

Condyloderes chidiyatapuensis sp. nov. (Kinorhyncha, Cyclorhagida, Centroderidae) from off Port Blair Andaman and Nicobar Islands, India.

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Abstract

One new Kinorhyncha species, *Condyloderes chidiyatapuensis* sp. nov., is described in Andaman and Nicobar Islands, India. The same genus was reported fifty years ago in India. This species was identified based on specific characteristics such as cuspidate spines in segment 2,4,8,9, a pair of the laterodorsal spine in the 10th segment in the male specimen, the presence of lateral accessory spine on segment 8, ventromedial sensory spots and smaller mid-terminal spine. Similarly, the largest segment (9th segment) also has a cuspidate spine, which is unique in this species.

Introduction

Andaman Island is an archipelago of India consisting of more than 672 Islands located in the North-East Indian Ocean, which abound a diverse group of floral and faunal organisms. Marine meiofaunal communities present in the sediments play a critical role in the ocean environment ecosystem at various spatial and temporal scales by providing several ecosystem services like the biogeochemical cycle, sediment stabilization, waste removal, food web dynamics and bioturbation (Parulekar and Ansari 1981; Schratzberger and Ingels 2018). Higgins and Rao conducted the earliest marine meiofaunal diversity studies in Andaman during the 1980s, thus enlightening the scientific community about the diversity and interrelationships between meiofaunal organisms and their environment in an Island ecosystem (Higgins and Rao 1979; Rao 1975, 1980, 1986a, 1986b, 1987a, 1987b). Jeeva *et al.* (2018) have carried out some latest meiofaunal studies, including Kinorhynch records from Andaman. Kinorhynchs are exclusively marine meiobenthic organisms recorded from different geographical locations and distributed from deep ocean trenches to intertidal regions, thus known to thrive even in extreme environmental conditions (Sanchez and Martinez 2019; Danovaro *et al.* 2002). They are soft-bodied organisms with a retractable head portion and cuticularized body with movable extensions, including spines sizes ranging from 0.1 to 1mm (Ordonez *et al.* 2010; Herranz 2014). Around 312 species have been recorded presently as per the information provided by the World Register of Marine Species (WoRMS) database. According to Dal Zotto *et al.* (2013), most species belong under the family Echinoderidae, followed by the Family Pycnophyidae (Sorensen *et al.*, 2013). The previously recorded genera from Andaman comprise *Echinoderes* sp., *Cateria* sp., and *Pycnophyes* sp. had the maximum number of species (12 species) identified (Higgins and Rao 1979; Jeeva *et al.* 2018; Sorensen *et al.* 2020). Here is a description of the species from the genus *Condyloderes* sp., as a new record, namely *Condyloderes chidiyatapuensis* sp. nov., from Port Blair, Andaman Islands. This genus belongs to the Family Centroderidae that comes under the order Kentrorhagata and has a current report of ten species (Neuhaus *et al.* 2019; Sorensen *et al.* 2019) under this genus.

Materials And Methods

Sediment samples were collected from nearshore water station located at Chidiyatapu, South Andaman, Andaman and Nicobar Islands, India (Lat:11°29'06.08" N; Long:092°42'19.05" E), at an approximate depth of 20 metres using a Van-Veen grab. Immediately after collecting the samples, isotonic (7%), magnesium chloride solution was added to anaesthetize meiofauna (Yamasaki 2017). The samples were transferred to the laboratory simultaneously. 63µm mesh sieves were used in the laboratory to sieve the sediment, followed by decantation. The sediments were simultaneously fixed and stored in 4% buffered formalin with filtered seawater. 2ml of supernatant was poured into petri dishes and scanned for Kinorhynchs under a stereo binocular microscope (Leica M205C, Germany). For optical microscopy, Kinorhynchs were mounted on glass slides, using Hoyer's medium and were observed under an Olympus BX51 microscope equipped with Differential Interference Contrast microscopy. For microphotography,

ULTRACAM-CMOS10000 camera was used, and measurements were taken by ULTRACAM software. The terminology used by Sorensen and Pardos (2008) and Sorensen *et al.* (2010) has been used for the diagnostic description of the animal.

