheidomenis* Treat, by original designation.

Genus *Prasadiseius* Wainstein, 1972

Prasadiseius Wainstein, 1972: 453, type species: *Otopheidomenis pholusis* Prasad, by original designation.

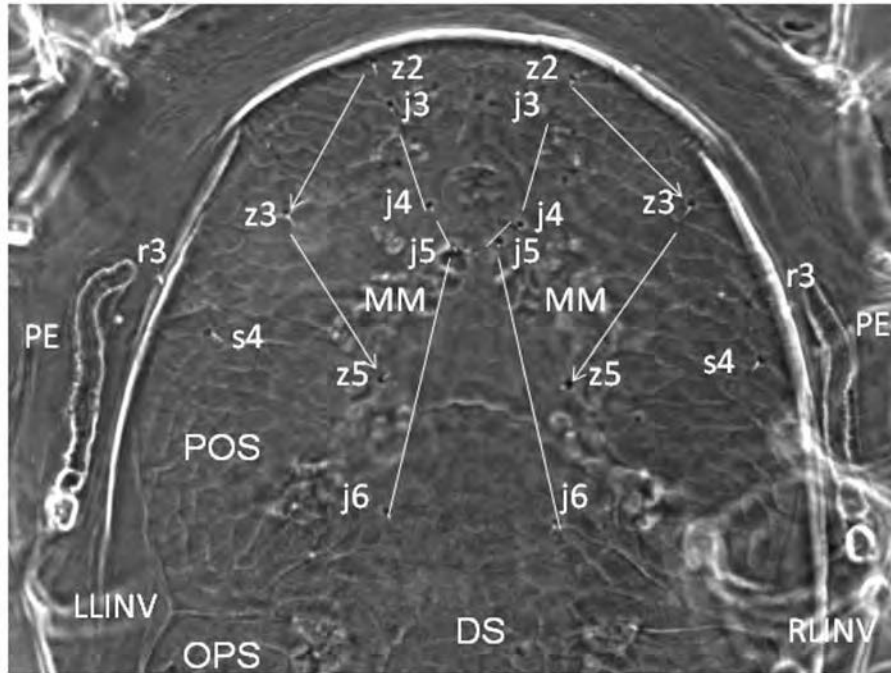


FIGURE 1: *Prasadiseius cocytes* (Female) — Anterior idiosoma showing peritremes (PE), setae r3 on the lateral integument, anterior dorsal shield (DS) showing entire podonotal shield (POS), anterior opisthonotal shield (OPS), left (LLINV) and right lateral invaginations (RLINV), muscle marks (MM), and setae j3, j4, j5, j6, z2, z3, z5, s4 (200x, VP10-36: 126).

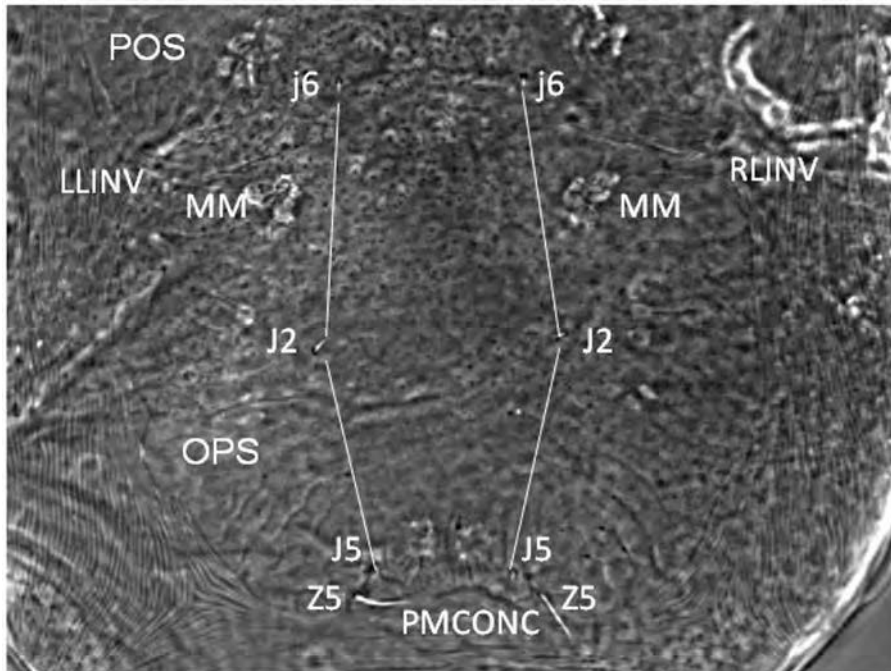


FIGURE 2: *Prasadiseius cocytes* (Female) — Posterior idiosoma showing posterior podonotal shield (POS), entire opisthonotal shield (OPS), left (LLINV) and right lateral invaginations (RLINV), posteromedial concavity (PMCONC) in the opisthonotal shield, muscle marks (MM), and setae j2, j5, z5 (200x, VP10-36: 146).

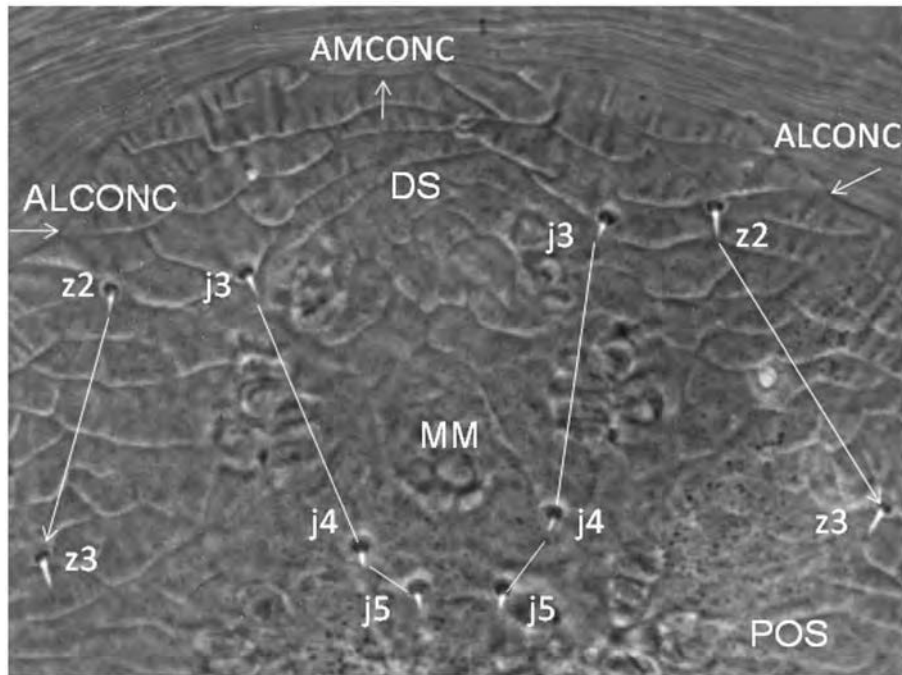


FIGURE 3: *Prasadiseius cocytes* (Female) — Anterior dorsal shield (DS) showing anteromedial podonotal shield (POS) with anteromedial (AMCONC) and anterolateral concavities (ALCONC), muscle marks (MM), and setae j3, j4, j5, z2, z3 in higher magnification (400x, VP10-36: 57).

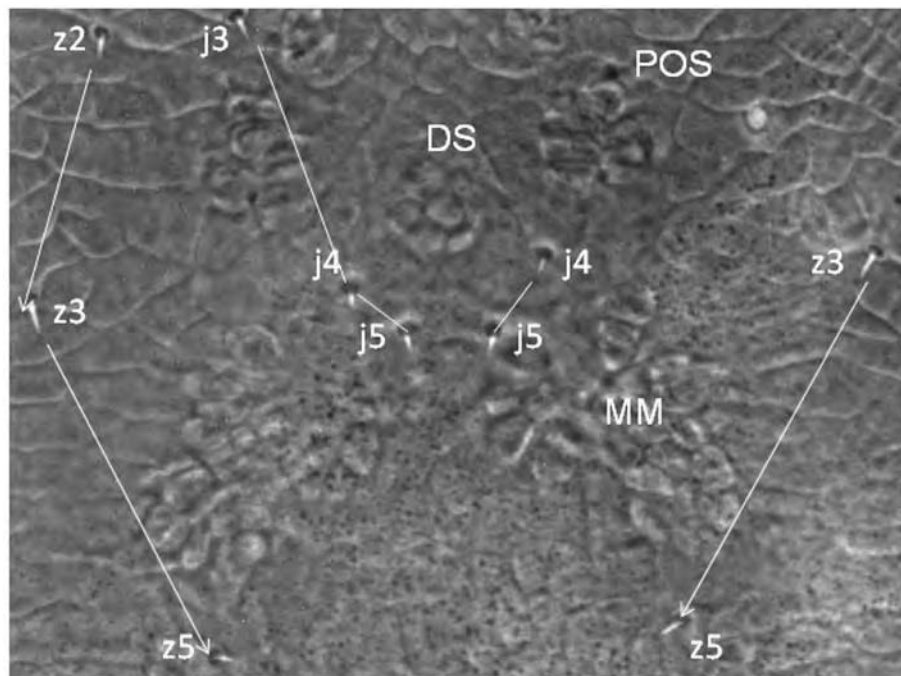


FIGURE 4: *Prasadiseius cocytes* (Female) — Anteromedial dorsal shield (DS) showing podonotal shield (POS), muscle marks (MM) and setae j3, j4, j5, z2, z3, z5. Note setae z2 and z3 comparatively larger than tiny setae j3, j4, and j5. Scale-like and hexagonal reticulation patterns are clearly seen on the shield (400x, VP10-36: 59).

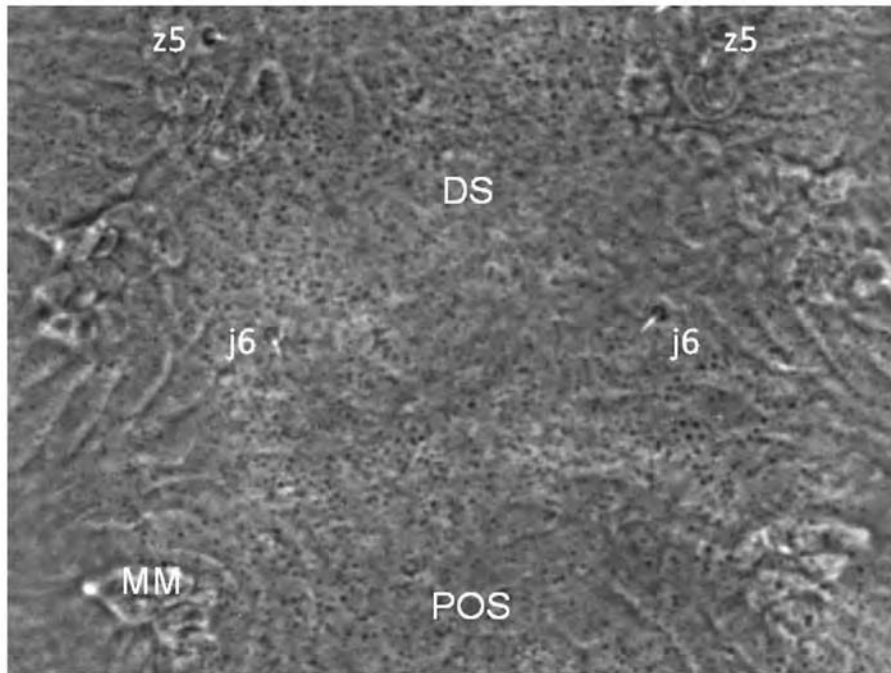


FIGURE 5: *Prasadiseius cocytes* (Female) — Anteromedial dorsal shield (DS) showing mid podonotal shield (POS), muscle marks (MM) and setae z5, j6 (400x, VP10-36: 62).

