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Journal of Threatened Taxa

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Open Access

10.11609/jott.2025.17.7.27171-27322
www.threatenedtaxa.org

26 July 2025 (Online & Print)
17(7): 27171-27322
ISSN 0974-7907 (Online)
ISSN 0974-7893 (Print)



ISSN 0974-7907 (Online); ISSN 0974-7893 (Print)

Publisher
Wildlife Information Liaison Development Society
www.wild.zooreach.org

Host
Zoo Outreach Organization
www.zooreach.org

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Cover: A Southern Rockhopper Penguin *Eudyptes chrysocome* stands on Tussock Grass on Westpoint Island. Painted in poster colors, this artwork is a reproduction of a photograph by Phillip Colla. Thanks to the photographer for the original image. © Pooja Patil.



A new species of millipede of the genus *Xiphidiogonus* Carl, 1932 (Paradoxosomatidae: Polydrepanini) from Satara District, Maharashtra State, India

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Abstract: The new species *Xiphidiogonus sinispinus* sp. nov. is described and illustrated from Satara District, Maharashtra. The new species belongs to the tribe Polydrepanini (Paradoxosomatidae). The genus was established by Carl in 1932 with three new species, all from Tamil Nadu. This is the first record of the genus *Xiphidiogonus* from Maharashtra. The species *X. sinispinus* sp. nov. differs from its congeners by the lack of a gonofemoral process whereas all three previously known species bear an either internal or external gonofemoral process.

Keywords: Arid zone, biodiversity, Diplopoda, millipedes, Polydesmida, taxonomy, *Xiphidiogonus sinispinus* sp. nov.

The family Paradoxosomatidae is one of the most diverse of class Diplopoda, having more than 200 genera worldwide (Jeekel 1968; Nguyen & Sierwald 2013; Golovatch et al. 2021). Golovatch & Wesener (2016) published the millipede (Diplopoda) checklist of India reporting more than 270 species falling under 16 orders and 125 families. A total of 22 genera and 56 species were reported in family Paradoxosomatidae.

There are three subfamilies within family Paradoxosomatidae. Of these, two subfamilies—Alogolykinae Hoffman, 1963 and Paradoxosomatinae

Daday, 1889 (Jeekel 1968; Golovatch et al. 2021)—are reported from India. Golovatch et al. (2021) revised the tribe Polydrepanini with a new species *Delarthrum anomalans* (Golovatch et al. 2021) from Kerala. The tribe Polydrepanini is distinguished on the basis of long, slender & untwisted gonofemorite (fe), and thin & subflagelliform solenomere (sl). The tribe currently comprises seven genera, which are illustrated by Golovatch et al. (2021). The genus *Xiphidiogonus* is a member of the tribe Polydrepanini (Jeekel 1968). The genus *Xiphidiogonus* was proposed by Carl (1932) to accommodate three new species from southern Indian states with distinctive characters, such as the presence of a leaf shaped acropodite and a small & twisted solenophore with a flagelliform solenomere.

The current paper puts forth a record of new species *Xiphidiogonus sinispinus* sp. nov. from Satara District, Maharashtra, India.

MATERIALS AND METHODS

The material underlying this study was collected by hand from a dry mixed deciduous forest region

ZooBank: urn:lsid:zoobank.org:pub:4CD22B22-9925-4D3C-A1F7-B4FCE5F4650B

Editor: Jackson Means, Virginia Museum of Natural History, Martinsville, Virginia.

Date of publication: 26 July 2025 (online & print)

Citation: Mane, S.B., M.D. Aswathy, P.P. Badade & V.Y. Deshpande (2025). A new species of millipede of the genus *Xiphidiogonus* Carl, 1932 (Paradoxosomatidae: Polydrepanini) from Satara District, Maharashtra State, India. *Journal of Threatened Taxa* 17(7): 27288–27294. <https://doi.org/10.11609/jott.9544.17.7.27288-27294>

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Funding: This study was not supported by any external funding agency. It was self-funded by the authors.

Competing interests: The authors declare no competing interests.

