

Article

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***Paraphytoseius nicobarensis* (Acari: Phytoseiidae): exact identity, comments and voucher photos of types after 37 years**

Vikram Prasad¹ & Krishna Karmakar²

1. 7247 Village Square Drive, West Bloomfield, MI 48322, USA; E-mail: v.prasad@ix.netcom.com

2. Department of Entomology, BCKV, Kalyani, Nadia District, West Bengal, India; E-mail: acarikarmakar@rediffmail.com

Abstract

Paraphytoseius nicobarensis (Gupta, 1977) is considered to be a junior synonym of *Paraphytoseius cracentis* (Corpuz & Rimando, 1966). Voucher photos of holotype female, a paratype female, and a paratype male are provided. Difficulties in the identification of seta S5 are discussed. Suggestions are made for researchers to take voucher photos of the holotype specimens and for museums to place these online along with a searchable database of the mites in their collection for benefit of researchers worldwide.

Key words: *Paraphytoseius nicobarensis*; *P. cracentis*; voucher photos; seta S5; solenostomes gd5 and gd8; lyrifissure idm5.

Introduction

Gupta (1977) described *Amblyseius nicobarensis* from an unidentified plant collected in Sawai, Car Nicobar Island, India. He had one female holotype, two female paratypes, and one male paratype in his collection that were deposited in the collection of the Zoological Survey of India (ZSI), Kolkata, West Bengal, India. He did not mention if these four type specimens were mounted on one or more slides. He reported the absence of a notch or invagination on each side of the dorsal shield lateral to seta s4, absence of seta S5 on the posterior dorsal shield, and illustrated the spermatheca as having a long tubular calyx. In addition, he stated that the movable digit has 3 teeth, the fixed digit multidentate, the genital shield is much wider than anterior margin of the elongate and pentagonal ventrianal shield and hind leg has one spatulate macroseta on each of genu IV, tibia IV, and basitarsus IV. There was no mention of the number or characteristics of macrosetae on genu I, genu II, or other segments of legs I-III.

Gupta & Ray (1981) placed *Amblyseius nicobarensis* in the subgenus *Paraphytoseius* as *Amblyseius (Paraphytoseius) nicobarensis* and included the same description and figures from Gupta (1977). Matthyse & Denmark (1981) considered the presence or absence of a notch in the dorsal shield and that of seta S5 to be variable features and synonymized *Paraphytoseius nicobarensis* (Gupta, 1977) and *P. orientalis* (Narayanan *et al.* 1960) with *Paraphytoseius multidentatus* Swirski & Schechter, 1961. Gupta (1986) and Moraes *et al.* (1986) accepted these views and the synonymy.

Schicha & Corpuz-Raros (1985), Ho & Lo (1989), and Moraes & Denmark (1999) presented evidence that the presence or absence of seta S5 is a stable and valid character. Therefore, *P. cracentis* Corpuz & Rimando, 1966 having seta S5 and *P. orientalis* (Narayanan *et al.*, 1960) not having seta S5 were considered distinct and valid species. But, Denmark in his publication (Denmark *et al.* 1999) continued to consider *P. nicobarensis* as a junior synonym of *P. multidentatus*. However, Chant & McMurtry (2003) did not agree with views of Matthyse & Denmark (1981) or of Denmark *et al.* (1999) and considered the presence of an invagination or notch in the dorsal shield lateral to seta s4 and that of seta S5 as non-variable features. Their correction made *P. multidentatus* a junior synonym of *P. orientalis* which was accepted by Moraes *et al.* (2004), Chant & McMurtry (2007), Prasad (2012), and Demite *et al.* (2014).

Chant & McMurtry (2003) stated that they examined the type specimen of *P. nicobarensis* but did not illustrate it. They considered seta S5 absent in this species and, therefore, placed it in their newly erected *orientalis* species group Chant & McMurtry, 2003 in which they also placed the following species: *bhadrakaliensis* (Gupta, 1969); *chihpenensis* Ho & Lo, 1989; *hilli* Beard & Walter, 1996; *horrifer* (Pritchard & Baker, 1962); *nicobarensis* (Gupta, 1977); *orientalis* (Narayanan *et al.*, 1960); [syn.: *multidentatus* Swirski & Schechter, 1961]; *santurcensis* (De Leon, 1965); *seychellensis* (Schicha & Corpuz-Raros, 1985); and *urumanus* (Ehara, 1967). Further, they stated that *P. nicobarensis* had some of the dorsal setae shorter than in other species and was a valid species. At the same time, they created the *cracentis* species group Chant & McMurtry, 2003 in which seta S5 was present and included the following species: *cracentis*, *hualienensis* Ho & Lo, 1989 [syn.: *cracentis*?]; *hyalinus* (Tseng, 1973) [syn.: *cracentis*?]; and *scleroticus* (Gupta and Ray, 1981).

While identifying species of *Paraphytoseius* from India in 2014, the senior author came across a paratype female of *P. nicobarensis* (Gupta, 1977) borrowed from USNM, Washington, DC, USA, that had seta S5 present and calyx of spermatheca was disc-shaped which Gupta (1977) had not reported. This female, collected on 24 XII 1972 by S.K. Gupta in Car Nicobar Island, India (described as new in 1977), was badly crushed and fragmented but still showed most diagnostic characters very well (Figs. 3–7). This slide (Fig. 1) had a typed identification label on left and collection data label on right. Having characteristics different from those described by Gupta (1977) and having a fragmented paratype female only, the senior author contacted ZSI in India inquiring if they had type specimens of *P. nicobarensis* (Gupta) or *Amblyseius nicobarensis* Gupta, 1977, which they confirmed as having. Since ZSI has a policy of not loaning type specimens outside its building to researchers, the senior author contacted the junior author asking him to examine and photograph the type specimens of *P. nicobarensis* in the ZSI collection and send the photos to him for study, which he did in December 2014.

The ZSI has only one slide of *P. nicobarensis* in its collection which has one female and one male specimen on it (Fig. 2). There is a hand-written label stating the holotype female (on left) and paratype male (on right). Dr. Shelley Acharya, in-charge of acarology section, ZSI, did not know the whereabouts of the remaining two paratype females.

This work on *P. nicobarensis* was completed the results of which are presented in this paper giving the voucher photos. This paper presents evidence that *P. nicobarensis* Gupta (1977) is a misidentification and junior synonym of *P. cracentis* (Corpuz & Rimando, 1966).

Material and methods

Two slides with types of *P. nicobarensis* were studied by us: (1) The first slide (Fig. 1), borrowed by the senior author from USNM, Washington, DC (Acarology collection housed in USDA, Beltsville, MD), USA, had a fragmented paratype female on it (Fig. 4); (2) The second slide (Fig. 2), studied by the junior author in ZSI museum, Kolkata, India, had a holotype female (Fig. 8) and a paratype male (Fig. 11) on the same slide (each mounted separately under its own cover slip).

(1) The paratype female specimen of the USNM was under a round coverslip having a clear ringing material around the edges (Fig. 1). This slide did not have the original labels of Gupta indicating his identification or collection data but had 2 nicely typed labels, left stating "Phytoseiidae, *Amblyseius nicobarensis* Gupta, Female, PARATYPE" and right stating "Car Nicobar, Sawai, Df, 24 XII 1972, S.K. Gupta, host plant (unknown), #8, Hoyer". A hand-written word stating "keep" was present on the right label.