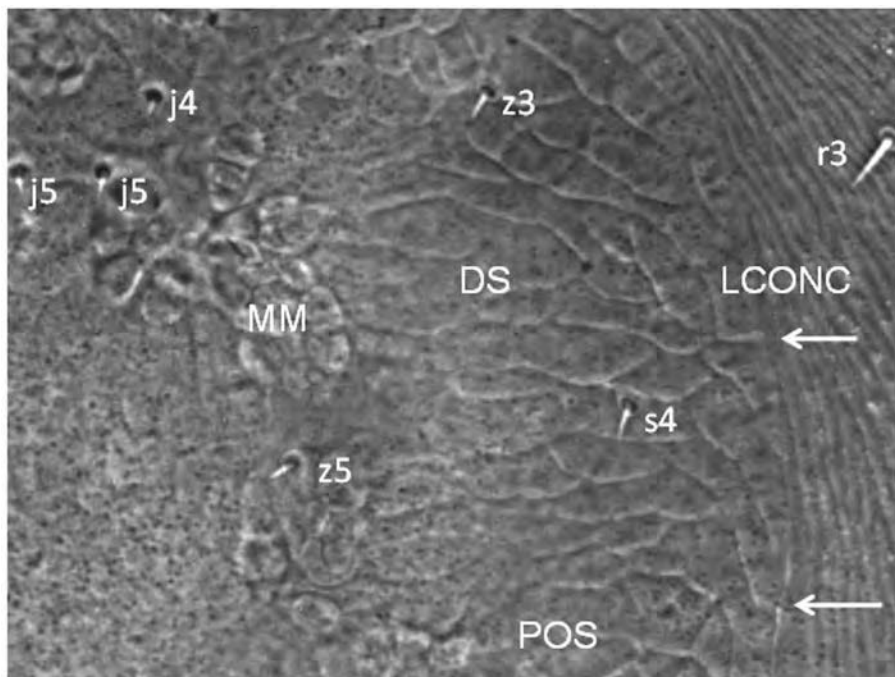


FIGURE 6: *Prasadiseius cocytes* (Female) — Anteromediolateral dorsal shield (DS) showing mid posterior podonotal shield (POS), lateral concavities (LCONC, see arrow), muscle marks (MM) and setae j4, j5, s4, z3, z5 on the podonotal shield and r3 on the soft integument beside this shield. Note seta s4 larger than j5 but similar to z3 and r3 much larger than s4 (400x, VP10-36: 64).

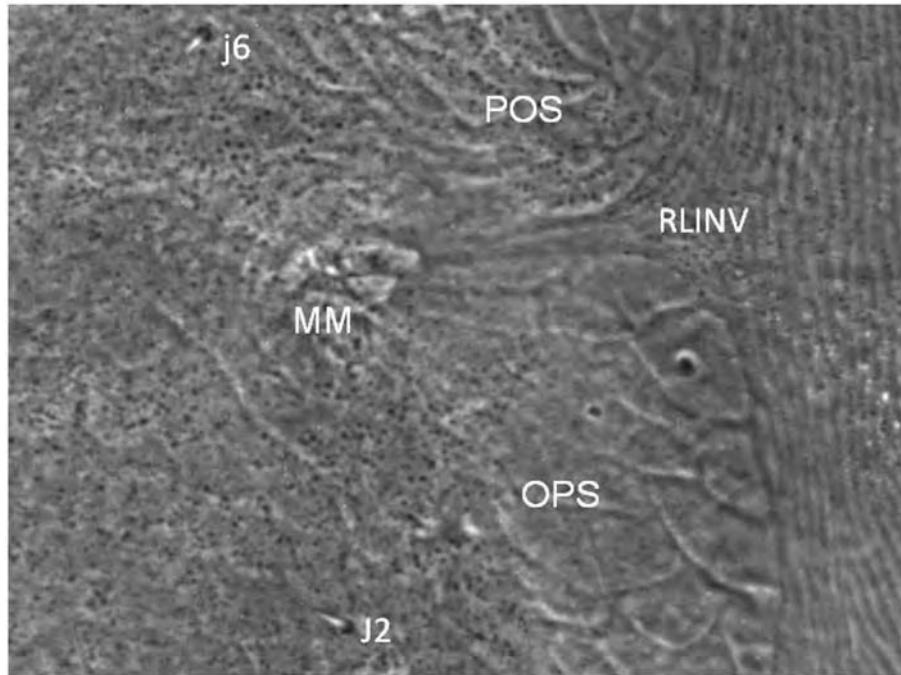


FIGURE 7: *Prasadiseius cocytes* (Female) — Right mediolateral dorsal shield showing right posterior podonotal shield (POS), right anterior opisthonotal shield (OPS), right lateral invagination (RLINV), muscle marks (MM), and setae j6 on the podonotal shield and J2 on the opisthonotal shield (400x, VP10-36: 67).

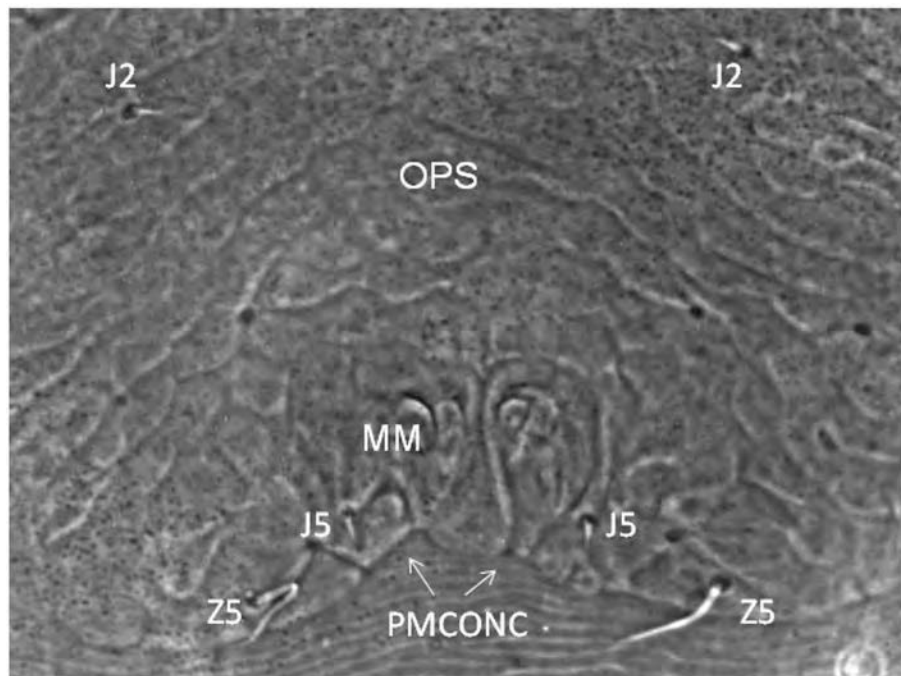


FIGURE 8: *Prasadiseius cocytes* (Female) — Posteromedial dorsal shield showing mid posterior opisthonotal shield (OPS) with postero-medial concavity (PMCONC), muscle marks (MM), setae J2, J5, Z5 on the opisthonotal shield (400x, VP10-36: 63).

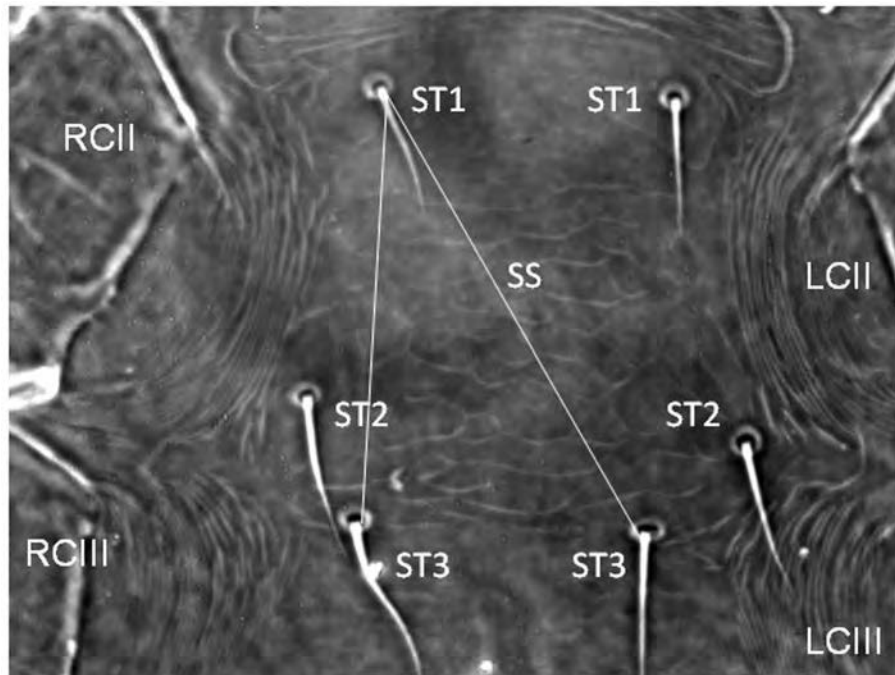


FIGURE 9: *Prasadiseius cocytes* (Female) — Shield-shaped sternal shield (SS) in between left (LCII) and right coxa II (RCII) and left (LCIII) and right coxa III (RCIII), with 3 pairs of sternal setae (ST1 – ST3) on it. Note distance between ST2 – ST2 much larger than ST1 – ST1 or ST3 – ST3. Also, note vertical distance between ST2-ST3 on each side much shorter than ST1 – ST2. Measurement of vertical distance between ST1 – ST3 and diagonal distance between ST1 – ST3 are also of diagnostic use (400x, VP10-36: 103).

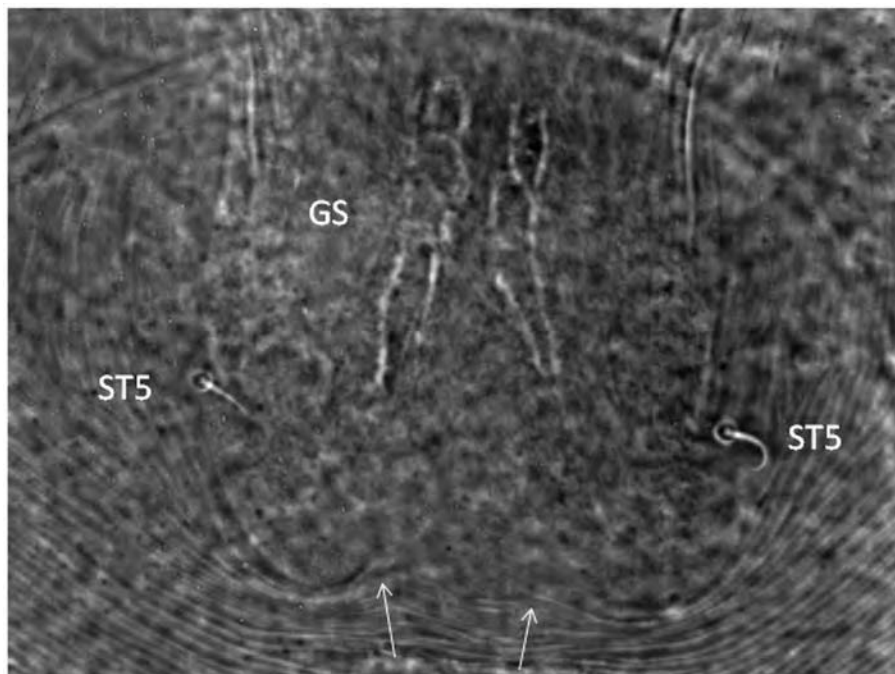


FIGURE 10: *Prasadiseius cocytes* (Female) — Genital shield (GS) with 1 pair of genital setae (ST5) on the integument. Note roughly truncate posterior margin with a short middle convexity and two short concavities beside the middle convexity — see arrows (400x, VP10-36: 75).

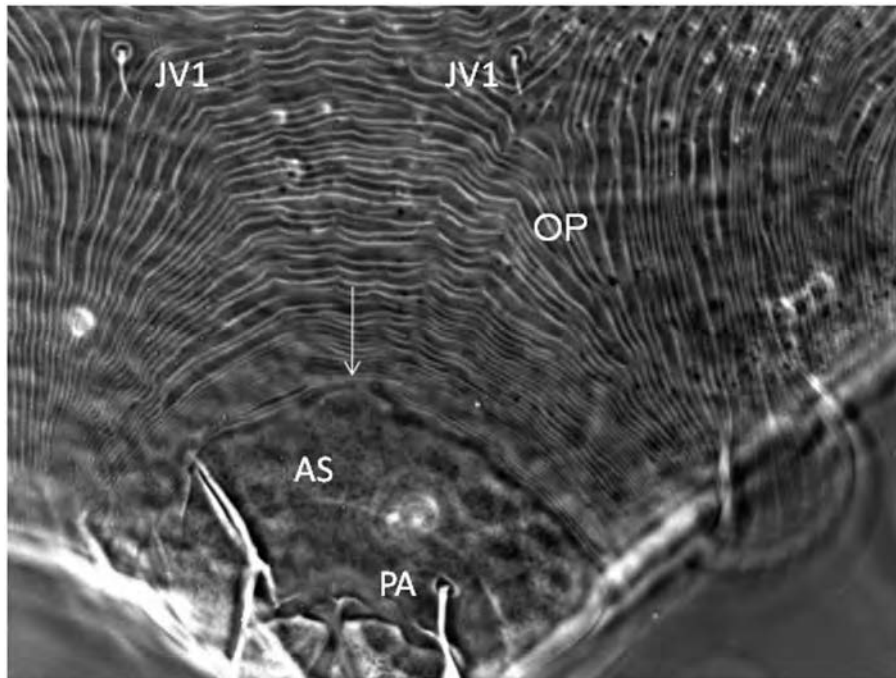


FIGURE 11: *Prasadiseius cocytes* (Female) — Posterior opisthosoma (OP) showing 1 pair of ventral setae (JV1), anal shield (AS), and paraanal setae (PA). Note anteromedial elongation (arrow) of anal shield (400x, VP10-36: 124).