Acknowledgements: The authors are thankful to Dr. Sergei Golovatch for providing support for identification of species. The authors are also thankful to all members of team VYD, Satara for their support and cooperation.

and agricultural field of Diwadi (17.696° N, 74.445° E), Dahiwadi Tehsil, Satara District, Maharashtra, India. The samples were collected between May 2024 (Summer) and July 2024 (Monsoon) and preserved in ethanol (98%). The holotype and paratypes are deposited in BNHS (Bombay Natural History Society) Depository.

The in-field photographs were taken with a Realme 3 Pro smartphone with a 64 MP rear camera. The laboratory work was done with a compound microscope with zoom capacity of 20–60 x. The laboratory photographs were taken by Realme 3 Pro smartphone and stacked by an online photo stacking website <https://focusstackingonline.com/>. The map used in this study was prepared using QGIS 3.34.11-Prizren software. Approximate coordinates were obtained from Google Earth Pro software and satellite data were accessed via quick map services. Scanning electron microscopy (SEM) was done after dehydrating samples in ethanol (90%, 2 x 100%) followed by drying for 24 hours, and mounted on aluminum stubs. The sample was then coated with gold for half a minute in a sputter coater and SEM images were taken by using a JEOL JSM IT 200 scanning electron microscope. The SEM samples were returned to ethanol after the study.

TAXONOMIC ACCOUNT

Order Polydesmida Latreille, 1802/03

Family Paradoxosomatidae Daday, 1889

Subfamily Alogolykinae Hoffman, 1963

Tribe Polydrepanini Jeekel, 1968

Genus *Xiphidiogonus* Carl, 1932

Type species: *Xiphidiogonus spinipleurus* Carl, 1932

Diagnosis: Carl (1942) described the genus *Xiphidiogonus* from peninsular India with three new species. The genus is defined by the following characters: metazonites with fine longitudinal and mostly smooth transverse furrows, weakly developed keels (paraterga) without corners. Sternal cones are present on coxae of 4th leg pairs of males. Legs robust, first & second pair of legs short, somewhat thick, more or less hooked, and femur with adenostyle. Gonofemurite straight, long, cylindrical, untwisted, and armed with processes on either or both sides. Acropodite leaf-shaped with short lobes; solenophore (sph) unusually small and strongly twisted with a free flagelliform solenomere (sl) (Golovatch et al. 2021).

Xiphidiogonus sinispinus sp. nov.

(Figure 1, Image 1–16, 23, 24)

urn:lsid:zoobank.org:act:1779DD8D-65CE-4539-ACA2-F6E876FF6EC2

MATERIAL EXAMINED

Holotype: Male, BNHS Mi 1, 27.v.2024, Diwadi, Dahiwadi Tehsil, Satara District, Maharashtra, India. (17.696° N, 74.445° E), coll. P. Badade & S. Mane.

Paratypes: 2 males, BNHS Mi 2, BNHS Mi 3, same as holotype. 2 females, BNHS Mi 4, BNHS Mi 5, same as holotype.

Other material examined: Aasrai Devi Temple (17.841° N, 74.340° E), Phaltan Tehsil, Satara District, Maharashtra. Near Kartik Swami Temple (17.604° N, 74.276° E), Rahimatpur, Koregaon Tehsil, Satara District, Maharashtra.

Etymology: The specific epithet '*sinispinus*' refers to the absence of gonofemoral spine/ wing-like projections.

Diagnosis: *Xiphidiogonus sinispinus* sp. nov. is defined by the presence of long, slender and untwisted gonofemurite lacking a gonofemoral process, unlike *Xiphidiogonus hendersoni* Carl, 1932 with internal wing-like femoral edge, *Xiphidiogonus dravidus* Carl, 1932 with one internal and two external femoral edges, or *Xiphidiogonus spinipleurus* Carl, 1932 with two internal and one external femoral edges.

Description

Colour of live animals black with brown shade on metazonites (Image 1); head, paraterga and prozonites black; clypeolabral and mandible region yellow; antennae, sterna, and legs black or black-brown; trochanter and prefemur joints are paler; tips of legs with yellow tint. After preservation in alcohol for two months the specimen appeared darker.