Results

Taxonomic account

Class Cyclorhagida Zelinka, 1896

Order Kentrorhagata Sorensen *et al.* 2015

Family Centroderidae Zelinka, 1896

Genus Condyloderes **Higgins, 1969**

***Condyloderes chidiyatapuensis* sp. nov.**

Diagnosis

This species is recognized by its triangular cross-section, anterior part of the trunk with angular corners and posterior segment with the tapering end. The primary segment is formed of a closed cuticular ring, and the following 2-9 segments have two sternal and one tergal plate. Middorsal spines are present from one to ten segments. Acicular spines are present from 1 to 11 segments on latero-ventral and middorsal positions—the presence of cuspidate spines on the 2, 4, 8 and 9th segments. Shorter mid-terminal and longer lateral terminal spines are present on the ending segment. It has a total length of 260µm, two lateral terminal spines with a size of 148µm and a mid terminal spine that measures about 14.22µm.

Etymology

The species name, *chidiyatapuensis*, has been derived from the station name, "Chidiyatapu".

Material examined

Holotype – DOSMB 6060 (Fig. 2A-E).

INDIA. ; Bay of Bengal; Lat: 11°29'06.0 N; Long:092°42'19.05 E; depth 25m; 13 March 2020; monthly sampling; SCT; Van Veen grab; offshore sediments; PUL. Specimen mounted in Hoyer's medium for light microscopy.

Additional paratypes were not available.

Full description

Head and neck

The Head region consists of a retractable mouth cone and an introvert. The pharyngeal crown is visible because of the protruded mouth cone. Scalids and inner and outer oral styles are present, but details are not clearly visible. The neck portion consists of narrow and broad places.

Trunk

The body appears with a triangular cross-section consisting of 11 trunk segments, ending with a tapering bottom portion. Middorsal spines are present from one to ten segments. Acicular and cuspidate spines are present in ventrolateral, lateroventral, middorsal, laterodorsal, and lateral accessory positions. The cuspidate spine is present on segments 2, 4, 8 and 9, which is a characteristic feature of this genus. The mid terminal spine is present but much shorter than the lateral terminal spines. MTS/LTAS is 10%. Lateral accessory cuspidate spines are present in segment 8.

Segment 1

The first segment with one tergal and one sternal plate has a cylindrical shape with a width of 91.27µm. The cuticular ring is closed with a slightly vaulted dorsal position. The middorsal spine is present, which extends up to the second segment. The posterior portion of this segment has a pectinate fringe that continues to overlap the anterior portion of the next segment. This feature is observed till the 10th segment. Ventromedial sensory spots are present. Minute cuticular hairs are present on the dorsal and ventral parts of the segment but are less prominent.

Segment 2

The segment with two sternal and one tergal plate is observed. This condition is repeated from segments 3 to 10. Segment 2 is characterized by lateral accessory cuspidate spines near the latero-ventral spine. One middorsal spine and a pair of latero-ventral spines are also seen here. The presence of ventromedial sensory spots was also observed in this segment.

Segment 3

Segment 3 lacks cuspidate spines. The middorsal spine is present, and it extends to the next segment. Pectinate fringe is present at the posterior portion, extending towards segment 4. Sensory spots are present in the ventromedial position.

Segment 4

The middorsal acicular spine is observed in this segment—a pair of cuspidate spines is present at the lateroventral position. On the sternal plasmid-ventral sensory spots are observed.

Segment 5

The absence of cuspidate spines and lateral accessory appendages are observed. The acicular middorsal spine is present.

Segment 6

Ventromedial type-6 sensory spot present. Middorsal acicular spine and a pair of latero-ventral spines are present. Cuspidate spines were not observed in this segment.

Segment 7

Segment 7 has one middorsal spine and a pair of latero-ventral acicular spines. Cuspidate spines absent. Ventromedial sensory spot present on both sternal plates. Female-specific ventromedial appendages are not seen on the 7th and 8th segments.

Segment 8

Segment 8 consists of one middorsal spine, a pair of the latero-ventral acicular spine, lateral accessory spine and ventro-lateral cuspidate spine. Sensory spots are present in the ventromedial position.

Segment 9

Segment 9 bears a middorsal spine, lateral accessory acicular spine and two latero-ventral acicular spines. One pair of cuspidate spines can be seen in the lateral accessory position. Sensory spots are placed ventromedially. It is the largest segment of all, measuring a size of 31.12µm.

Segment 10

Segment 10 is characterized by a prominent cuticular ridge and middorsal and laterodorsal acicular spines, which are male-specific characters of *Condyloderes* sp. specimens. Latero-dorsal spines are extended up to the anterior portion of the final segment. The pectinate fringe is smaller and thinner, which makes it inconspicuous. Sensory spots are also present on sternal plates.