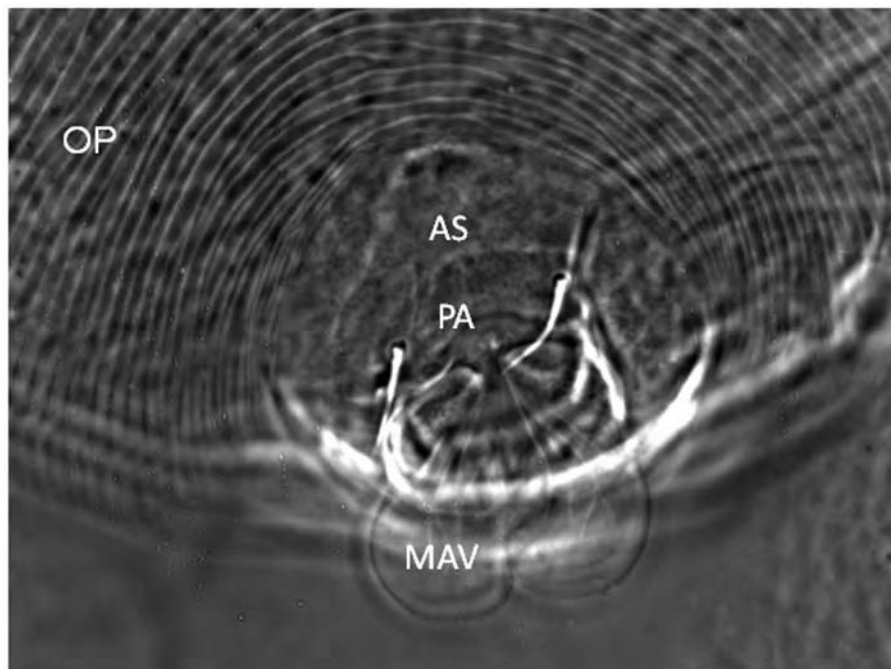


FIGURE 12: *Prasadiseius cocytes* (Female) — Posterior opisthosoma (OP) showing anal shield (AS), paraanal setae (PA), and membranous anal volvular or lobular projections (MAV). Two lateral and one posterior anal valves are not visible (400x, VP10-36: 89).

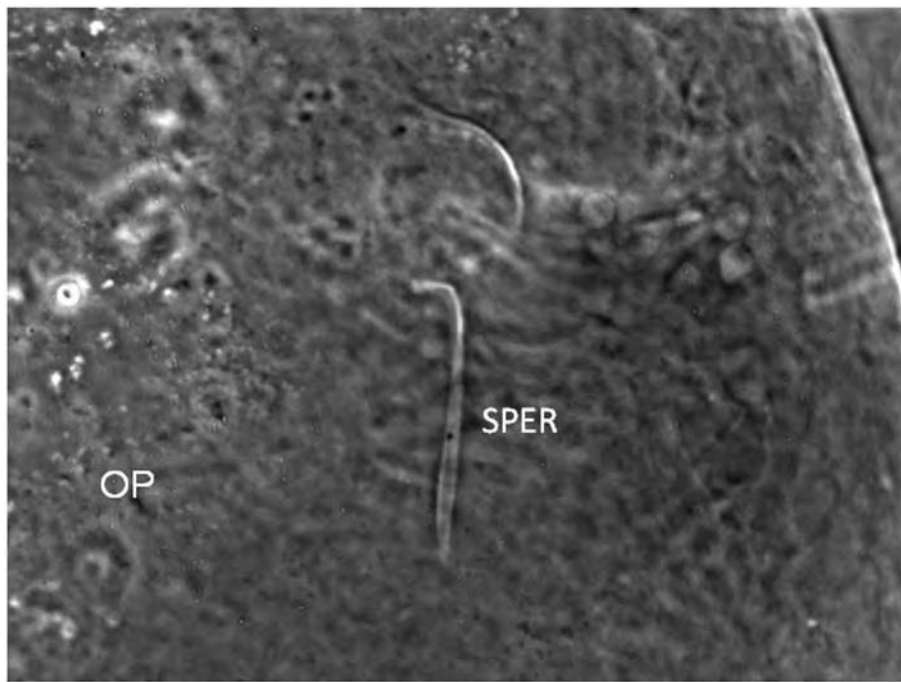


FIGURE 13: *Prasadiseius cocytes* (Female) — Midventral opisthosoma (OP) showing tubular spermatheca (SPER) (400x, VP10-36: 101).

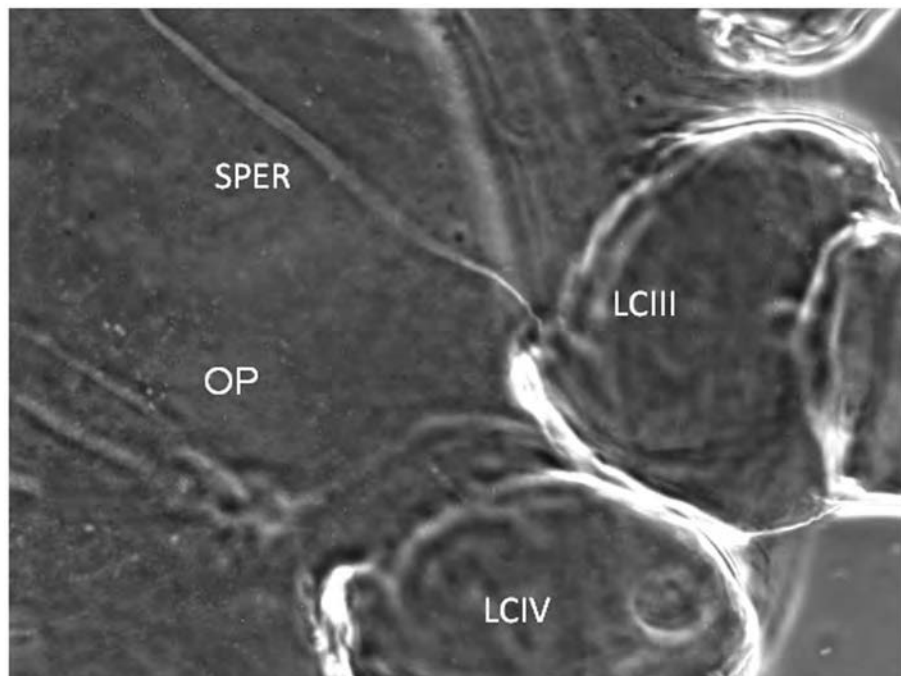


FIGURE 14: *Prasadiseius cocytes* (Female) — Ventrolateral opisthosoma (OP) showing tubular spermatheca (SPER) entering in left coxa (LCIII) (400x, VP10-36: 142).

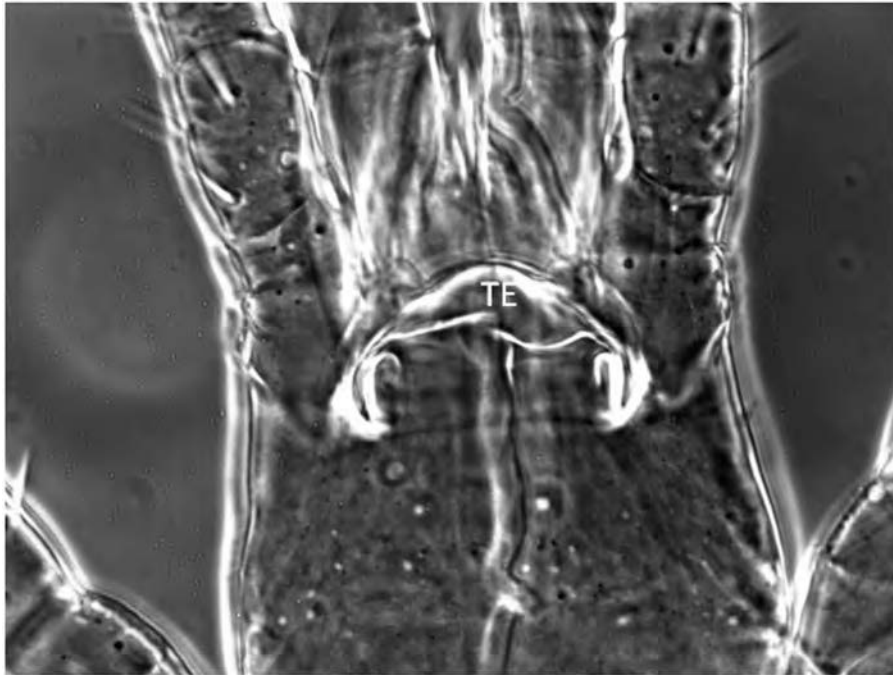


FIGURE 15: *Prasadiseius cocytes* (Female) — Dorsal gnathosoma showing palps and the tectum (TE), which is rounded anteromedially (400x, VP10-36: 113).

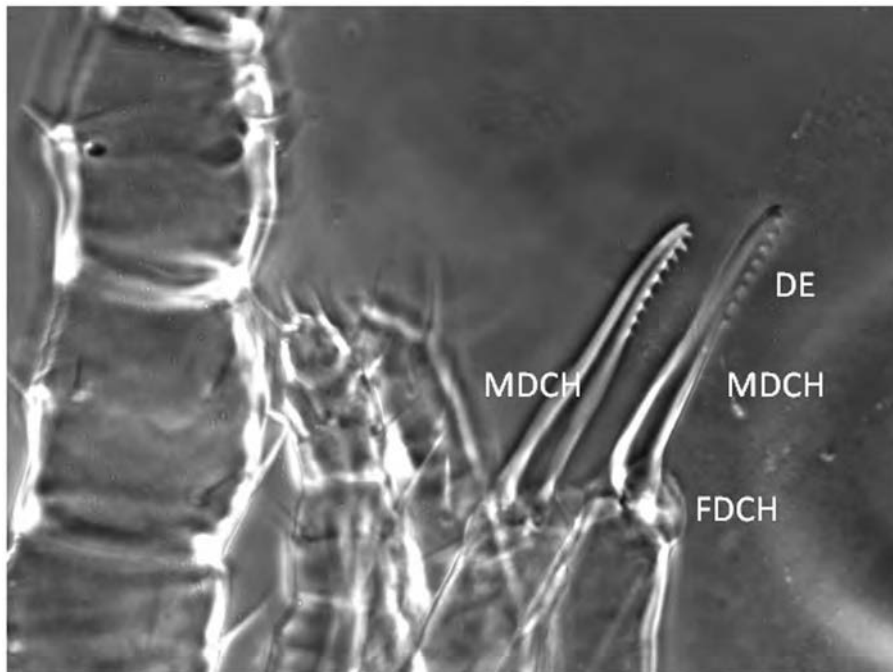


FIGURE 16: *Prasadiseius cocytes* (Female) — Reduced fixed digit of chelicera (FDCH) and elongated movable digit of chelicera (MDCH) with denticles (DE) (400x, VP10-36: 127).