Body moniliform with 20 segments. Length of holotype, 28 mm, of paratypes, 27–29 mm (male) or 28–31 mm (female). Antennae longer in males (reaching up to segment 4) than in females (reaching up to segment 3). Body width, head < collum < segment 2 < segment 5 – 16 (both male & female), thereafter tapering towards epiproct. Segment 3 and 4 comparatively smaller than others. Head setose with longitudinal groove starting from vertex to clypeus. Clypeolabrum setose. Collum with minor arc shape and two rows of setae, anteriorly 4+4, and posteriorly 3+3 setae. Post collum terga with a single row of 2+2 setae at anterior side and 3+3 setae at posterior side of metazonites. Collum shows a sagittal sulcus from anterior to posterior side. Some segments show traces of sagittal sulcus. Metazonites with clearly visible transverse sulcus up to 18th segment. Paraterga



Image 1–3. *Xiphidiogonus sinispinus* sp. nov.: 1—in-situ photograph of male paratype (BNHS Mi 3) | 2,3—Habitat. © Shubham Mane.

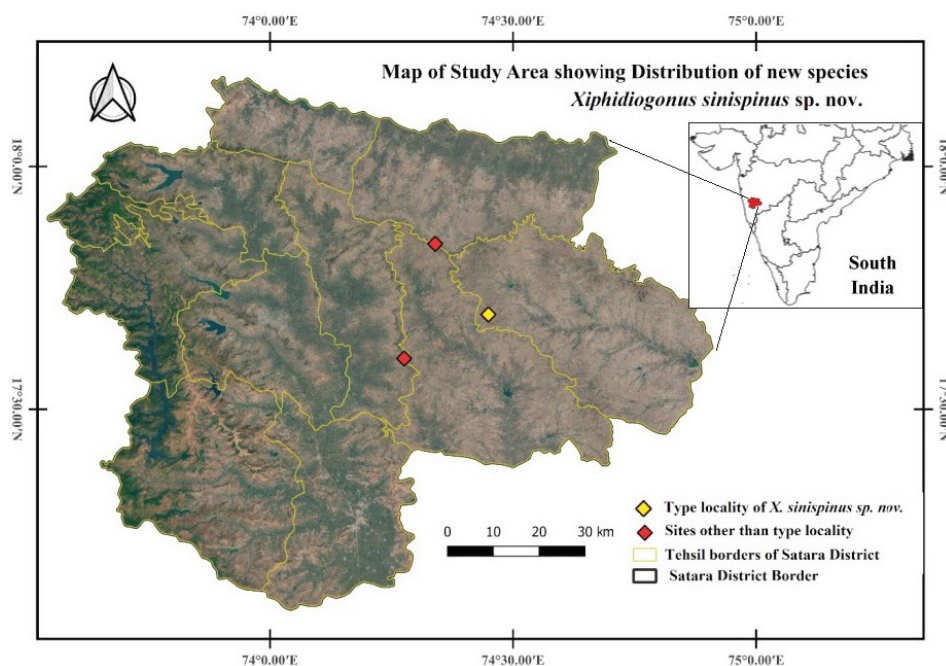


Figure 1. Known localities of *Xiphidiogonus sinispinus* sp. nov. from Satara District surveyed between May 2024 and July 2024. © Shubham Mane.