Segment 11

Segment 11 is the smallest and consists of one tergal and one sternal plate. The distal part of the segment appears to have a mid-ventral cuticular thickening, thus giving an optically separated view. A pair of lateral terminal spines and a short, mid terminal spine is present in this segment. One pair of ventromedial sensory spots can also be observed.

Taxonomic remarks

Condyloderes chidiyatapuensis is differentiated from other *Condyloderes* sp. by the presence of a pair of lateral accessory acicular spine on segment eight and lateral accessory cuspidate spine on the spine 2nd and 9th segment, lateroventral cuspidate spine on 4th segment, and cuspidate ventrolateral spine on 8th segment (Table 2- Existing *Condyloderes* species segment measurements (µm) along with presently studied specimen). The size of the mid-terminal spine is lesser than all other available species (Table 1-*Condyloderes chidiyatapuensis* sp. nov.

Measurements(µm) for the main characters of the male specimen, numbers after abbreviation indicates number of trunk segment), and the presence of cuspidate spines also varies in other species (Table 3. Existing *Condyloderes* species segment showing cuspidate spine and mid-terminal spine length and its ratio with total length).

Discussion

Kinorhynchs have been previously studied from the Andaman Islands, but *Echinoderes* sp. and *Pycnophyes* sp. were the only genera reported (Higgins and Rao 1979; Jeeva *et al.* 2018; Sorensen *et al.* 2020). Here is the first time report of *Condyloderes* sp. from the Andaman Islands. However, 50 years ago, Higgins and Rao (1969) reported the same genera with two species description from the east coast of India, viz., Vishakapatnam and Kakinada beach sediments. International revision of the Kinorhyncha study suggested that 11 species of *Condyloderes* genera are identified from different geographic locations around the globe (Neuhaus *et al.* 2019). Presently identified *Condyloderes* sp., has latero-dorsal spines on segment 10. It is a diagnostic feature of *Condyloderes* sp., male specimen, which is also observed in males of *C. agnetis*, *C. rohalorum*, *C. flosfimbriatus*, and *C. kurienlensis* (Neuhaus *et al.* 2019, Sorensen *et al.* 2019). Another discriminative trait for this species is a lateral

accessory spine on segment one. The existence of a ventro-lateral cuspidate spine on segment eight was also observed in *C. clarae* and *C. agnetis* (Neuhaus *et al.* 2019, Sorensen *et al.* 2010,2019). However, compared with the existing species segment measurement (Table.2. Existing Condyloderes species segment measurements (μm) along with presently studied specimen), this genus showed an interesting character in the ventro-lateral cuspidate spine observations. After segment 6, where we observed a pair of cuspidate spines in a segment, the preceding or latter segment appeared as the largest segment of that species. However, in the present identified species, one of the cuspidate spines occurred in the same largest segment of the species (segment 9). Further, in this species, it was also observed that the second smallest segment was in the latter segment, i.e. 11th one, but in other species of this genus, this feature was observed in preceding segments. This species may be considered new in this region based on the above factors. So, it has been named *Condyloderes chidiyatapuensis* sp. nov.

Abbreviations

Abbreviations for institutions and museums:

AICOPTAX- All India Co.ordinatedTaxonomical Study

DOSMB – Department of Ocean Studies & Marine Biology, Pondicherry University off Campus, Brookshabad, Port Blair-744112, Andaman & Nicobar Islands India

MoEFCC- Ministry of Environment, Forest and Climate Change

SCT- Station name Chidiyatapu

PUL- Pondicherry University Laboratory

Abbreviations used in table legends:

cr- cuticular ridge

cu- cuspidate spine

lts- lateral terminal spine

ldas- laterodorsal accessory spine

ls- largest segment

lvs- lateroventral spine

mds- middorsal spine

msw- maximum sternal width

mts- mid-terminal spine

pc- pharyngeal crown

s - segment

s1 to s11- segment one to segment eleven

sc- scalids

ss- sensory spots

sw- standard width

tl- total length

vmss- ventromedial sensory spot

vlcu - ventrolateral cuspidate spine

() - sexually dimorphic male character

Declarations

Ethical Approval and Consent to participate

Not applicable

Human and Animal Ethics

Not applicable

Consent for publication

All the authors gives the consent to publish the work in this publication.