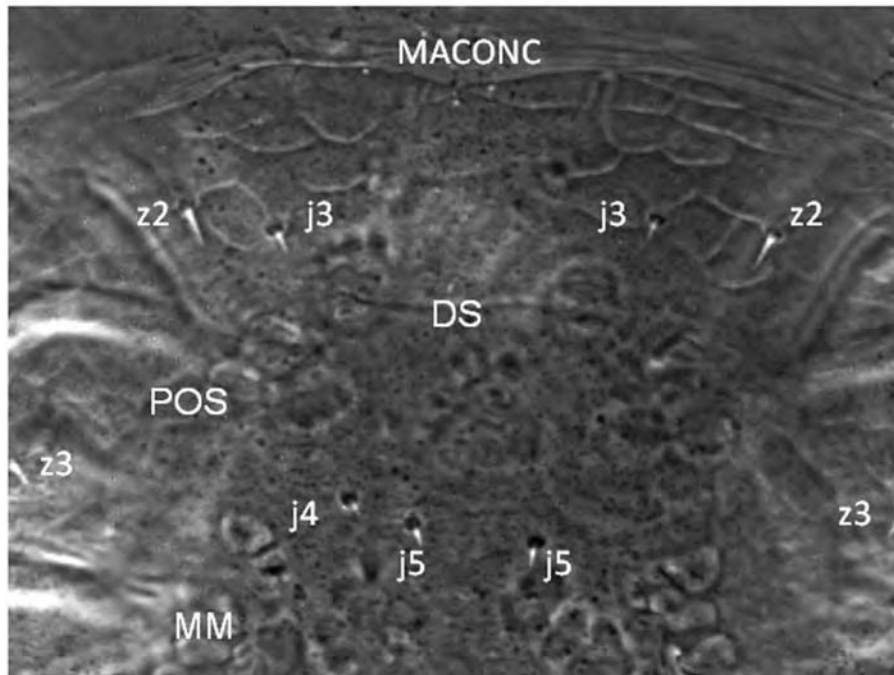


FIGURE 17: *Prasadiseius cocytes* (Male) — Anterior dorsal shield (DS) showing mid anterior podonotal shield (POS), muscle marks (MM), and setae j3, j4, j5, z2, z3 on the podonotal shield in high magnification. Note setae z2 much larger than j3, j4 or j5 (note j4 absent on right side) (400x, VP10-36: 164).

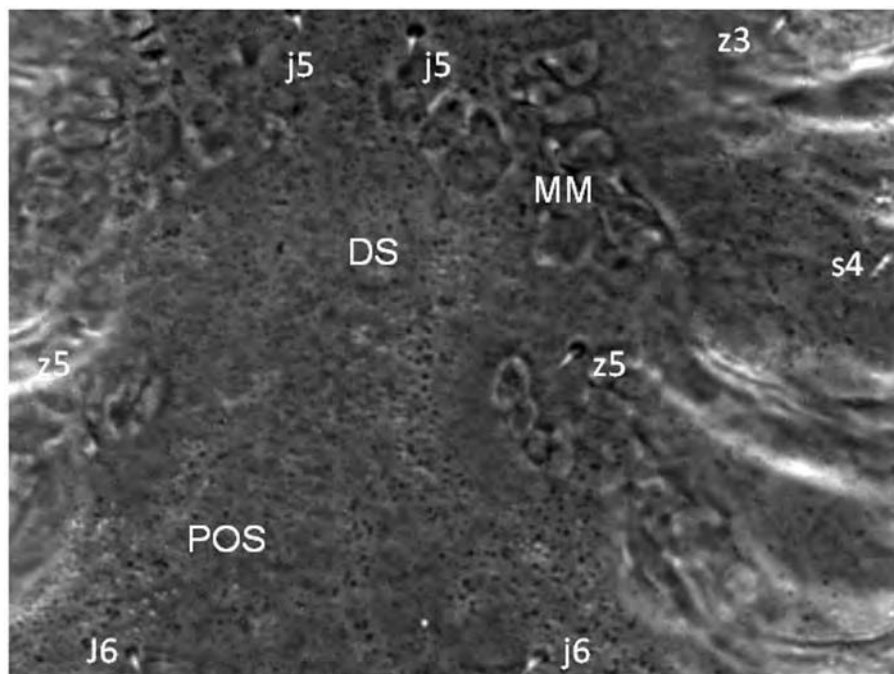


FIGURE 18: *Prasadiseius cocytes* (Male) — Anteromedial dorsal shield (DS) showing mid podonotal shield (POS), muscle marks (MM) and setae j5, j6, z3, z5, s4 on the podonotal shield in high magnification. Note s4 larger than j5, j6 or z5 (400x, VP10-36: 166).

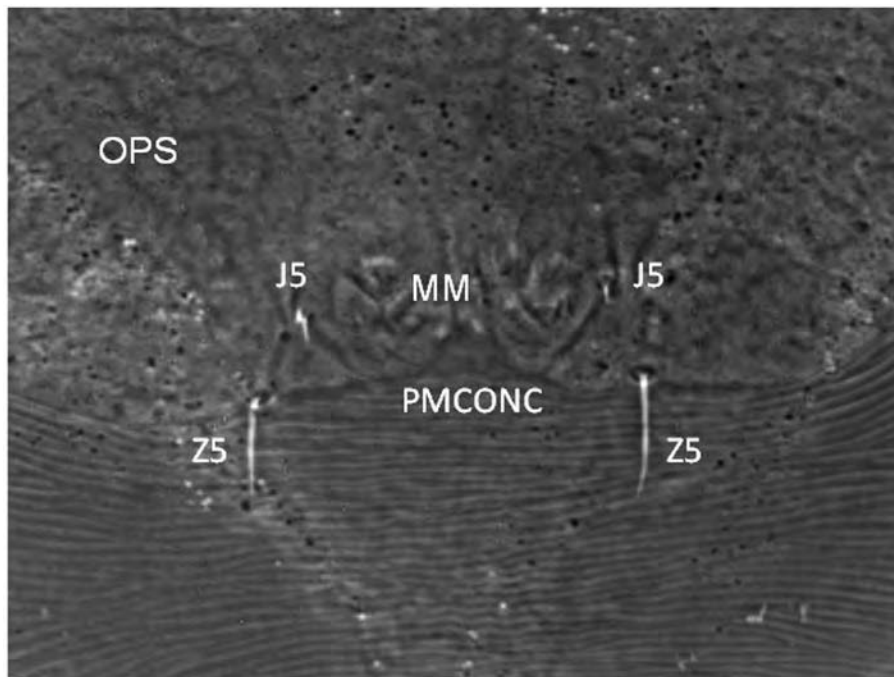


FIGURE 19: *Prasadiseius cocytes* (Male) — Posterior idiosoma showing posteromedial opisthonotal shield (OPS) with posteromedial concavity (PMCONC), muscle marks (MM), and setae J5 and Z5. Note that serrations of Z5 are not clearly evident in this magnification (400x, VP10-36: 165).

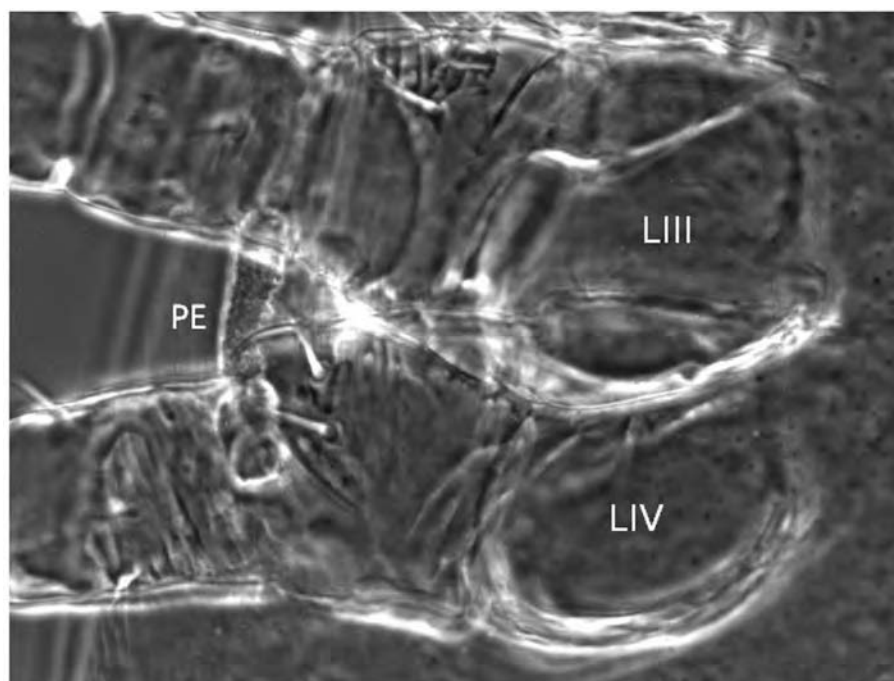


FIGURE 20: *Prasadiseius cocytes* (Male) — Short peritremes (PE) in between and lateral to legs III-IV (400x, VP10-36: 168).

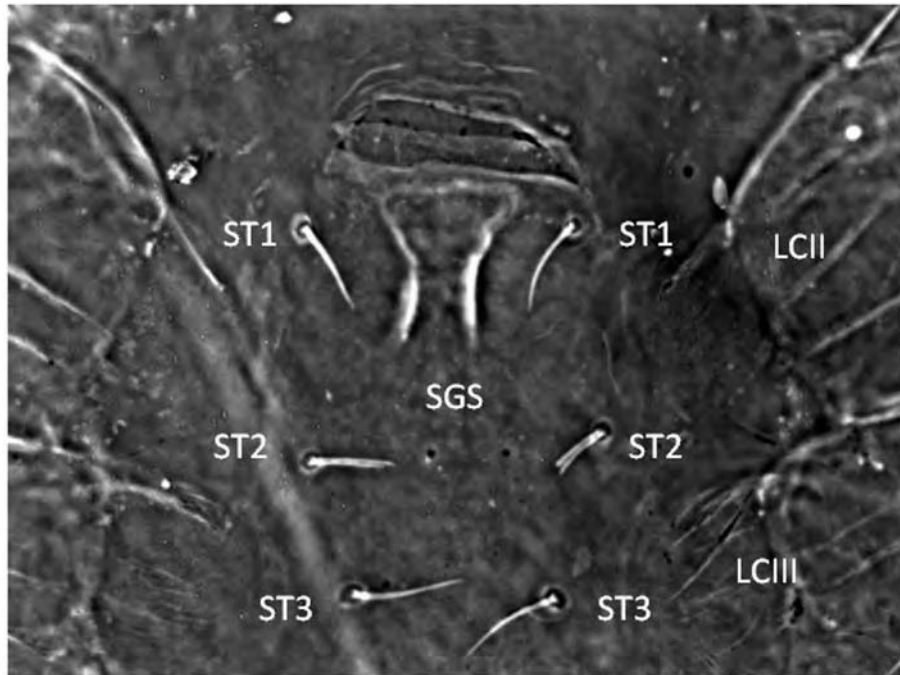


FIGURE 21: *Prasadiseius cocytes* (Male) — Anterior sternogenital shield (SGS) in between left (LCII) and right coxae III (RCIII) showing setae ST1, ST2, and ST3. Note distance between ST3 – ST3 much shorter than ST1 – ST1 or ST2 – ST2 (400x, VP10-38: 42).

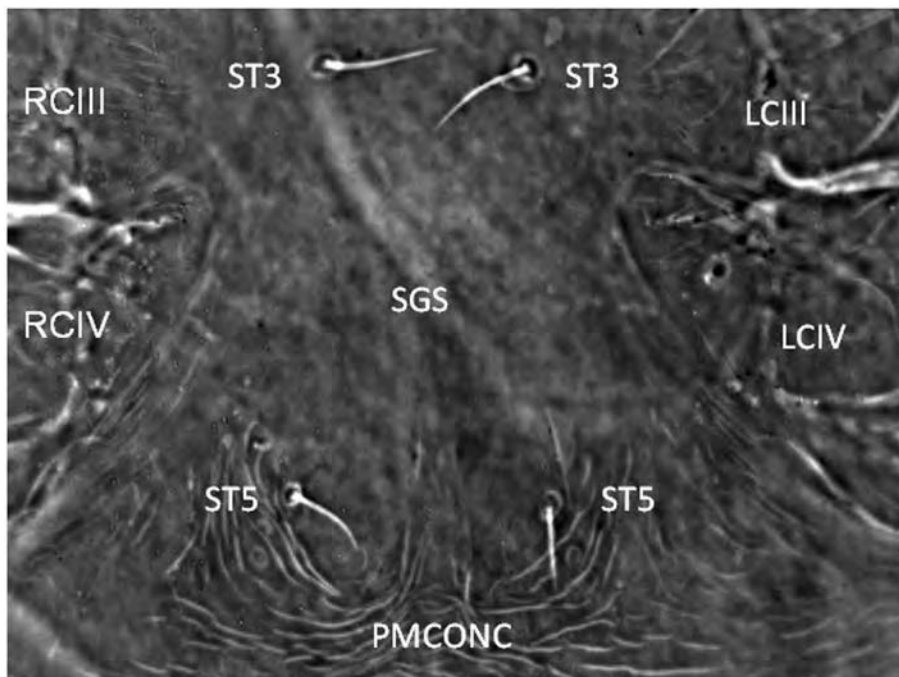


FIGURE 22: *Prasadiseius cocytes* (Male) — Posterior sternogenital shield (SGS) in between left (LCIII-LCIV) and right coxae III – IV (RCIII – RCIV) showing posteromedial concavity (PMCONC) and setae ST3 and ST5 on it. Note distance between ST5 – ST5 larger than ST3 – ST3 (400x, VP10-38: 43).