The above paratype female was remounted in Hoyer's medium by technician (deceased Ms. Donnie Fields) of Dr. Harold Denmark, in Florida, where new typed labels were placed and word "keep" written. It was there that the female got crushed and fragmented during the preparation. Finally, this slide was deposited in USNM. The paratype female of this slide was examined in the laboratory of the senior author in West Bloomfield, Michigan, USA. It was examined using an Acc-Scope 3000 phase-contrast microscope (Acc-Scope, New York, NY, USA) under 200–400x. Occasionally, magnification of 1000x was needed to see the structural and setal details under the oil immersion lens. Different characters were measured under 200–400x using mounted Micrometrics™ camera. The voucher photos of the female were taken using a Canon EOS T2i camera. The mite was photographed under 100–400x magnifications after mounting this camera on the trinocular lens. These photos were saved in ADOBE PHOTOSHOP CS5™. For some features, several photos had to be taken as all characters were not clear in the same focus. Thus, many of these photos, including those scattered body parts, were placed in several stacks (layers) to prepare a single voucher photo included in this paper. After the study, the slide was returned to the acarology collection of the USNM, in Beltsville, MD, in September 2014.

All measurements are given in micrometers (μm). As the paratype female was fragmented, only the lengths of the setae were measured from the base to the tip. The setal nomenclature is based on the system proposed by Lindquist and Evans (1965) as adapted for the family Phytoseiidae by Rowell *et al.* (1978); the dorsal and caudoventral setal patterns of Chant & Yoshida-Shaul (1989, 1991); and the idiosomal setal patterns of Chant & Yoshida-Shaul (1992), who also provided the designations for these setae.

(2) The holotype female and a paratype male of ZSI were mounted separately on the same slide under 2 round coverslips and rung, possibly, with locally available red nail polish. The hand-written label in red ink on left stated, "Holotype (left), Female, #3553/17" and label on right stated, "Paratype (right), Male, #3554/17". In addition, this slide also had 2 hand-written labels in black ink stating on the left label, "*Amblyseius nicobarensis* sp. nov., Holotype female (Left - 3553, Paratype male (Right - 3554), Det. S.K. Gupta". The label on the right includes the collection data as given by him in the original publication.

Voucher photos of the holotype female and the paratype male were taken by the junior author in December 2014 with the help of a ZSI staff member using a camera

attached to a Nikon 80i phase contrast microscope located in ZSI. Measurements of only some setae and leg IV were taken that were clear to measure. The photos were sent to the senior author who enhanced them for clarity in Photoshop CS5™ and imported them into the Adobe InDesign CS5 program in which the setae were labeled appropriately.

The voucher photos of the slide # 1 will be deposited in USNM and for slide # 2 will be deposited in ZSI. These will also be placed on the site of Indira Publishing House (www.indirapublishinghouse.com) for online use of other acarologists.

The abbreviations used on Figs. 3–13 and given in Results and Discussion refer to the following (in alphabetical order): ATR = atrium of spermatheca; CAL = calyx of spermatheca; EG = Egg; ENDS = endopodal shield; FD = fixed digit of chelicera; gd5 = solenostome near z5; gd8 = solenostome near Z4; GN = gnathosoma; GS = genital shield; idm5 = lyrifissure near S5; j1-j6, J5 = central row setae on dorsal shield; JV1, JV2 = ventral seta on ventrianal shield; JV4 = ventral seta on integument posterolateral to ventrianal shield; JV5 = ventral seta on integument posterior or posterolateral to ventrianal shield; LI-LIV = legs I-IV; MAD = major duct of spermatheca; MD = movable digit of chelicera; MgeII = modified seta on genu of leg II; PE = peritreme; R1 = sublateral row seta on integument lateral to dorsal shield in female but on dorsal shield in male; s4, S5 = lateral row setae on dorsal shield; SbtaIV = [primary] macroseta on basitarsus of leg IV; SdtaIV = [primary] macroseta on distitarsus of leg IV; SgeIV = [primary] macroseta on genu of leg IV; SPER = Spermatheca; SS = sternal shield; ST1-ST3 = setae on sternal shield; ST4 = seta on metasternal shield; ST5 = seta on genital shield; StiIV = [primary] macroseta on tibia of leg IV; TRI = tritosternum; VAS = ventrianal shield; z2, z4, z5, Z1, Z4, Z5 = middle row setae on dorsal shield; ZV1 = ventral seta on integument anterolateral to anterior ventrianal shield; ZV2 = ventral seta on ventrianal shield posterior to JV1 and anterior to JV2; and ZV3 = ventral seta on integument lateral to ventrianal shield.

Taxonomy

Paraphytoseius cracentis (Corpuz & Rimando, 1966) (Figs. 1–13)

Ptenoseius cracentis Corpuz & Rimando, 1966: 115; Holotype female, Philippines, Isabela, Gamu, on *Achyranthes aspera*, deposited in the Department of Entomology, University of the Philippines.

Paraphytoseius cracentis (Corpuz & Rimando, 1966); McMurtry and Moraes, 1985: 77; Moraes, McMurtry, Denmark & Campos, 2004: 160.

Paraphytoseius multidentatus Swirski & Schechter, 1961: 113; synonymy according to Matthyse & Denmark, 1981: 342; not a synonym according to McMurtry & Moraes, 1985: 77.

Amblyseius nicobarensis Gupta, 1977: 631, Figs. 26–32. *Amblyseius* (*Paraphytoseius*) *nicobarensis* Gupta; in Gupta & Ray, 1981: 45, Fig. 3 E, F.

Amblyseius nicobarensis Gupta; *Paraphytoseius nicobarensis* (Gupta); synonym of *Paraphytoseius multidentatus* Swirski & Schechter, 1961; per Matthyse & Denmark, 1981: 342.

Amblyseius (*Paraphytoseius*) *nicobarensis* Gupta [synonym of *Amblyseius* (*Paraphytoseius*) *multidentatus* Swirski & Schechter, 1961]; Gupta, 1986: 123, 126 - accepted synonymy of Matthyse & Denmark, 1981: 342.

Paraphytoseius nicobarensis (Gupta); Moraes, McMurtry & Denmark, 1986: 105.

- Paraphytoseius nicobarensis* (Gupta); Denmark, Evans, Aguilar, Vargas & Ochoa, 1999: 11 accepted synonymy of Matthyse & Denmark, 1981: 342.
- Paraphytoseius nicobarensis* (Gupta); not junior synonym of *Paraphytoseius orientalis* [syn.: *Paraphytoseius multidentatus* Swirski & Schechter, 1961] - per Chant & McMurtry, 2003: 220.
- Paraphytoseius nicobarensis* (Gupta); Moraes, McMurtry, Denmark & Campos, 2004: 162.
- Paraphytoseius nicobarensis* (Gupta); not junior synonym of *Paraphytoseius orientalis* [syn. *Paraphytoseius multidentatus* Swirski & Schechter, 1961] - Chant & McMurtry, 2007: 53.
- Paraphytoseius nicobarensis* (Gupta); Prasad, 2012: 771.
- Paraphytoseius nicobarensis* (Gupta); Demite, Moraes, McMurtry, Denmark & Castilho, 2014: October 2014.
- [*Paraphytoseius nicobarensis* (Gupta, 1977)]; **new synonymy.**

Systematics

The absence of seta S4 and presence of some dorsal idiosomal setae on the tubercles or humps (along with some other features) places *Paraphytoseius cracentis* (syn.: *P. nicobarensis*) in the tribe Kampimodromini Kolodochka of the subfamily Amblyseiinae Muma. The presence of the notch or incision on the lateral margin of the dorsal shield at level of base of seta s4 places *P. cracentis* in the subtribe Paraphytoseiina Chant & McMurtry, 2003. The absence of setae J2 and S2 and presence or absence of seta S5 are key features of the genus *Paraphytoseius* Swirski & Schechter, 1961. As it has seta S5 present, it belongs in *P. cracentis* species group Chant & McMurtry, 2003, which also includes *P. hualienensis* Ho & Lo, 1989; *P. hyalinus* (Tseng, 1973); and *P. scleroticus* (Gupta and Ray, 1981).