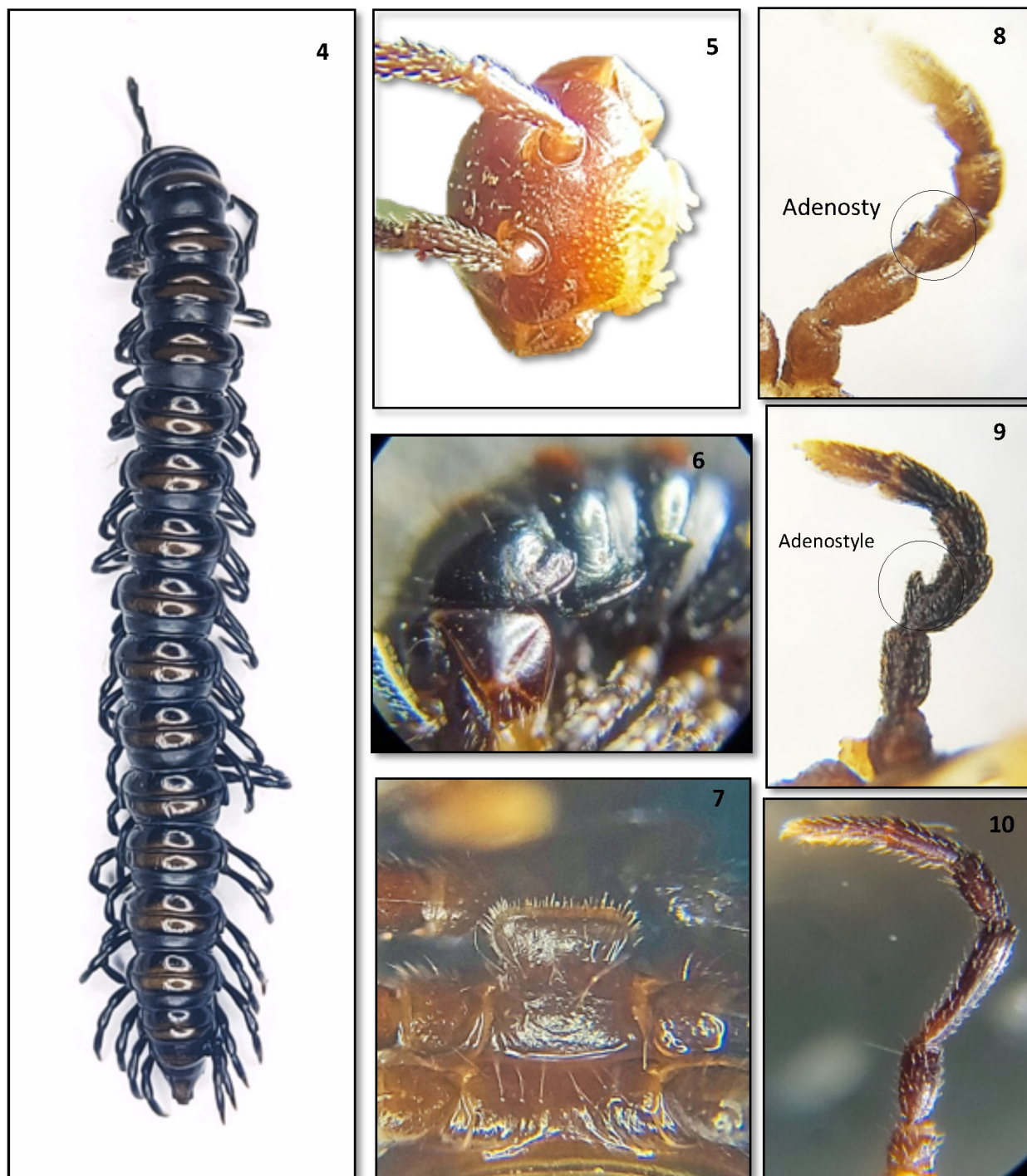


Image 4–10. *Xiphidiogonus sinispinus* sp. nov.: 4—Whole animal dorsal view | 5—Head from anterior view | 6—Lateral view of head with next three segments | 7—Sternal cones of 4th coxa | 8—First leg | 9—Second leg | 10—Leg of midbody segment. © Shubham Mane.

smooth and well developed from segment 3–18 and relatively smaller on segments 3, and 4; paraterga of second segment with rounded corners and extended forward, and backward. All paraterga anteriorly convex; caudal corner of paraterga rounded laterally. Ozopores evident, lateral at ovoid groves of paraterga of

segment—5, 7, 9, 10, 12, 13, 15–19. Epiproct conical, not pointed posteriorly, dorsoventrally flat. Sterna granular, setose, dark brown coloured. Fourth coxa of males with sternal cones (Image 7) directed towards anterior side. Sternal cones are trapezoid, bearing setae. Sterna of segments 2–4 with small triangular outgrowth ventrally.