Availability of supporting data

Data supporting this publication is available with the corresponding author and will be submitting if necessary.

Competing interests

There are no financial or non-financial interests that are directly or indirectly related to the work submitted for publication.

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Authors' contributions

Arunima Anand TK, collected the samples from the sediments taken using the grab, separated the individual specimens and identified the kinorhynchs present in the sample by using the existing keys. P.M Mohan collected the sediment samples using the Van-Veen grab, confirmed the specimen identification, reviewed the manuscript and approved the final version of the draft.

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Tables

Table 1. *Condylodereschidiyatapuensis* sp. nov. Measurements (µm) for the main characters of the male specimen. Number after abbreviation indicates number of trunk segment

Characters	Measurement (μm)
TL	260
LTS	148
MTS	14.22
MTS/TL	5.46%
MTS/LTS	9.60%
MSW-7	100.90
MSW-7/TL	38.80%
SW-10	81.52
SD10/TL	31.35%
S1	17.40
S2	22.18
S3	20.06
S4	20.97
S5	24.28
S6	24.27
S7	24.50
S8	27.64
S9	31.12
S10	29.53
S11	18.05

Table 2. Existing Condyloderes species segment measurements (μm) along with presently studied specimen.

Species	TL	S1	S2	S3	S4	S5	S6	S7	S8	S9	S10	S11
<i>C. setoensis</i>	279	21	28	29	31	32	33	35	35	38	31	18
LS/S		0.55	0.74	0.76	0.82	0.84	0.87	0.92	0.92	1.00	0.00	0.47
<i>C. multispinosus</i>	246	14	26	28	29	28	29	32	33	35	28	16
LS/S		0.40	0.74	0.80	0.83	0.80	0.83	0.91	0.94	1.00	0.80	0.46
<i>C. flosfimbriatus</i>	213	29	31	31	31	33	35	37	38	42	34	21
LS/S		0.69	0.74	0.74	0.74	0.79	0.83	0.88	0.90	1.00	0.81	0.50
<i>C. paradoxus</i>	326	24	25	26	29	30	33	34	36	35	30	20
LS/S		0.68	0.70	0.74	0.83	0.84	0.92	0.95	1.00	0.97	0.84	0.56
<i>C. agnetis</i>	229	23	22	22	24	23	26	27	31	29	26	23
LS/S		0.74	0.71	0.71	0.77	0.74	0.84	0.87	1.00	0.94	0.84	0.74
<i>C. clarae</i>	215	16	20	21	21	25	26	27	31	30	25	19
LS/S		0.52	0.65	0.68	0.68	0.81	0.84	0.87	1.00	0.97	0.81	0.61
<i>C. kurilensis</i>	402	28	37	40	41	46	47	47	54	54	45	25
LS/S		0.52	0.69	0.74	0.76	0.85	0.87	0.87	1.00	1.00	0.83	0.46
<i>C. storchi</i>	226	19	24	27	30	30	30	30	32	34	30	19
LS/S		0.56	0.71	0.79	0.88	0.88	0.88	0.88	0.94	1.00	0.88	0.56
<i>C. rohalorum</i>	381	32	35	36	39	40	43	47	52	53	47	26
LS/S		0.6	0.7	0.7	0.7	0.8	0.8	0.9	1.0	1.0	0.9	0.5
<i>C. shirleyi</i>	386	23	38	40	40	41	44	47	47	51	43	22
LS/S		0.45	0.75	0.78	0.78	0.80	0.86	0.92	0.92	1.00	0.84	0.43
<i>C. chidiyatapuensis</i>	260	17	22	20	21	24	24	25	28	31	30	18
LS/S		0.56	0.71	0.64	0.67	0.78	0.78	0.79	0.89	1.00	0.95	0.58

Table 3. Existing Condyloderes species segment showing cuspidate spine and mid-terminal spine length and its ratio with total length.