Unique features of *P. cracentis*

The presence of seta S5 is unique feature for this species. Although this seta is present also in other species of *cracentis* species group, some of these could be synonyms of *P. cracentis*. In addition to this seta, the dish or disc-shaped calyx and 3 teeth on movable digit are also significant. These may indicate a close relationship with several species of *orientalis* species group Chant & McMurtry, 2003, that have similar features.

Results

(1) *Description* (from Gupta, 1977; holotype female, measurements in micrometers):

Dorsum - Dorsal shield length = 282, width = 184; cleavage in dorsal shield lateral to s4 absent [error in his observation, it is actually present, see our observation given below]; dorsal shield sculpturing pattern smooth; 1 pair of pores on dorsal shield near z5; peritreme reaching to j1 base; length of setae on dorsal shield, j1 = 32, j3 = 80, z2 = 8, z4 = 8, Z4 = 60, Z5 = 85, s4 = 100, r3 = 32, and R1 = 32 (other measurements of setae on dorsal shield = not given).

Venter - Ventrianal shield length = 84, anterior width = 56; JV5 = 56.

Spermatheca - Calyx long [possibly major duct], vesicle not illustrated.

Chelicerae - Movable digit with 3 teeth and fixed digit multidentate.

Legs - Length of macrosetae on leg IV: genu [SgeIV] = 26, tibia [StiIV] = 36, and

basitarsus [SbtaIV] = 42.

(2) *Our study of the paratype female from USNM* (Figs. 1, 3–7) - Dorsal shield not measured because of being broken and fragmented (Fig. 4); cleavage in dorsal shield lateral to s4 present; length of setae on dorsal shield (of Gupta's holotype in brackets, xx = not given by him), j1 = 33 [32], j3 = 79 [80], j4 = 4 [xx], j5 = 4 [xx], j6 = 4 [xx], J5 = 4 [xx]; z2 = 8 [8], z4 = 8 [8], z5 = 4 [xx], Z1 = 7 [xx], Z4 = 65 [60], Z5 = 92 [85]; s4 = 109 [100], S5 = 7 [xx]; r3 = 42 [32], and R1 = 30 [32]. The longest seta being s4 = 109 [100], followed by Z5 = 92 [85], j3 = 79 [80], Z4 = 65 [60], r3 = 42 [32], j1 = 33 [32], and R1 = 30 [32]. Solenostomes gd5 (Fig. 5), gd8 and gd9 and lyrifissure idm5 seen clearly (Fig. 6) [xx].

Venter - ST1 = 31 [xx], ST2 = 31 [xx], ST3 = 31 [xx], ST4 = 31 [xx]; ventrianal shield length not measured as not clear [84], anterior width not measured as not clear [56]; JV1 = 18 [xx], JV2 = 18 [xx], JV4 = 26 [xx], JV5 = 70 [56]; ZV1 = 27 [xx], ZV2 = 24 [xx], ZV3 = not measured [xx].

Spermatheca (Fig. 7) - Calyx disc-shaped, with atrium, and major duct.

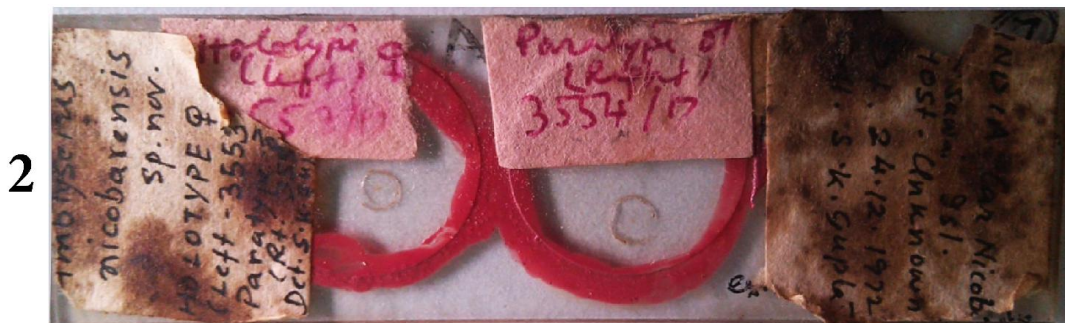
Chelicerae (Fig. 3) - Movable digit with 3 teeth [3 teeth] and fixed digit with at least 9 teeth and a pilus dentilis [multidentate].

Legs (Fig. 4) - Length of [primary] macrosetae on leg IV: SgeIV = 29 [26], StiIV = 37 [36], and SbtaIV = 44 [42]. Clavate modified macroseta present on genu of leg II (MgeII) = 1 [xx], and on tibia III (MtiIII) = 1 [xx]; length of legs: I = 313 [xx], II = 289 [xx], III = 291 [xx], and IV = 537 [xx]. Thus, the longest leg being leg IV, followed by leg I, and (almost of same length) leg III and leg II.

(3) *Our study of the holotype female and paratype male from ZSI* (Figs. 2, 8–12) - The low magnification photo of the holotype female in Fig. 8 shows an egg in the opisthosoma and several landmark setae very well (j3, Z4, Z5, s4, and r3; j1 barely visible). It also shows seta JV5, and [primary] macrosetae on leg IV: SgeIV, StiIV, SbtaIV, and SdtaIV. The short and stout modified macroseta (MgeII) on genu of leg II is barely visible. Enlarged Fig. 9 shows an almost transparent mite with a barely visible lateral margin of the dorsal shield on the left side of the mite posterior to seta R1. Minute setae j5, j6, z4, z5 (near gd5); large and stout setae Z4, Z5, and s4 are seen on the dorsal shield; r3 longer and more stout than R1, both on integument, are also seen. Barely visible seta S5 in between Z4 and Z5 is also seen on the dorsal shield. In addition, somewhat long and stout ventral seta JV4 is also seen. Solenostome gd8 is seen at the base of seta Z4. Enlarged Fig. 10 shows seta S5 on right lateral to Z4 and gd8 at the base of seta Z4. Our measurements of some legs and some dorsal setae in the holotype female include: Leg IV = 410, Z4 = 64, Z5 = 85, s4 = 100, r3 = 40, and R1 = 25.

The low magnification photo of the paratype male in Fig. 11 shows setae s4, Z4 and Z5 and modified macroseta MgeII on genu of leg II. Enlarged parts of the dorsal idiosoma of the male in Fig. 12 shows setae j1, j3, s4, and r3 on the dorsal shield. Barely visible are gd5.

(4) *Investigations about the type slides* - Gupta (1977) had mentioned in his original publication that he had the holotype female, two paratype females, and one paratype male in his collection that he deposited in ZSI collection. He did not mention if these four specimens (three females and one male) were mounted on one or more slides. As mentioned before, 1 intact holotype female and 1 paratype male are in ZSI, and 1 fragmented paratype female is in USNM. Thus, whereabouts of remaining 1 paratype female is not known.



Figures 1–3. *Paraphytoseius nicobarensis* (Gupta, 1977) – 1. Slide with paratype female (USNM); 2. Slide with holotype female (ZSI); 3. Movable digit of chelicera with 3 teeth and fixed digit with 9 teeth and a pilus dentilis in paratype female (USNM).

(5) *Illustration of paratype female by Harold Denmark* (Fig. 13) - It was remarkable to know that Dr. Denmark had made an illustration of the remounted paratype female of this species at that time he had the specimen on loan, which he never published and still had with him. To know if his illustration showed the characters

we had in our voucher photos of this species, the senior author requested him to send this illustration which he did as shown in Fig. 13 (setal signatures placed by the senior author).