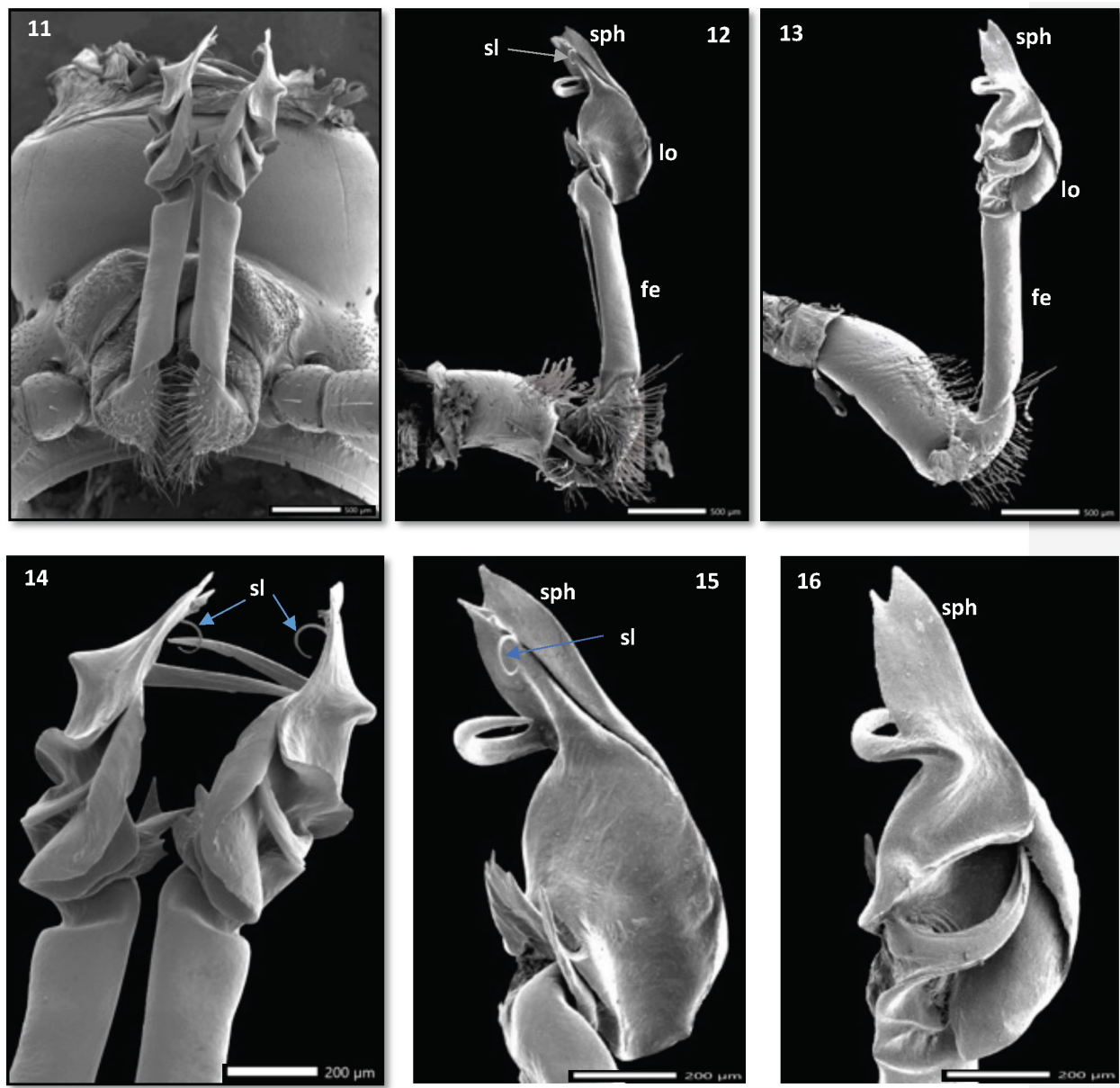


Image 11–16. SEM photographs of gonopods of *Xiphidiogonus sinispinus* sp. nov.: 11—7th segment with gonopods | 12—Entire gonopod mesal view | 13—Entire gonopod lateral view | 14—Acropodite ventral view | 15—Acropodite mesal view | 16—Acropodite lateral view. Abbreviations: fe—gonofemorate | lo—lateral lobe | sph—solenophore | sl—solenomere. © Shubham Mane.

Legs long, first two pairs are modified, thickened, with femoral adenostyle (Image 8, 9). Adenostyle of 1st leg pair is small while 2nd leg pair bears a more protruding adenostyle. Tarsi with small and dense bristles.

Gonopods with strong, cylindrical, untwisted gonofemorate (fe) lacking a femoral process while *X. hendersoni* with internal wing-like femoral edge, *X. dravidus* with one internal and two external femoral edges, *X. spinipleurus* with two internal and one external femoral edges. Coxite sparsely setose near prefemur. Prefemur short, dark, and densely setose, with cannula.