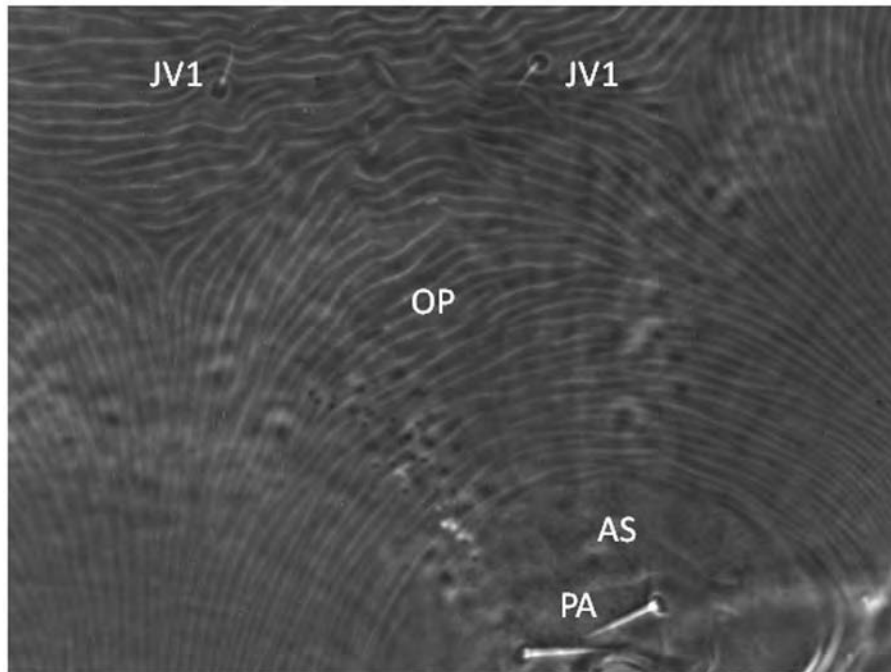


FIGURE 23: *Prasadiseius cocytes* (Male) — Posterior opisthosoma (OP) showing 1 pair of ventral setae (JV1), anal shield (AS) rounded anteriorly, and paraanal (PA) setae (400x, VP10-36: 178).

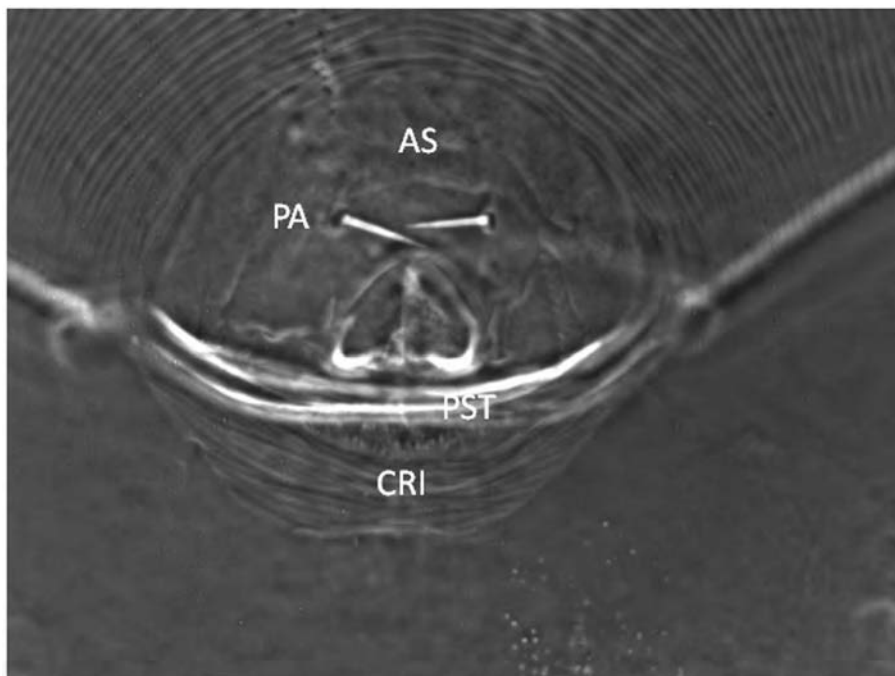


FIGURE 24: *Prasadiseius cocytes* (Male) — Posterior opisthosoma showing anal shield (AS), paraanal setae (PA), barely visible postanal seta (PST), and cribriform pattern (CRI) (400x, VP10-36: 163).

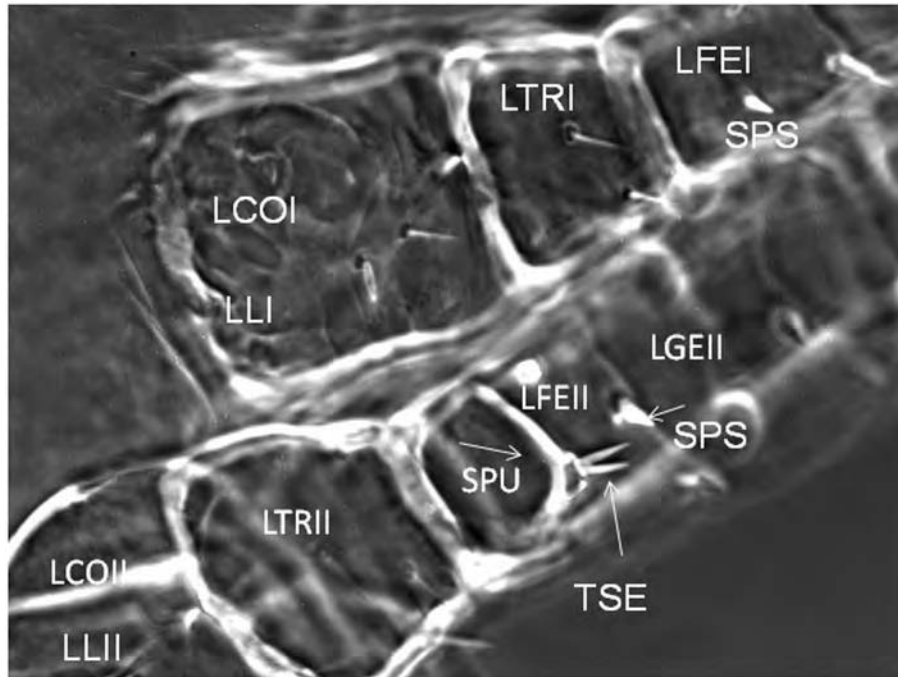


FIGURE 25: *Prasadiseius cocytes* (Male) — Left leg I (LLI) and left leg II (LLII) in ventral view showing left coxa II (LCOII), left trochanter II (LTRII), left femur II (LFEII), left genu II (LGEII), and bi-furcate twin setae (TSE) on ventral hump or spur (SPU) of left basifemur II. A short, thick, spinose, ventral seta (SPI) is seen distal to spur on telofemur I and II (400x, VP10-36: 169).

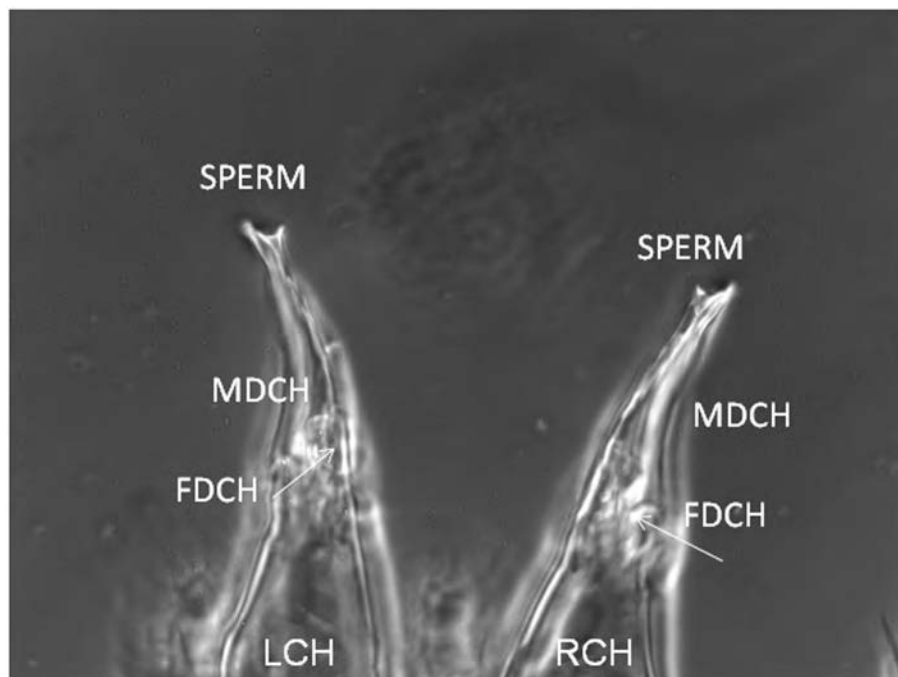


FIGURE 26: *Prasadiseius cocytes* (Male) — Left chelicera (LCH) and right chelicera (RCH) showing reduced fixed (FDCH) and elongate movable digit (MDCH) with spermatodactyl (SPERM) (400x, VP10-36: 174).

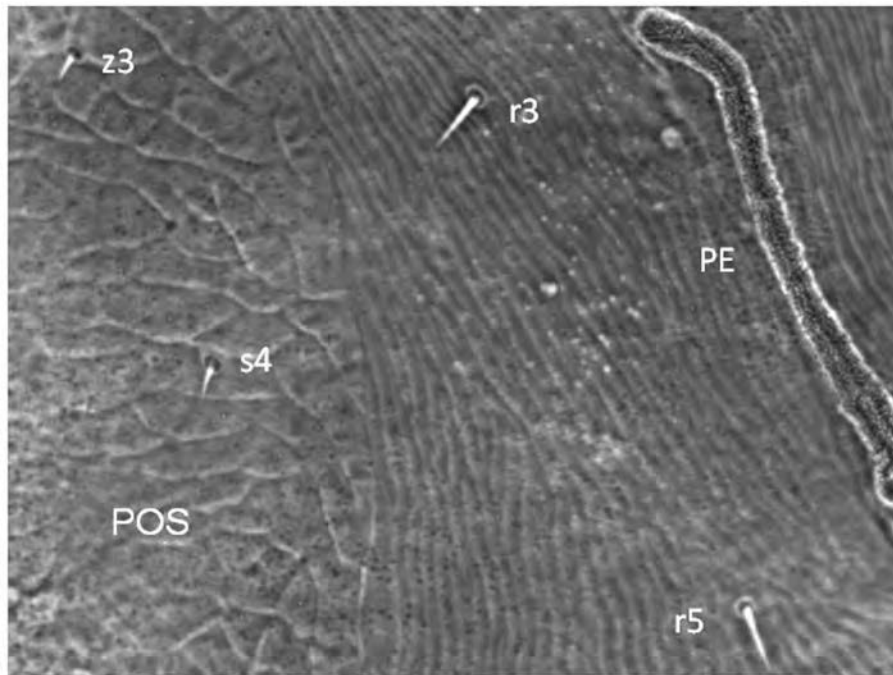


FIGURE 27: *Prasadiseius cocytes* (Female) — Right anterolateral dorsal shield and idiosoma showing right lateral podonotal shield (POS) with seta r3 and anterior part of peritreme (PE). Note that seta r5 is also present on soft integument medial and slightly posterior to the peritreme (PE) (400x, VP10-36: 66).