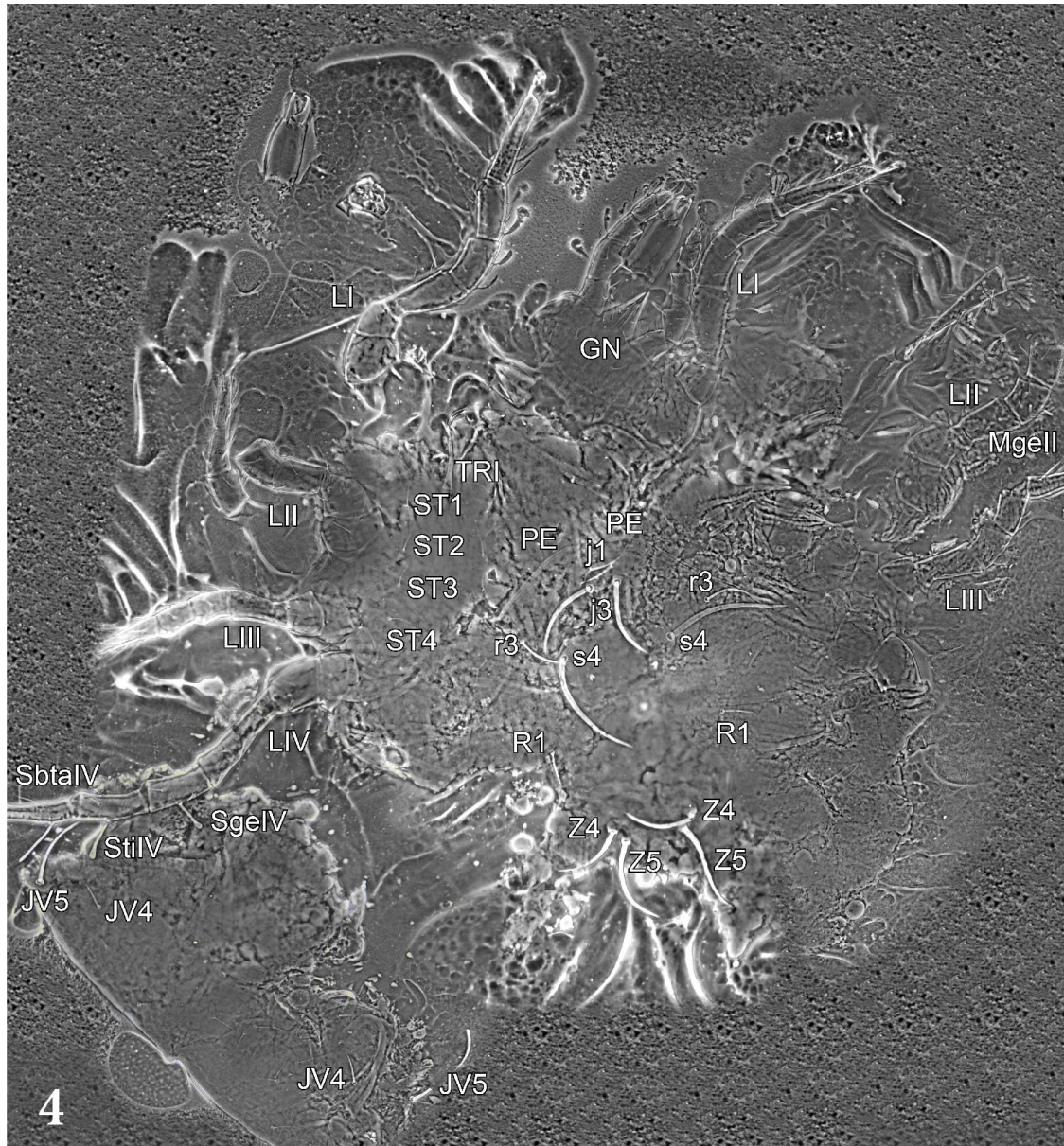


Figure 4. *Paraphytoseius nicobarensis* - Crushed and fragmented idiosoma, gnathosoma, and legs I-IV still showing peritremes and landmark dorsal setae j1, j3, Z4, Z5, s4, r3, R1; ventral setae ST1-ST4, JV4, JV5; (primary) macrosetae SgeIV, StiIV, and SbtIV on leg IV; and modified macroseta MgeII on genu of leg II (USNM, paratype female, composite, 200x).

The above illustration shows 14 pairs of setae on the dorsal shield (j1, j3, j4, j5, j6, J5; z2, z4, z5, Z1 - not illustrated but present in his original penciled figure, Z4, Z5; s4, and S5) and 2 pairs of setae on the integument lateral to the dorsal shield (r3 and R1). Thus, it clearly shows seta S5 posterolateral to seta Z4 and lateral to seta Z5. It also shows an incision on left and right side of the dorsal shield and the peritreme reaching

anteriorly to the base of seta j1. In addition, it shows a pair of solenostomes gd5 posterior to base of z5 and gd8 anterior to base of Z4, seta r3 larger than seta R1, calyx of spermatheca dish-shaped, fixed digit of chelicera at least with 9 teeth, and movable digit with 1 tooth.