Species name	Segments with cuspidate spine	Widest pair of sternal plate	MTS (μm)	MTS/TL
<i>C. agnetis</i>	2,5,7,8,9	msw 8	30	10%
<i>C. clarae</i>	5,8,9	msw 6	55	24%
<i>C. setoensis</i>	2,4,5,8,9	msw 8	89	31%
<i>C. multispinosus</i>	2,4,5,8,9	msw 8	94	38%
<i>C. storchi</i>	3,6,7,9,10	msw 8	92	40%
<i>C. paradoxus</i>	2,4,5,8,9	msw 8	105	32%
<i>C. shirleyi</i>	2,4,6,7,8,9	msw 7	111	28%
<i>C. flosfimbriatus</i>	2,5,8,9	msw 7	122	41%
<i>C. kurilensis</i>	9,8	msw 7	114	31%
<i>C. rohalorum</i>	1,5,8	msw 7	182	56%
<i>C. chidiyatapuensis</i> sp. nov.	2,4,8,9	msw 7	14.22	05%

Figures

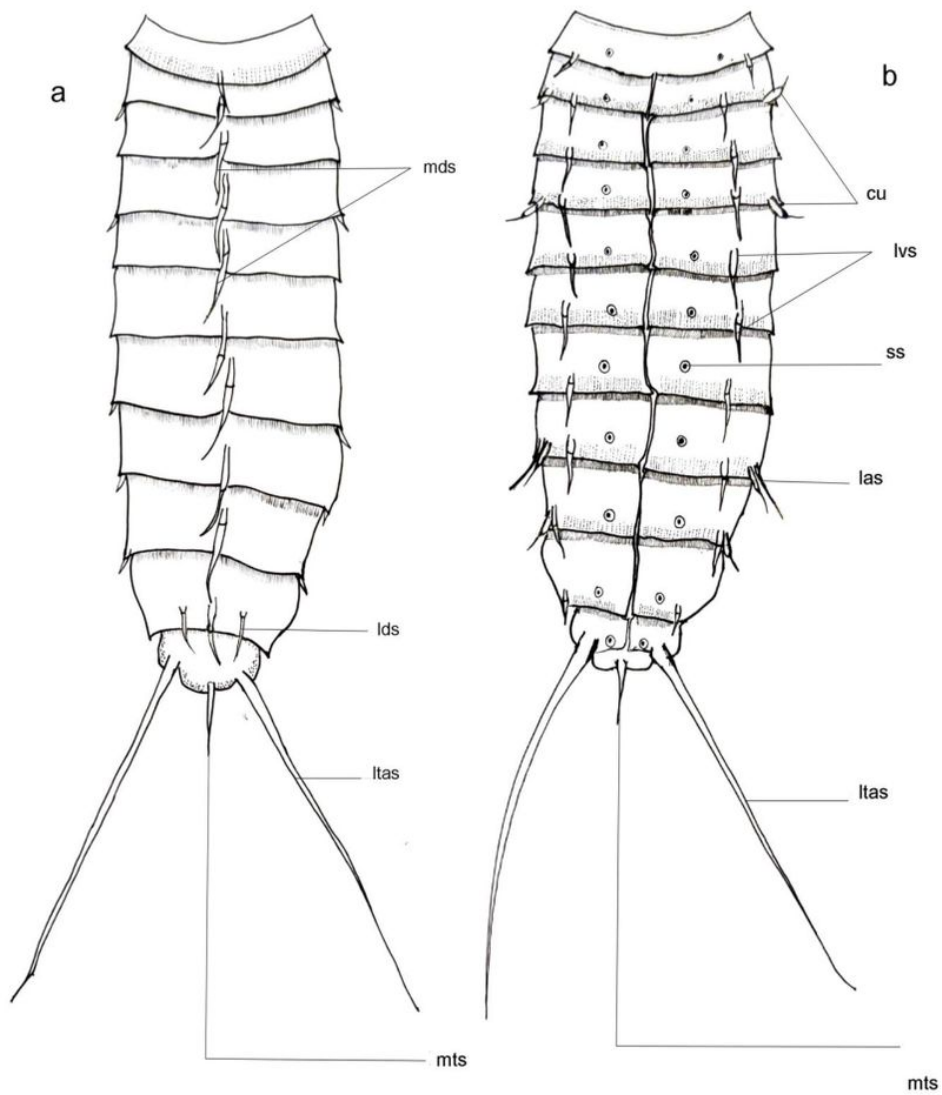


Figure 1

Condyloderes chidiyatapuensis. Schematic drawing **A**. Male, dorsal view. **B**. Ventral view. Abbreviations: **cu**, cuspidate spine; **las**, lateral terminal spine; **lvs**, lateroventral spine; **mds**, mid-dorsal spine; **mts**, mid-terminal spine.