Acropodite from mesal view with semilunar extension, i.e., lateral lobe (lo) at exterior side (Image 12, 13) with seminal canal which runs internally towards the solenophore (sph) located at caudal part of acropodite (Image 12, 13). Solenophore (lateral view) is a leaf-like structure with two pointed edges at the tip, between which solenomere (sl) extends out (Image 14, 15). Solenomere (sl) is a short, unprotected, hair-like extension from solenophore.

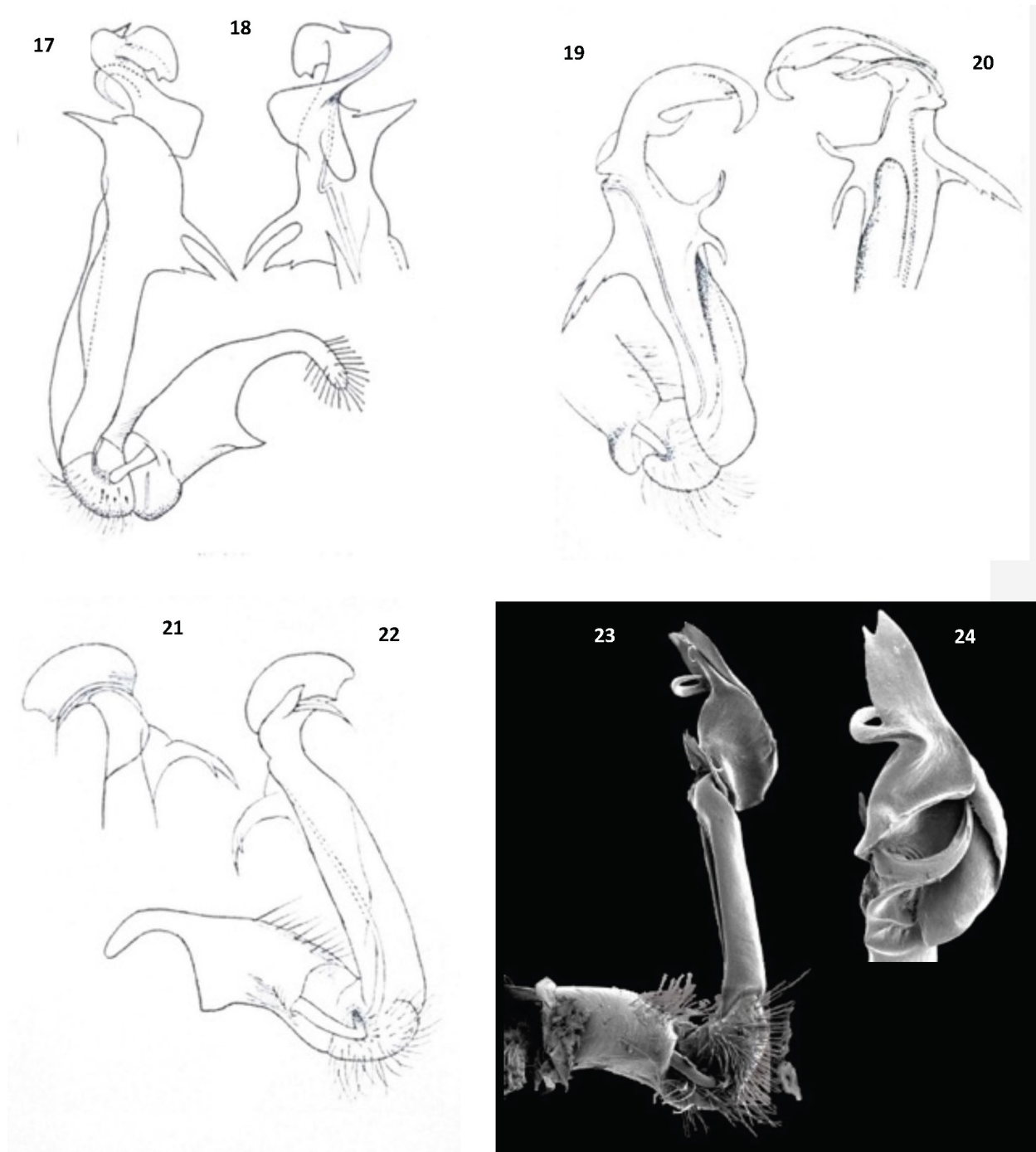


Image 17–24. Gonopods of all species of genus *Xiphidiogonus* (Carl): 17–18—*X. spinipleurus* (Carl) gonopods: 17—Entire gonopod mesal view | 18—Acropodite lateral view | 19–20—*X. dravidus* (Carl) gonopods: 19—Entire gonopod mesal view | 20—Acropodite lateral view | 21–22—*X. hendersoni* (Carl) gonopods: 21—Acropodite lateral view | 22—Entire gonopod mesal view | 23–24—*X. sinispinus* sp. nov. gonopods: 23—Entire gonopod mesal view | 24—Acropodite lateral view. © 17–22—taken from Carl (1932) | 23–24—Shubham Mane.

Habitat

Xiphidiogonus sinispinus sp. nov. is reported from three tehsils of Satara District named Dahiwadi, Koregaon, and Phaltan (Figure 1). All three regions are relatively arid as compared to the western region of

Satara District. The species is commonly found under small logs, along with other burrowing animals in dry regions. The species is moderately abundant in dry areas.

Key to the accepted genera of Polydrepanini, based on gonopodal characters (Golovatch et al. 2021)

1. Gonofemurite clearly twisted 2
 Gonofemurite untwisted 3
2. Solenophore particularly simple, two upright lobes on either side of a higher, and suberect solenomere, the latter devoid of a basal curve/loop **Dasypharkis**
 Solenophore much more complex, strongly coiled; solenomere with a basal loop/curve **Polydrepanum**
3. Solenomere with neither a distinct basal loop nor a protecting lobe at its base 4
 Solenomere with both a distinct basal loop and a protecting lobe at its base 5
4. Solenophore relatively small but clearly twisted **Xiphidiogonus**
 Solenophore usually large, varied **Delarthrum**
5. Solenophore cup-shaped, enlarged **Pocockina**
 Solenophore otherwise 6
6. Both solenophore and solenomere either suberect or subcircular **Grammorhabdus**