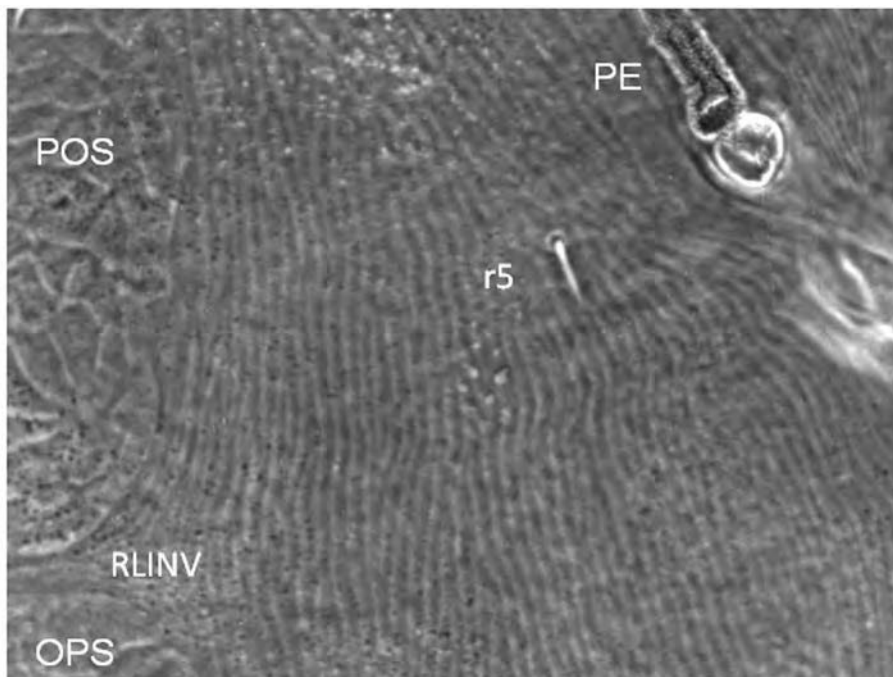


FIGURE 28: *Prasadiseius cocytes* (Female) — Right mediolateral dorsal shield and idiosoma showing posterior part of peritreme (PE), right lateral podonotal shield (POS), and part of right anterior opisthonotal shield (OPS) and right lateral invagination (RLINV) in between the two shields. Note that seta r5 is present on soft integument medial and posterior to the peritreme (PE) (400x, VP10-36: 68).

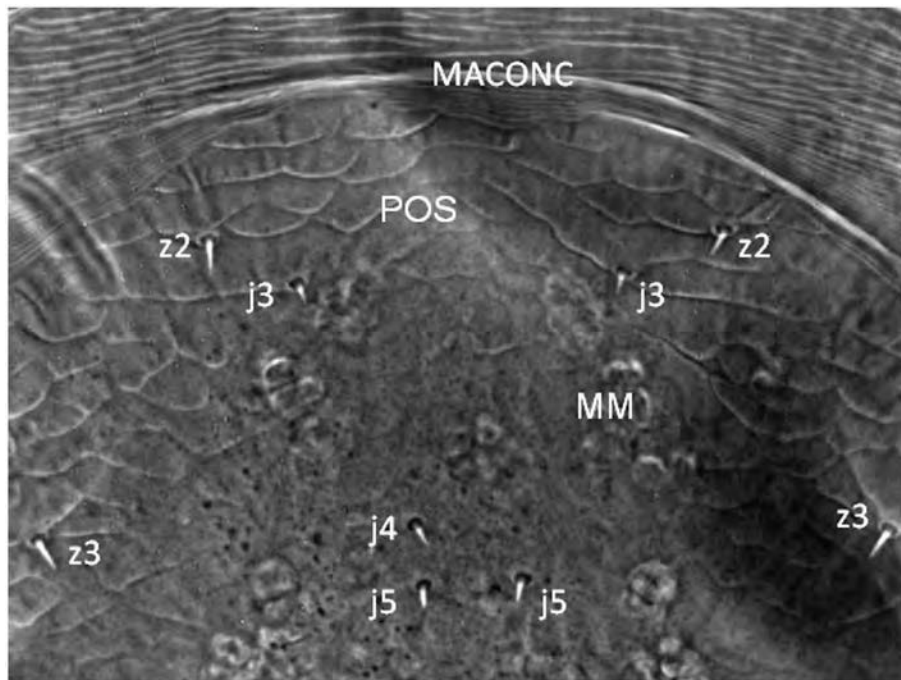


FIGURE 29: *Prasadiseius cocytes* (Female) — Anteromedial podonotal shield (POS) showing muscle marks (MM) and setae j3, j4, j5, z2, z3 in high magnification. Note that j4 on right is missing (400x, VP10-36: 106).

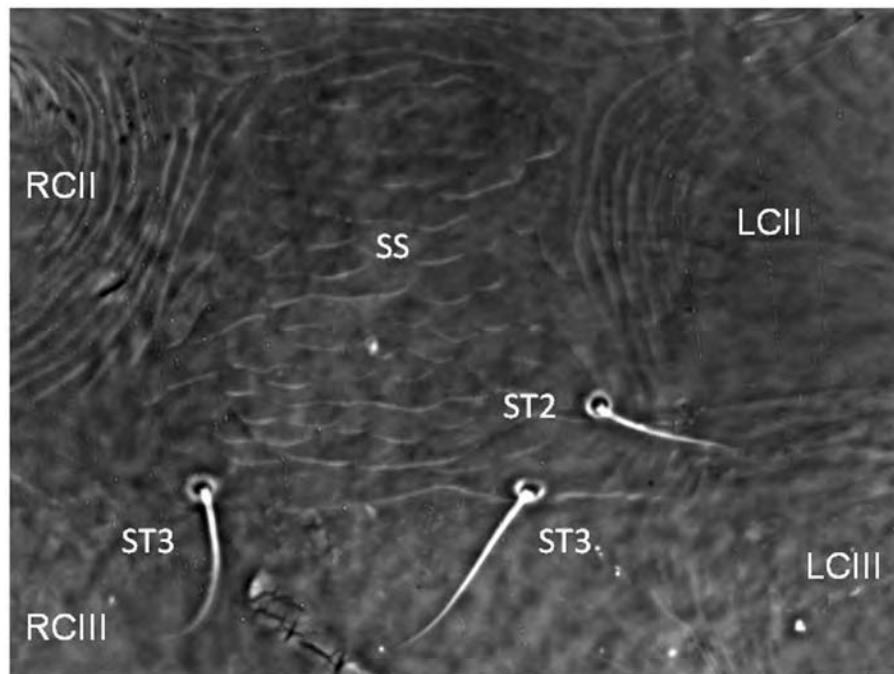


FIGURE 30: *Prasadiseius cocytes* (Female) — Sternal shield (SS) in between left and right coxae II (LCII-RCII) and coxae III (LCIII-RCIII) with setae ST2 and ST3. Note that both setae ST1 and one ST2 are missing (400x, VP10-36: 92).

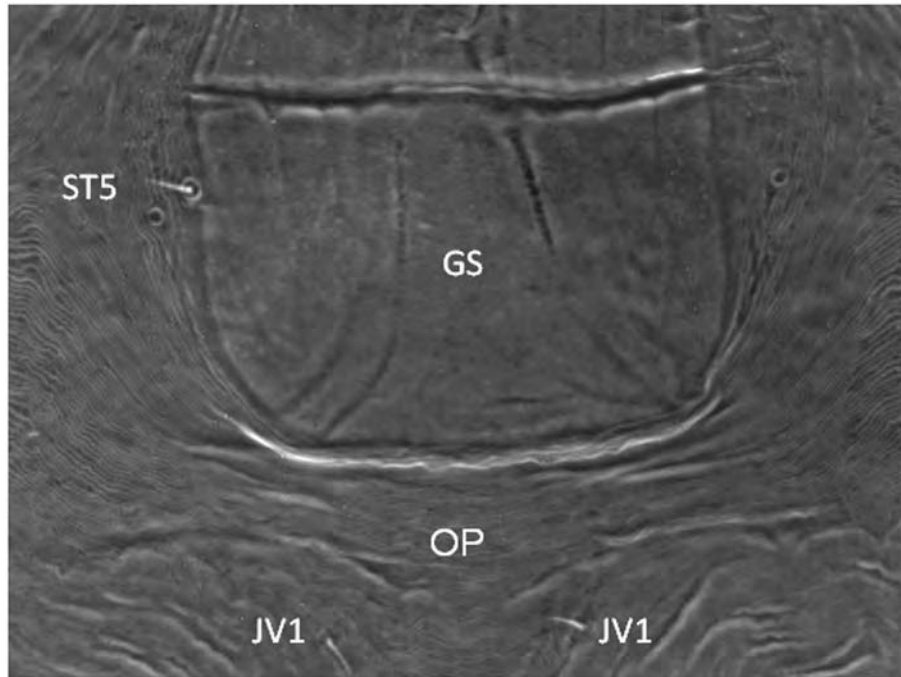


FIGURE 31: *Prasadiseius cocytes* (Female) — Ventral opisthosoma (OP) with setae JV1 and genital shield (GS) with genital seta (ST5). Note that one ST5 is present on soft integument beside the shield while other is missing. Genital shield is truncate with rounded corners. Compare with Fig. 10 of female in which both ST5 are present beside the genital shield on the soft integument. Note also in Fig. 22 of male in which ST5 are present on sternogenital shield (400x, VP10-36: 130).

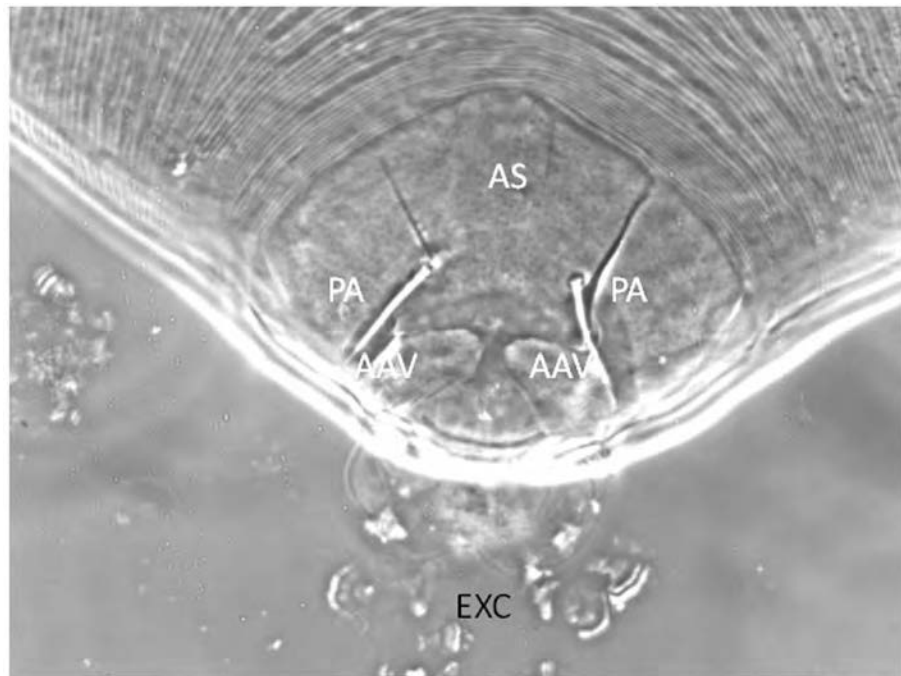


FIGURE 32: *Prasadiseius cocytes* (Female) — Posterior opisthosoma showing anal shield (AS), paraanal setae (PA), pair of anterior anal valves (AAV) and excreta (EXC). The triangular posterior anal valve in between AAV is lightly visible. Note extended and narrow anteromedial margin of anal shield (400x, VP10-36: 143).

***Prasadiseius cocytes* (Prasad, 1970)
(Figs. 1-35)**

Otopheidomenis cocytes Prasad, 1970a: 29.
Prasadiseius cocytes (Prasad), Wainstein, 1972: 453.

Redescription

Female ($n = 9$, Figs. 1–16, 27–34)

Largest of all life stages. Body oval. Idiosoma length = 539 – 730 (646), width = 318 – 492 (430). Peritreme (PE) long [122 – 128 (125)], bent antero-medially (may be straight), located on the antero-lateral margin of the idiosoma, beside the podonotal shield. Idiosomal dorsum with 12 pairs of setae, of which 11 pairs (j3, j4, j5, j6, J2, J5, z2, z3, z5, Z5, s4) are on the dorsal shield (DS) and 1 pair (r3) [13 – 15 (14)] is on the integument, located lateral to the podonotal shield and close to the peritreme.