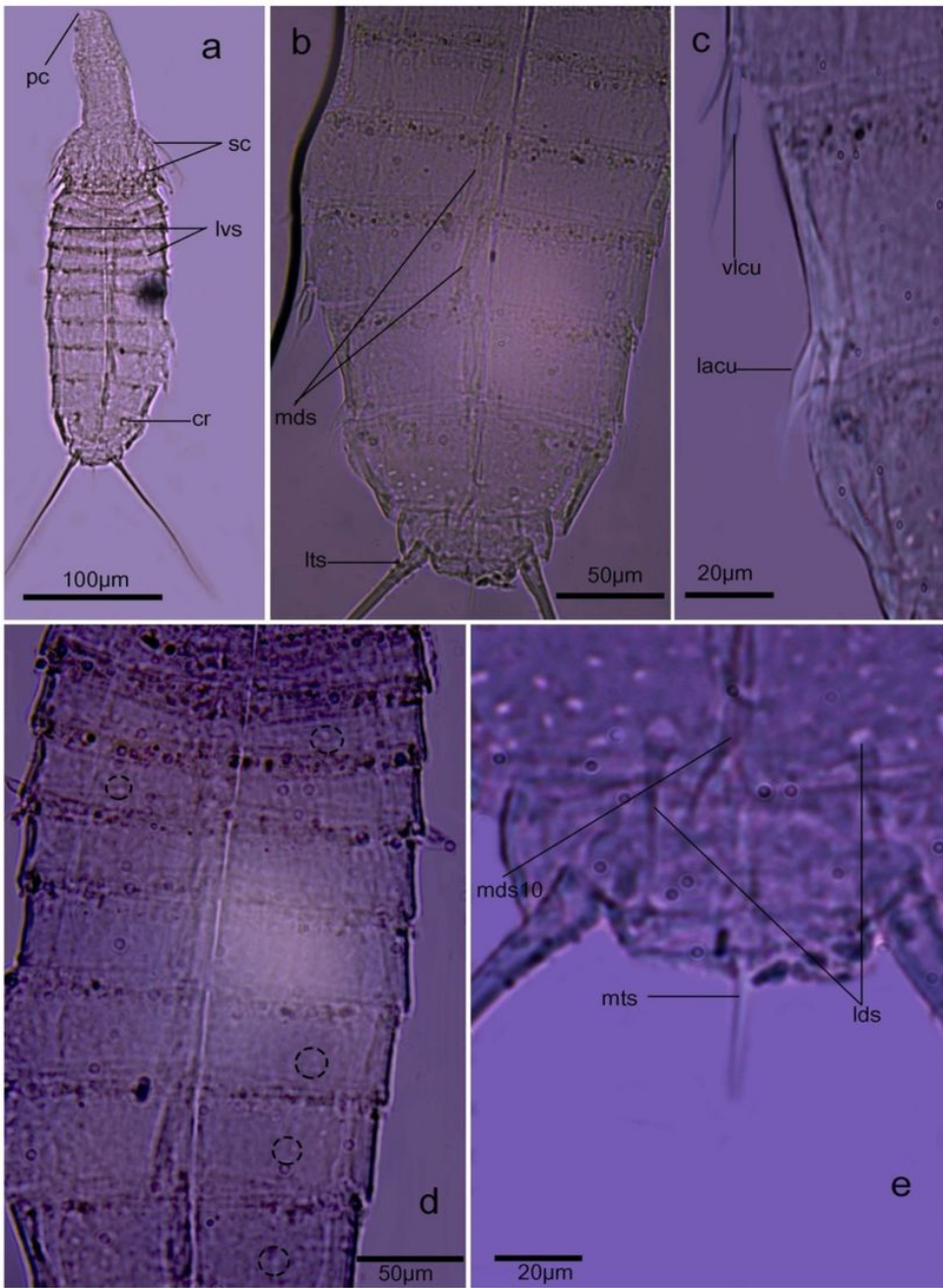


Figure 2

Light micrographs showing details of *Condyloderes chidiyatapuensis* sp.nov. **A.** Holotype, Male ventral view. **B.** dorsal segments 6-11 **C.** cuspidate spines **D.** Ventral segments 2-9 **E.** Terminal segment. Abbreviations: **cr**, cuticular ridge; **lacu**, lateral accessory cuspidate spine; **lds**, laterodorsal spine; **lts**, lateral terminal spine; **mds**, mid-dorsal spine; **mdss**, mid-dorsal sensory spots; **mts**, mid-terminal spine; **pc**, pharyngeal crown; **sc**, scalids; **vlc**, ventrolateral cuspidate spine.