 Both solenophore and solenomere strongly coiled, the former with two distomesal processes (a and b), b being unusually large and shield-like **Telodrepanum**

The above key is the modified version of key suggested by Golovatch et al. (2021)

We suggest the new key to all species of genus *Xiphidiogonus* as below:

Key to all species of the genus *Xiphidiogonus*

1. Gonofemurite without additional wing-like edges or outgrowths *X. sinispinus* sp. nov.
 Gonofemurite with additional wing-like edges 2
2. Gonofemurite with internal wing-like edges only *X. hendersoni*
 Gonofemurite with both internal and external wing-like edges 3
3. Gonofemurite with one internal and two external edges *X. dravidus*
 Gonofemurite with two internal and one external edges *X. spinipleurus*

DISCUSSION

The genus *Xiphidiogonus* was established on the basis of long, untwisted gonofemurite with small solenomere (Carl 1932; Golovatch et al. 2021). The genus was established with three new species named *X. hendersoni* having internal wing like gonofemoral edges, *X. dravidus* with one internal and two external gonofemoral edges, *X. spinipleurus* with two internal and one external gonofemoral edges (Carl 1932). Herein we describe a fourth species in the genus *Xiphidiogonus* and provide the first report of the genus from Maharashtra. The novel species lacks any type of gonofemoral edges with a long, straight, cylindrical gonofemurite.

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Print copies of the Journal are available at cost. Write to:
The Managing Editor, JoTT,
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3A2 Varadarajulu Nagar, FCI Road, Ganapathy, Coimbatore,
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Journal of Threatened Taxa is indexed/abstracted in Bibliography of Systematic Mycology, Biological Abstracts, BIOSIS Previews, CAB Abstracts, EBSCO, Google Scholar, Index Copernicus, Index Fungorum, JournalSeek, National Academy of Agricultural Sciences, NewJour, OCLC WorldCat, SCOPUS, Stanford University Libraries, Virtual Library of Biology, Zoological Records.

NAAS rating (India) 5.64



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ISSN 0974-7907 (Online) | ISSN 0974-7893 (Print)

July 2025 | Vol. 17 | No. 7 | Pages: 27171–27322

Date of Publication: 26 July 2025 (Online & Print)

DOI: 10.11609/jott.2025.17.7.27171-27322

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