Dorsal shield (Figs. 1–8, 27–29) — Length = 459 – 498 (482), width = 298 – 310 (306). Entire shield moderately sclerotized, covered with variously shaped polygonal and scale-like reticulations. Muscle marks (MM) are present throughout the dorsal shield in a similar bilateral pattern. The lateral margin of the dorsal shield is not entirely rounded, but rather has small anteromedial concavity (AMCONC), anterolateral concavities (ALCONC) and posteromedial concavity (PMCONC) (Figs. 3, 8). The dorsal shield is partially incised, mediolaterally in one place, by left lateral invagination (LLINV) and, right lateral invagination (RLINV), dividing the shield into the podonotal shield, which occupies approximately the anterior two thirds of the shield, and the opisthonotal shield, which occupies approximately the posterior one third of the shield. The podonotal shield is slightly wider in middle than the opisthonotal shield. At least 7 – 8 muscle marks are present on each side on the podonotal shield; whereas, there are only 4 – 5 on each side on the opisthonotal shield. The length of left lateral (LLINV) and right invagination (RLINV) = 44 – 50 (47).

Setae on dorsal shield (Figs. 1–8, 27–29) — Of the 11 pairs of setae present on the dorsal shield, the podonotal shield has 8 pairs of setae (j3, j4, j5, j6, z2, z3, z5, s4), with the j5, j6 and z5 setae forming

a hexagonal pattern. The opisthonotal shield has 3 pairs of setae (J2, J5, Z5). Seta J2 is located medially and posterior to the lateral invaginations and J5 is located medially, very close and anterior to Z5 at the posterior apex of the shield. Most dorsal setae are very tiny (Figs. 3, 4) and difficult to see using magnification of less than 200x. Seta Z5 is the longest pair of setae followed respectively by r3, z2, z3, and s4. Setae j4, j5, j6, J2 and z5 are minute, without visible serrations in 400x; Z5 with clear serrations in its distal half (observable at 200–400x). The length of setae are as follow: j3 = 5 – 7 (6), j4 = 5 – 7 (6), j5 = 5 – 7 (6), j6 = 5 – 7 (6), J2 = 5 – 8 (7), J5 = 4 – 7 (5), s4 = 7 – 10 (9), z2 = 8 – 11 (9), z3 = 7 – 9 (8), z5 = 5 – 7 (6), and Z5 = 22 – 34 (27). The distances between setal pairs are: j3 – j3 = 65 – 83 (74), j4 – j4 = 22 – 50 (41), j5 – j5 = 16 – 35 (29), j6 – j6 = 39 – 84 (78), J2 – J2 = 82 – 138 (113), J5 – J5 = 48 – 64 (54), s4 – s4 = 176 – 250 (243), z2 – z2 = 104 – 116 (112), z3 – z3 = 172 – 190 (180), z5 – z5 = 84 – 104 (95), and Z5 – Z5 = 85 – 102 (92). The vertical distances between different setal bases are: j3 – j4 = 62 – 69 (65), j3 – j5 = 75 – 78 (77), j3 – z2 = 18 – 26 (22), j4 – j5 = 13 – 24 (19), j5 – j6 = 110 – 145 (135), j5 – z5 = 67 – 82 (74), j6 – J2 = 100 – 140 (124), J2 – J5 = 100 – 108 (105), J2 – Z5 = 110 – 120 (115), J5 – Z5 = 17 – 29 (22), z2 – s4 = 90 – 98 (94), z2 – z3 = 66 – 80 (74), z2 – z5 = 139 – 148 (144), z3 – z5 = 77 – 97 (85), z3 – s4 = 62 – 69 (71), z5 – j6 = 56 – 78 (66), s4 – j6 = 100 – 126 (116), and s4 – z5 = 67 – 86 (76). Note that average distance between setal pair j5 – j5 (29) was the shortest of all the setal pairs, followed by that between the j4 – j4 (41), and vertical distance between j4 – j5 (19) was the shortest of all, followed by j3 – z2 (22) and J5 – Z5 (22).

Ventral shields and setae (Figs. 9–12, 30–32) — The sternal shield (SS) length (along midline) = 88 – 108 (96), width at level ST2 (including the triangular flares) = 92 – 131 (104), located between coxae I – III, is slightly convex anteriorly and posteriorly, concave lateromedially, widest in middle at level of ST2, and lightly sclerotized with a polygonal reticulation pattern. ST1, ST2 and ST3 are relatively long and with fine serrations, barely visible at 1000x magnification and are located on the lateral margin of the shield. ST4 is absent. ST1 extends about two-thirds the distance between ST1 and ST2. Seta ST2

extends to, or beyond, the base of ST3. The lengths of the setae are: ST1 = 34 – 43 (38), ST2 = 36 – 44 (41) and ST3 = 37 – 42 (40). The distances between the setal pairs are: ST1 – ST1 = 50 – 60 (57), ST2 – ST2 = 83 – 95 (91), ST3 – ST3 = 48 – 57 (51). The genital shield (GS) length is 166 – 184 (173), its width is 96 – 112 (103), and it is concave posteromedially and laterally. ST5 [11 – 16 (14)] is much shorter than ST3 (Fig. 10) and is located on the lateral margin of the shield. The distance between ST5-ST5 is 101 – 106 (103). JV1 is short [15 – 29 (16)], and located on the soft integument (Fig. 11) between the genital and anal shield. The distance between JV1 – JV1 is 58 – 105 (77). The anal shield (AS) length is unable to be measured. Its width is 85 – 109 (99); it is rounded or slightly pointed anteromedially and has some fine reticulations (Figs. 11, 12). The paraanal setae (PA) [25 – 29 (28)] is slightly shorter than ST3 and much longer than JV1. Single postanal seta (PST) [17 – 23 (20)] is shorter than PA. The distance between PA – PA is 27 – 47 (40) and PA – PST is 37 – 48 (47). Three triangular anal valves (AV), two anterior lateral (AAV), and one posterior (PAV) are evident (Fig. 12, 32).

Sperm access system (Figs. 13, 14) — Long, tubular, ribbon-shaped when flat, entering in coxae III (may represent 'tubulus annulatus' or 'minor duct').

Gnathosoma (Figs. 15, 16) — Palp length = 104 – 130 (115). The tectum (TE) is round anteriorly (Fig. 15), its length is 30 – 40 (36), and its width is 57–70 (62). The fixed digit of chelicera (FDCH) is small, reduced to stubby structures, = 15 – 19 (17); the movable digit of chelicera (MDCH) is 71 – 74 (73) (Fig. 16), each with 9–10 denticles or teeth (DE). Hypostome (HYP) with usual 3 pairs of hypostomal setae (HYPS). The corniculi (CO), and other gnathosomal structures, are difficult to observe using phase contrast microscopy and may require studies at much higher magnification using a scanning electron microscope.

Legs — I and II are almost of the same length, III is shorter than I and II, and leg IV is much larger than I, II and III, each with pretarsus. The length of its legs (including pretarsus): I = 470 – 514 (490), II = 462 – 502 (482), III = 422 – 473 (448), and IV = 520 – 568 (541). Details of the leg setae will require a separate detailed study.

Male (n = 8, Figs. 17–26, 35)

Similar to the female, but smaller in size. The idiosoma length is 540 – 648 (606), and its width is 360 – 510 (444). The peritreme is similar to that of the female, but shorter (Fig. 20) in length being 42 – 66 (51). The length of r3 is 14 – 17 (15).

Dorsal shield (Figs. 17–19) — As in the female, but slightly shorter, its length is 462 – 500 (480), and its width is 209 – 360 (294).

Setae on dorsal shield (Figs. 17–19) — As in the female in that it has 11 pairs of setae, of which 8 pairs (j3, j4, j5, j6, z2, z3, z5, s4) are on the podonotal shield (Figs. 17, 18) and 3 pairs (J2, J5, Z5) are on the opisthonotal shield (Fig. 19). The lengths of the setae are: j3 = 4 – 6 (5), j4 = 4 – 6 (5), j5 = 4 – 7 (5), j6 = 4 – 5 (5), J2 = 7 – 8 (7), J5 = 4 – 6 (5), s4 = 8 – 10 (8), z2 = 7 – 10 (8), z3 = 6 – 10 (8), z5 = 4 – 6 (5), Z5 = 16 – 34 (27). Distance between bases of setal pairs: j3 – j3 = 81 – 98 (89), j4 – j4 = 27 – 53 (41), j5 – j5 = 18 – 26 (24), j6 – j6 = 50 – 93 (76), J2 – J2 = 124 – 142 (134), J5 – J5 = 54 – 72 (64), z2 – z2 = 115 – 139 (128), z3 – z3 = 164 – 212 (186), z5 – z5 = 106 – 117 (111), and Z5 – Z5 = 78 – 96 (86). The distances between the setal bases of different setae are: j3 – j4 = 36 – 72 (60), j3 – j5 = 76 – 85 (81), j3 – z2 = 17 – 55 (29), j4 – j5 = 9 – 27 (19), j5 – j6 = 110 – 148 (136), j5 – z5 = 61 – 87 (75), J2 – Z5 = 114 – 128 (124), J5 – Z5 = 15 – 36 (23), j6 – J2 = 96 – 108 (102), J2 – J5 = 89 – 118 (106), s4 – z5 = 64 – 125 (88), z2 – z3 = 47 – 81 (63), z3 – j5 = 74 – 78 (76), z3 – s4 = 45 – 80 (64), z5 – j6 = 51 – 78 (63), and z5 – Z5 = 91 – 95 (93).

Ventral shields and setae (Figs. 21–24, 35) — The sternogenital shield (SGS) length is 187 – 230 (209), and its width is 75 – 108 (90). It is lightly sclerotized and located between coxae I–IV (Figs. 21, 22). It is widest at the level of ST2 – ST2 and ST5 – ST5, and is narrow at level of ST3 – ST3, with a small posteromedial concavity (Fig. 22). ST1, ST2, ST3 and ST5 are located on the shield; all setae are relatively long, finely serrated, and none are touching or surpassing the base of the next seta in the same vertical line. ST2 is located closer to ST3 than to ST1; ST3 is located much closer to each other than to the other ST setae. ST5, unlike that of the female (Fig. 10), is comparatively long and about as long as ST3 (Fig. 22). The length of the setae are: ST1 = 19 – 23 (21),

ST2 = 18 – 25 (22), ST3 = 19 – 30 (22), ST5 = 15 – 19 (17). Distance between setal pairs: ST1 – ST1 = 53 – 67 (58), ST2 – ST2 = 52 – 70 (56), ST3 – ST3 = 31 – 53 (33), and ST5 – ST5 = 36 – 47 (41). The distances between different setae are: ST1 – ST2 = 41 – 49 (44), ST2 – ST3 = 31 – 42 (36), and ST3 – ST5 = 83 – 96 (90). The JV1 is short [8 – 12 (11)] (Fig. 23) and is located between the sternogenital and anal shield. JV1 – JV1 = 59 – 70 (62). The anal shield (AS) length is 112 – 122 (117), its width is 78 – 115 (98) (Fig. 24), it is rounded anteriorly, with light reticulations, and is located at the posterior apex of the opisthosoma (Figs. 23, 24). The paraanal setae are short, and are located closer to each other than those of female. The length of setae PA = 17 – 36 (25) and the PST = 12 – 18 (14). Distances between the bases of the setal pairs are: PA – PA = 29 – 45 (36), PA – PST = 37 – 48 (41).

Legs (Fig. 25) — Each legs I – IV with a pretarsus. The lengths of legs (including pretarsus) are: I = 407 – 428 (418), II = 380 – 418 (395), III = 340 – 385 (386), and IV = 375 – 440 (406). The basifemur II has a large, rounded hump, on which occurs a thick, single or bifurcate seta and a short, thick, spinose seta (SPI) distal to it (Fig. 25).

Gnathosoma (Fig. 26) — The tectum is rounded anteriorly. The palp length is 105 – 120 (112). The spermatodactyl (Fig. 26) is 60 long. Similar to the female, the details of the gnathosoma in the male are difficult to study at the magnification of a phase contrast microscope and may require studies using a scanning electron microscope (SEM).