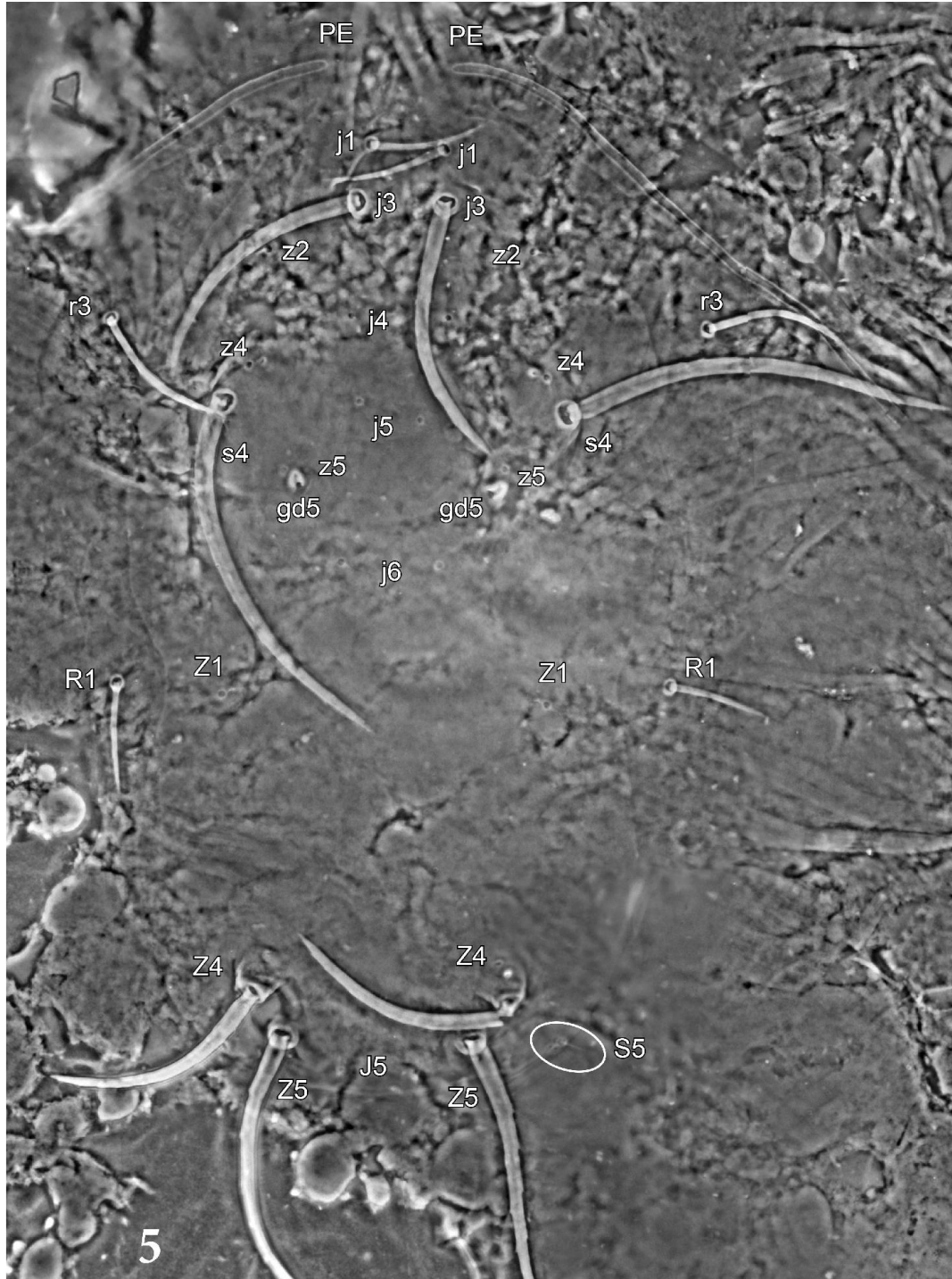
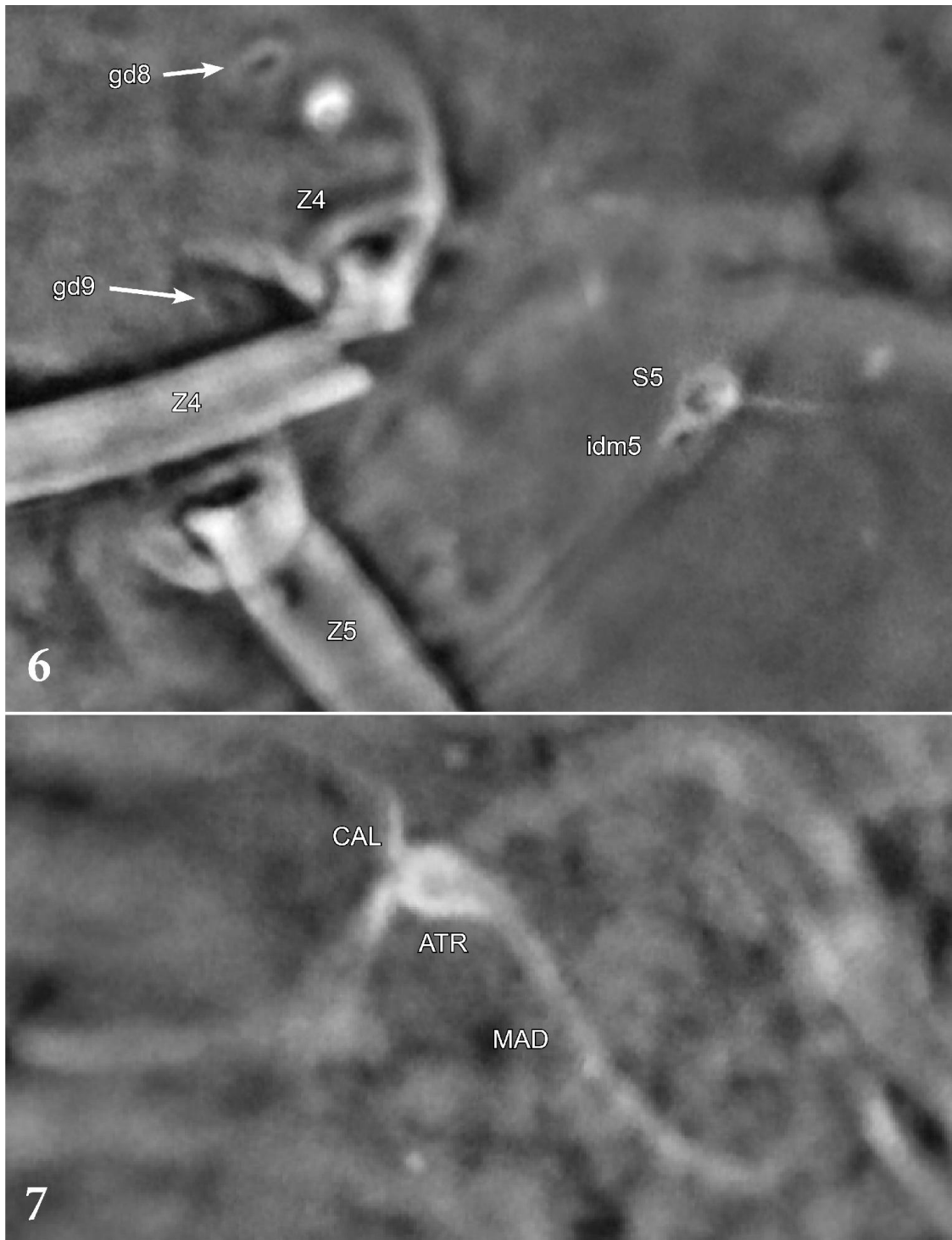


Figure 5. *Paraphytoseius nicobarensis* - Landmark setae j1, j3, Z4, Z5, and s4 on dorsal shield and setae r3, R1, and JV5* (*ventral seta) on integument. Minute setae j4, j5, j6, J5, z5 (anterior to landmark gd5) and short setae z2, z4, Z1, and S5 near idm5 (circled) on dorsal shield barely seen (USNM, paratype female, 400x).



Figures 6–7. *Paraphytoseius nicobarensis* – 6. Dorsal shield with setae Z4, Z5, and S5. Solenostome gd8 near base of Z4, gd9 in between bases of Z4-Z5, and lyrifissure idm5 posterior but close to base of S5; 7. Disc-shaped calyx (CAL), nodular atrium (ATR), and major duct (MAD) (USNM, paratype female, 400x).

Remarks

The illustration of Denmark shows all characters as were seen by us in the paratype female of the USNM except that we saw: (1) 3 teeth on the movable digit, (2) a stout

and clavate modified macroseta on genu of leg II (MgeII), and (3) JV4 was much larger and more stout than JV1 or JV2. Denmark illustrated only 1 tooth on movable digit, did not illustrate stout and clavate modified macroseta on genu of leg II (MgeII), indicated JV4 shorter than and similar to JV1 and JV2, and illustrated 2 pairs of lyrifissures (possibly id7 and id8) posterior to stigmata of the peritreme on the endopodal shield, and macroseta on each genu (SgeIV), tibia (StiIV), basitarsus (SbtaIV), and distitarsus (SdtaIV) of leg IV.



Figure 8. *Paraphytoseius nicobarensis* - Idiosoma, gnathosoma, and legs I-IV with landmark setae j1, j3, Z4, Z5, s4, r3, R1; primary macrosetae SgeIV, StiIV, SbtaIV, and SdtaIV on leg IV; and small modified macroseta MgeII; EG - Egg (ZSI, holotype female, 200x).

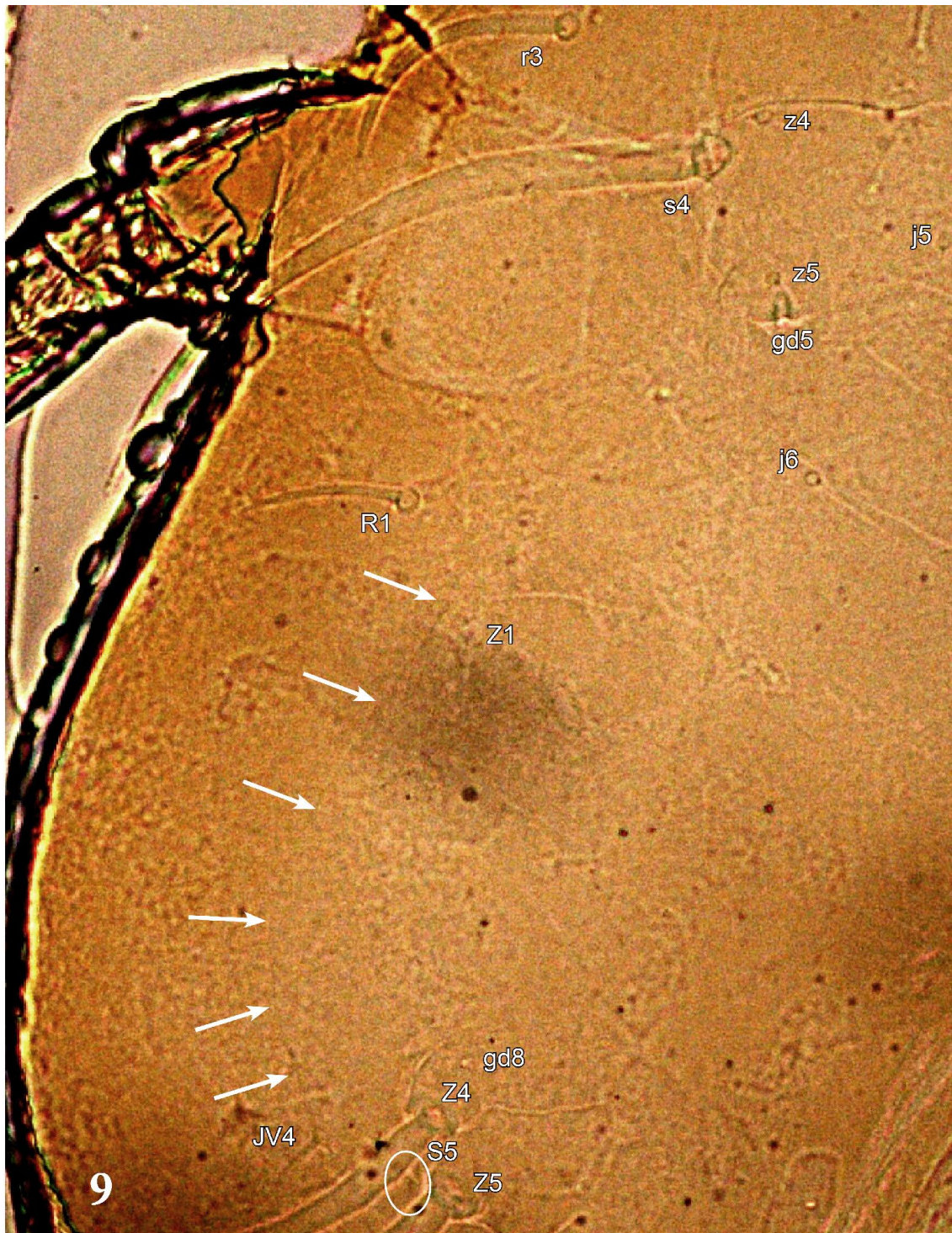
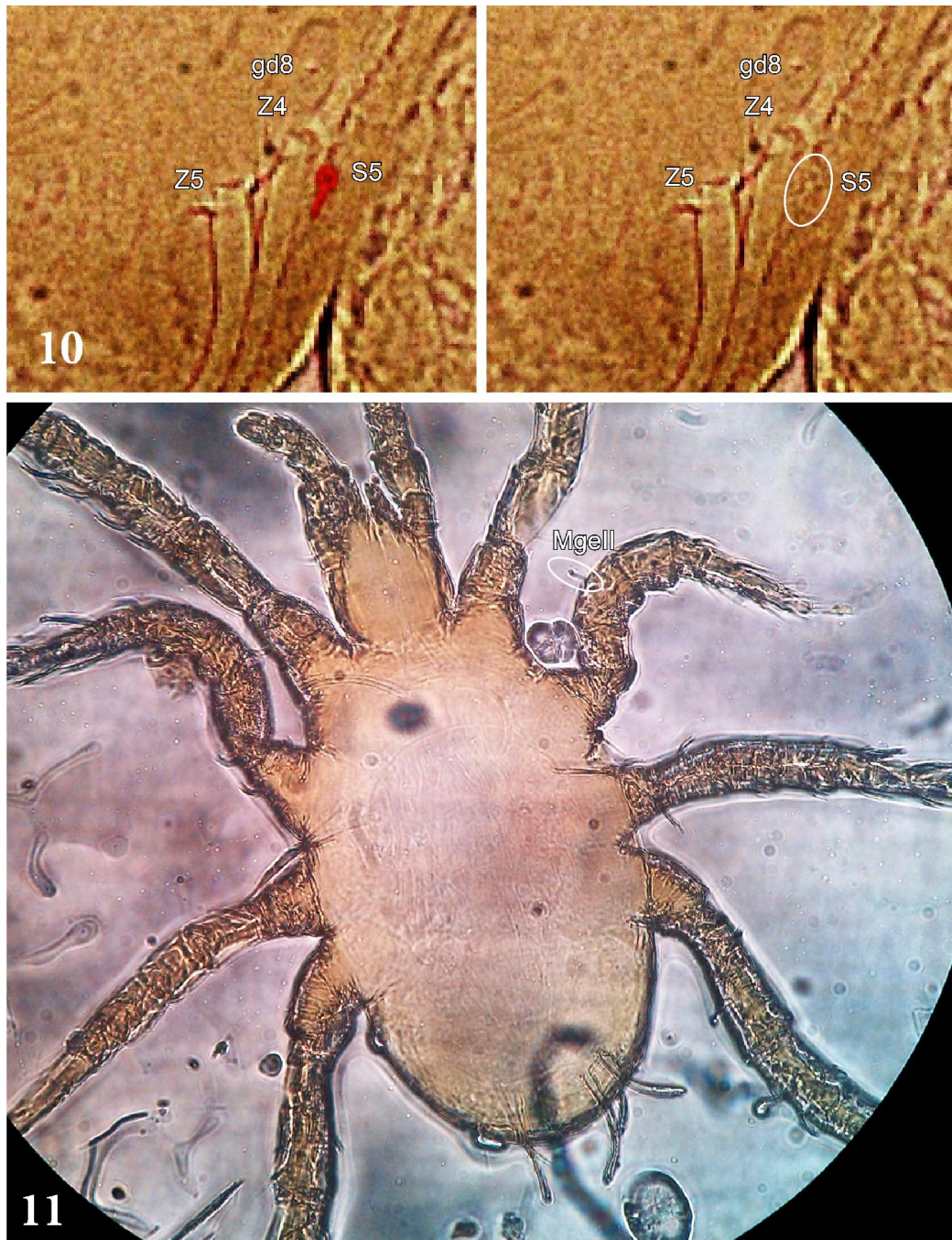


Figure 9. *Paraphytoseius nicobarensis* - Idiosoma with some landmark setae Z4, Z5, s4, r3, and R1 (shorter and less stout than r3); minute setae j5, j6, z5, and Z1; and heavier and longer JV4 that may be confused with shorter and less stout S5 (circled) located lateral but close to Z5. Left lateral border of dorsal shield (arrows) barely visible (ZSI, holotype female, 400x).