DISCUSSION

Variation in the dorsal idiosomal setae (Figs. 1–4, 33) — The greatest variation was observed in the j4 and j5 setae. Although these 2 pairs of setae were often present in their normal locations, occasionally, one seta of the setal pair (e.g. j4) was placed well anterior to the corresponding seta on the other side of the body (Figs. 1, 3, 4, 33). Occasionally, a seta was absent on one side but present on the other side (Figs. 17, 29). In comparison to j4, setae j5 appeared to be more consistent in its location and position (Fig. 3) but, occasionally, one was placed well ante-

rior to the other (Figs. 1, 17, 18). The position of setae z2 was also variable. These are normally located anterolateral to j3 (Fig. 1), but occasionally they occurred in their normal lateral position but not anterior to j3 (Figs. 3, 17). Setae z3 were located in their normal position, lateral and posterior to z2, and approximately in line with and lateral to j4–j5 (Figs. 1, 3, 4). Occasionally, one or both the J2 setae were not clearly evident or one was slightly shorter than the other (Fig. 2). The same was the case with setae J5 where one appeared shorter than the other and was difficult to observe (Fig. 2). All dorsal setae, except for Z5, were very tiny but easy to observe at 400x magnification. Some of the differences in length of these tiny setae mentioned above could be due to the position of the setae on the dorsal shield or to difficulties in observing and measuring them with the optics that were used. When the setae were observed properly, having the correct depth of focus, their length was normal and within the limit of variation, but when they were photographed one seta would sometimes appear shorter than the other. Prasad (1970a) drew a complete set of setae (12 pairs) on the idiosoma for *P. cocytes* showing 11 pairs on the shield (8 pairs of podonotal and 3 pairs of opisthonotal) and 1 pair (r3) on soft integument, but did not give the chaetotaxy. It was subsequently provided by (Prasad, 2011a). He did not discuss variation either, which is done in this paper. In his original paper, he showed the z2 setae located anterolateral to j3, z3 in line with j4 – j5, and s4 located posterior to r3 and slightly anterior to z5. These setae are in the same position as previously described, unless otherwise mentioned.

A very important and puzzling variation was found in some of the adult females of *P. cocytes* that were collected from Peru in this study. The r5 setae, which have never been seen before in any species of *Prasadiseius*, were found present on soft integument in some adult females (Figs. 27, 28). These were symmetrical, located in their normal position, medial and slightly posterior to the posterior end of the peritreme and posterolateral to s4. In these cases, the r3 setae were always present. In Phytoseiidae, r5 has been considered a variable seta (Chant and McMurtry, 2007).

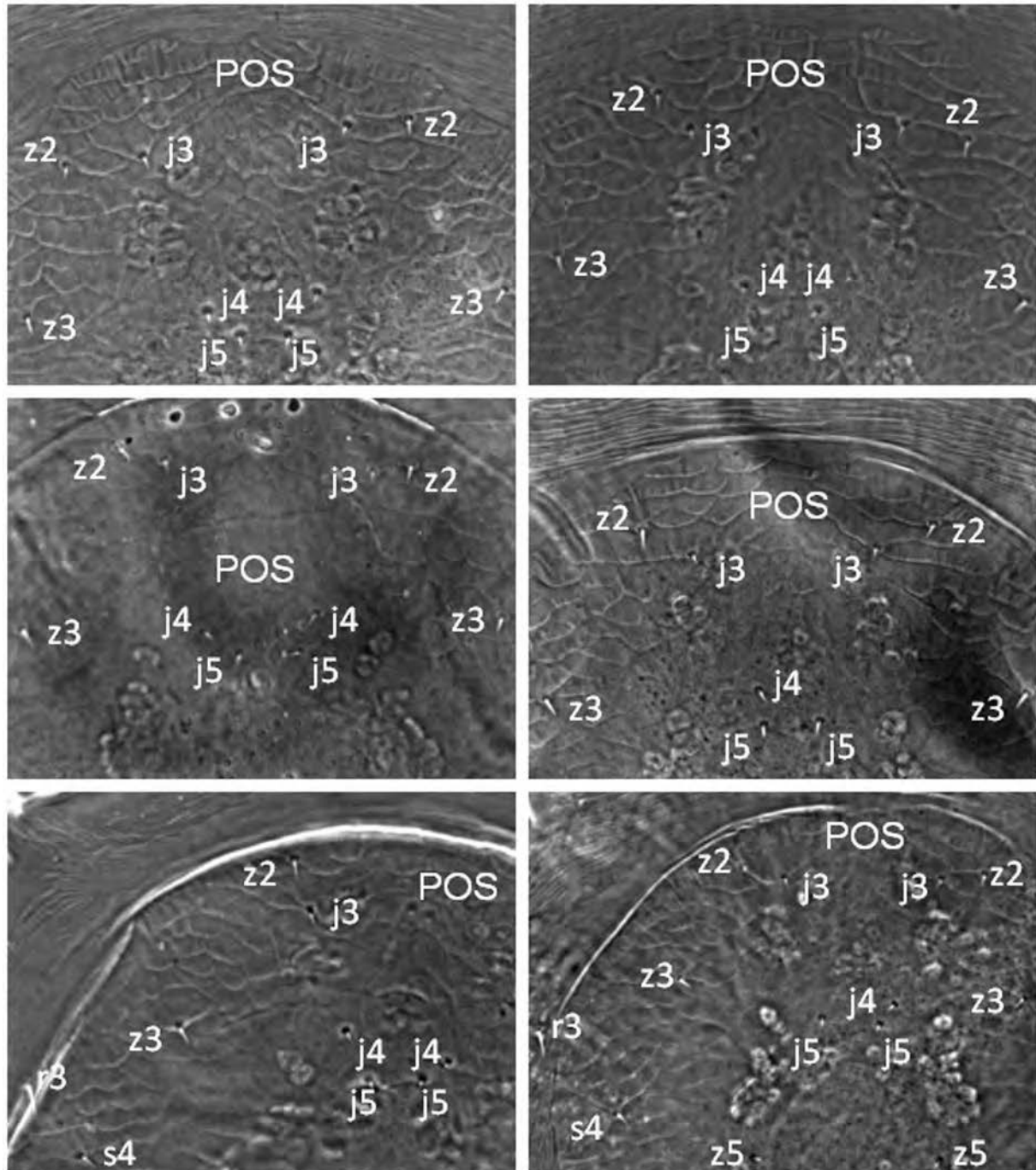


FIGURE 33: *Prasadiseius cocytes* (Female) — Podonotal shield (POS) in 6 females showing variation in presence and location of setae j3, j4, j5, z2, and z3 (see discussion) (VP10-36, VP10-38).

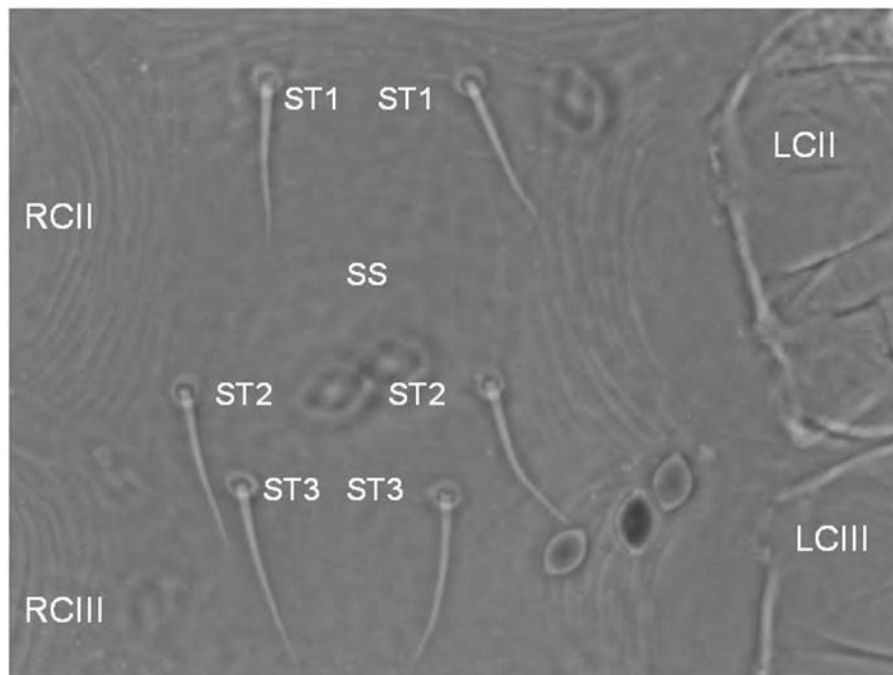


FIGURE 34: *Prasadiseius cocytes* (Female) — Shield-shaped sternal shield in a paratype female in between left and right coxae II-III (LCII-RCII, LCIII-RCIII) showing normal 3 pairs of setae on it (VP69-101).

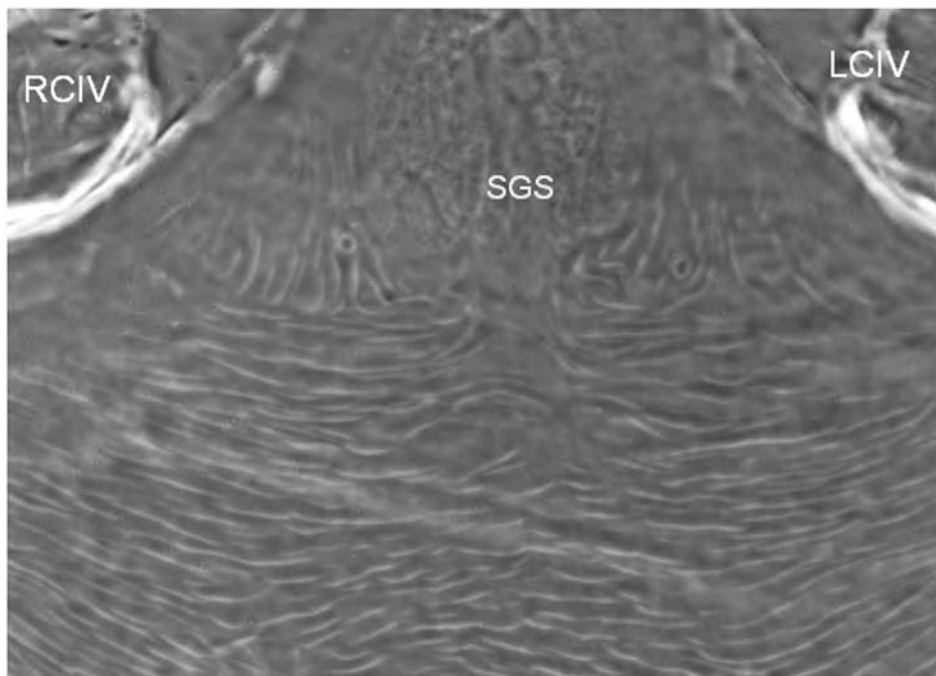


FIGURE 35: *Prasadiseius cocytes* (Male) — Posterior part of sternogenital shield (SGS) in between left and right coxae IV (LCIV – RCIV) showing absence of ST5 (VP10-36: 177).

The same is found in the present study in *Prasadi-seius* spp. A study of a large series of these adults in the future will be necessary to determine if this presence is constant in the species.

Variation in the ventral idiosomal setae — The most significant variation noted in one female was in the sternal setae, in which the ST1 pair of setae and one of the ST2 setae were absent, resulting in the presence of only 3 sternal shield setae versus its normal complement of 6 setae (Fig. 30). The setae in this case were not broken, as no setal bases or sockets were evident. Occasionally, a female was seen having only one of the ST5 setae (Fig. 31). In addition, the ST5 present in adult males was found absent in one male (Fig. 35).

Variation in the shape of the sternal shield — Prasad (1970a) illustrated the sternal shield of this species as being much longer than wide and without showing the anterior and posterior triangular extensions or the shield-shape pattern. These are clearly visible in the present study (Figs. 9, 30) and on the paratypes of *P. cocytes* examined (Fig. 34). It is believed that the use of the measurements of the vertical distance between bases of ST1 – ST3 and diagonal distance between ST1-ST3 for the measurement of the length of the sternal shield is more appropriate than measuring the sternal shield, including the triangular flares that vary in the different specimens.

Variation in the shape of the genital shield — Prasad (1970a) illustrated a rounded posterior margin of the genital shield. In the present study, it was found to be roughly truncated (Figs. 10, 31). This difference may be due to the way the specimens are mounted on slides or to the age of the mite as it was found round when females were gravid and had eggs.

The variations mentioned above seem to be normal interspecific variation. However, presence of r5 is puzzling and needs further investigation. So does study of large population of these mites present on one host if two species or sub-species are present.

REMARKS

The description of different species of Otopheidomenidae using better optics with higher magnification capabilities, such as the use of low temperature scanning electron microscopy LT-SEM and/or regular scanning electron microscopy (SEM), would lead to a better understanding of the morphological features in these mites. The study and description of the immature stages and the study of a large series of these mites are necessary to learn more about the variation in this and other species than is discussed in this paper. Detailed studies of the different gnathosomal structures and leg chaetotaxy are also needed for better understanding of these mites.

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