Prasad & Karmakar (2015), in case of *P. scleroticus* (Gupta & Ray, 1981), called "Primary macrosetae PgeIV, PtiIV, PbtIV, and PdtIV" to traditionally called macro-

setae SgeIV, StiIV, SbtIV, and SdtaIV of leg IV and "Secondary macrosetae SgeIV, StiIV, SbtIV, and SdtaIV" to rod-shaped or clavate macrosetae of legs I-IV (present or absent on legs I-III). Here, not to confuse with the old established system of naming macrosetae on leg IV, we have called primary macrosetae just as "macrosetae SgeIV, StiIV, SbtIV, and SdtaIV" and rod to clavate macrosetae on legs I-IV as "modified macrosetae MgeI, MgeII, MgeII, MgeIV, MtiIV, and MbtaIV, etc. We believe that these clavate or rod-shaped setae are modified and variable macrosetae.



Figures 10–11. *Paraphytoseius nicobarensis* – 10. (*Holotype female*): Right seta S5 lateral to Z5 barely visible (colored on left and circled on right); tiny gd8 at base of Z4; 11. (*Paratype male*): In low magnification, barely showing landmark setae (ZSI, 200x).

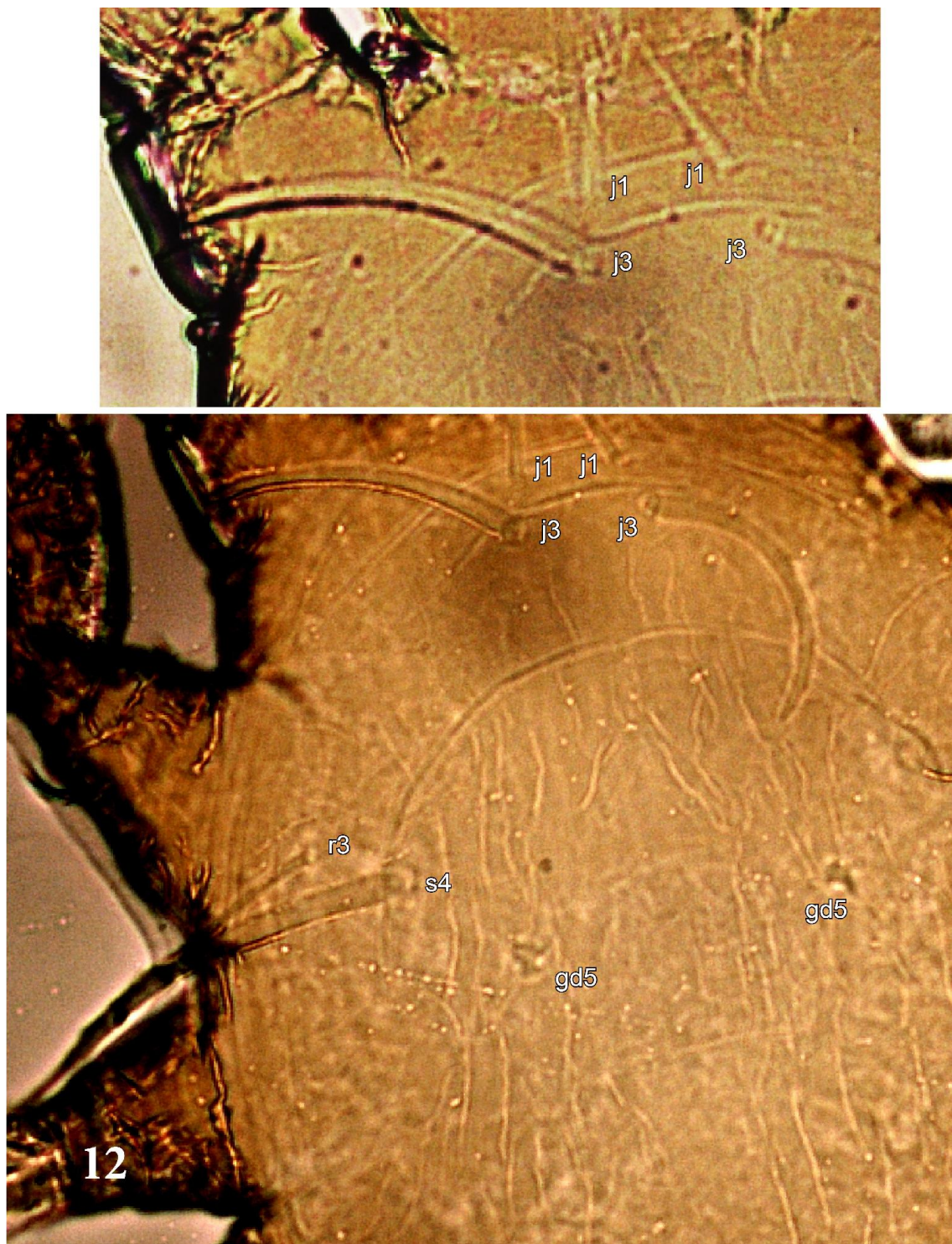


Figure 12. *Paraphytoseius nicobarensis* - Top: Seta j1, j3 and barely visible peritreme. Bottom: Setae j1, j3, s4, r3, and gd5 on dorsal shield (ZSI, paratype male, 400x).

Discussion

(1) *Investigation about the type specimens* - It is necessary to conduct the investigations to resolve some problems in the original or subsequent description of a

species. From the details given above, it is clear that the investigation of the senior author lead to resolving several problems about the type specimens of *P. nicobarensis*.

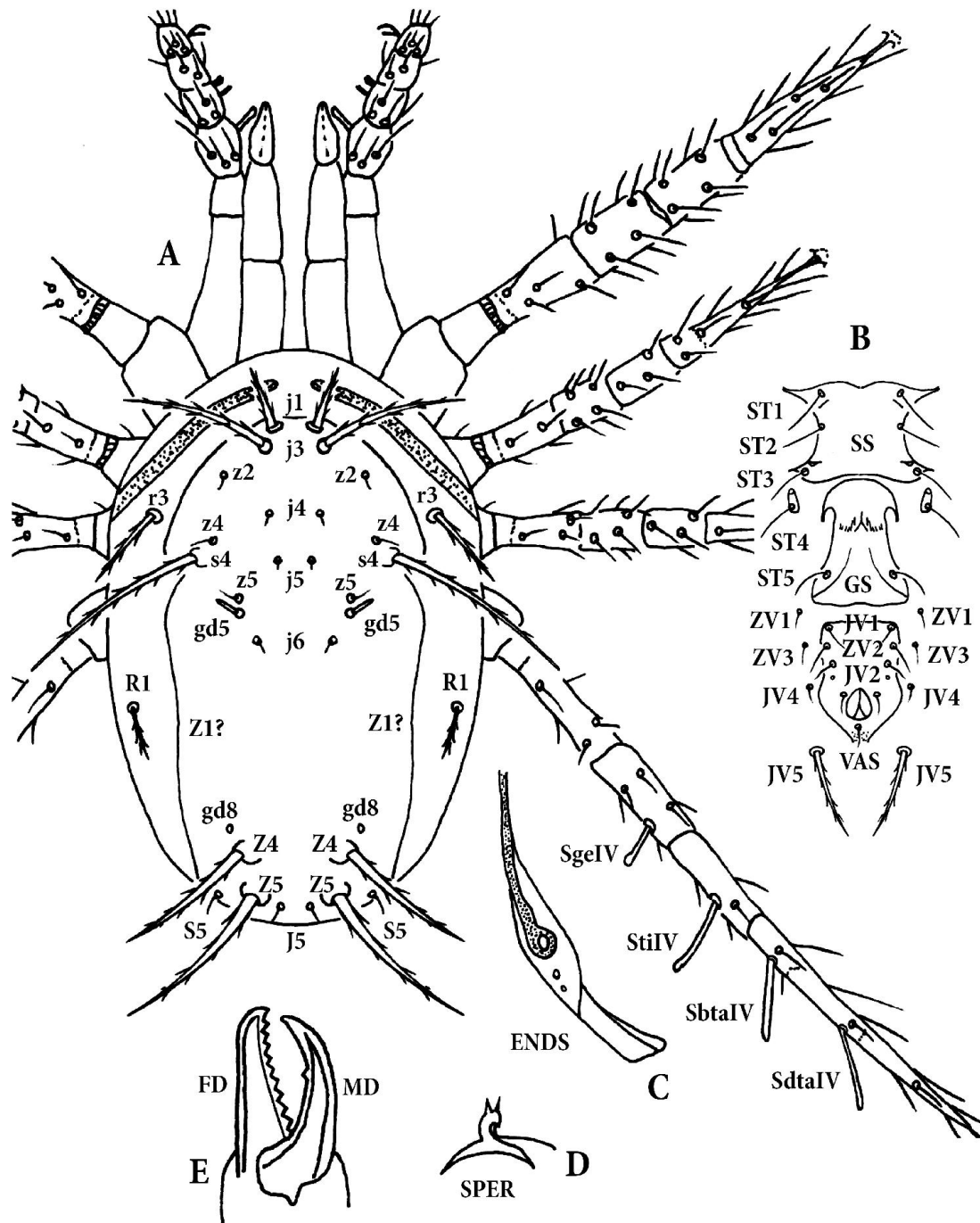


Figure 13. *Paraphytoseius nicobarensis* - A. Dorsum (Z1 not illustrated); B. Venter; C. Endopodal shield; D. Spermatheca; E. Chelicera with fixed and movable digits (after H.A. Denmark, unpublished, paratype female; setal and structural signatures by V. Prasad).

Establishing a synonymy is a responsibility of the authors, but not always accepted by other workers. After studying the paratype female of *P. nicobarensis* from the

USNM, the ZSI photographs, and the unpublished illustration of *P. nicobarensis* by Dr. Harold Denmark, we concluded that it and *P. cracentis* are conspecific.

(2) *Difficulties in the identification of seta S5* - Seta S5 is located on the lateral margin of the dorsal shield posterolateral to seta Z5 and lateral to seta Z4 (Fig. 6). It is placed slightly anterior but very close to lyrifissure idm5 which is, almost always, present even if seta S5 is absent (as in *orientalis* species group). Usually, this seta is small (less than 15 μm long) and the tip bent ventrally or medially. Also, it is located several micrometers below the base of seta Z4 and Z5 that are placed on a large hump. Often, this seta is difficult to see unless a good number of specimens are examined that are mounted properly in dorsoventral position.

In addition to the above, another problem is encountered. The setae on the ventrianal shield and those surrounding the shield on the integument (ZV1, ZV3, JV4 and JV5) are located under setae Z4 and Z5 on the dorsum. When these almost transparent female specimens are flattened, setae ZV3 and JV4 appear in same area as seta S5. Seta JV4 (Fig. 4) is always larger and more stout than seta ZV3 so that it is more easily identifiable; however, when seta S5 is absent or not clear, ZV3 may be confused as being seta S5. It is useful to note that seta S5 is always located on the lateral margin of the dorsal shield lateral to seta Z5 and is placed slightly anterolateral or lateral to lyrifissure idm5 (Fig. 6) to avoid confusion with the ZV3 setae.

(3) *Voucher photos of type specimens needed* - As type slides of mites mounted in Hoyer's medium often deteriorate over a period of time due to crystallization, discoloration, and shrinkage of the Hoyer's medium, or types are lost or not available to the international researchers, it is wise that museums and other collections where type specimens are deposited take voucher photos of these mites and post them online. Some museums have begun to place the list of their type specimens online and make voucher photos as well. We acarologists are way behind in these respects.

(4) *Lesson(s) from the present study* - It is clear from our study discussed above that the misidentification of mites are not uncommon. Published literature is full of misidentifications. We were able to complete this work, without any financial assistance to us, only because type specimens were deposited in museums and we were allowed to examine these specimens. Unfortunately, types of several species of *Paraphytoseius* (and species of Phytoseiidae) have not been deposited in any national or international museum but rather in local colleges or department collections and can not be located. Thus, this kind of situations should be avoided and at least one type specimen should be deposited in at least one of the major national and/or international museums.

(5) *Difficulties in taking voucher photos of type specimens* - If one has a DSLR (digital single lens reflex) camera with the appropriate adapter attachment, it can be used with a phase contrast microscope on its trinocular tube, for taking photos in 100–400x with good results if the mite is in good condition and well flattened. This adapter gives an additional enlargement to 2x. Most characters, including the spermatheca, are usually visible even if the mite is crushed. However, different structures, including setae, can not be seen clearly in the same plane of focus. Therefore, multiple photos are required for one specimen. These can be stacked in layers and a single photo of those structures may be made. We found the reasonably priced Canon EOS T2i photo camera very useful for our work and taking photos under 200–400x better than taking photos in 1000x. It has Canon EOS utility software that allows to zoom-in on some structures to magnify, including setae, see the details in best focus and take the photos. It magnifies structures to bring these in best focus. The EOS utility program comes with the camera

and can be downloaded from Canon site.

A modern confocal microscope could be very useful for taking voucher photos of mites for the purpose discussed above but it is very expensive and beyond reach of many acarologists.

Remarks

Other species of *Paraphytoseius cracentis* species group such as *P. hualienensis* Ho & Lo, 1989 and *P. hyalinus* (Tseng, 1973), also have a similar calyx and 3 teeth on the movable digit of the chelicerae and genu of leg II with a short and heavy clavate modified seta. We agree with Chant & McMurtry (2003) and Moraes *et al.* (2004) that both of these species are possible synonyms of *P. cracentis*.

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گونه *Paraphytoseius nicobarensis* (Acari: Phytoseiidae): هویت واقعی،

تفسیرها و تصویرهای مستند نمونه‌های تایپ پس از ۳۷ سال

ویکرام پراساد^۱ و کریشنا کارماکار^۲

۱. ۷۲۴۷ ویلیج اسکوار درایو، وست بلومفیلد، ام_آی ۴۸۳۲۲، امریکا؛ رایانامه:

v.prasad@ix.netcom.com

۲. گروه حشره‌شناسی، بی‌سی‌کی‌وی، کلیانی، ناحیه نادیا، بنگال غربی، هند؛ رایانامه:

acarikarmakar@rediffmail.com

چکیده

گونه *Paraphytoseius nicobarensis* (Gupta, 1977) به عنوان مترادف کم‌سابقه *Paraphytoseius cracentis* (Corpuz & Rimando, 1966) در نظر گرفته شد. تصویرهای مستند هولوتایپ ماده، پاراتایپ‌های ماده و نر تهیه شد. مشکلات در تشخیص موی S5 مورد بحث قرار گرفته است. پیشنهادهایی برای پژوهشگران ارایه شد تا تصویرهای مستند نمونه‌های هولوتایپ تهیه کنند و برای موزه‌ها ارایه شد تا این تصویرها را به صورت بر خط همراه با پایگاه اطلاعاتی قابل جستجوی کنه‌ها در کلکسیون‌هایشان برای استفاده پژوهشگران سراسر جهان قرار دهند. واژگان کلیدی: *Paraphytoseius nicobarensis*، *P. cracentis*، تصویرهای مستند، موی S5، سولنوستوم‌های gd5 و gd8، روزنه idm5.

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