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New species record of hammer-headed worm (*Bipalium Spp*.) from Jhansi, Bundelkhand region, India

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Abstract
In present study, total 5 specimens were collected and preserved. In live condition, the animal was showing bright brownish colour on the dorsal body. They had a dark brown colour with a whitish long groove having alimentary canal, and a gonopore on the ventral side. Eye spots were present on the semilunar head. One white band was present on the rim of the semi-lunar head, and a narrow neck was also present. There was no other band found on the body. The entire body was slimy, dorso-ventrally flattened and bilaterally symmetrical. The biometric measurements were taken as Body length (40-64 mm), Body Width (4-7mm), Head Breadth (5-6 mm), Neck Breadth (3-4 mm), and distance between anterior end to Gonopore (26-46 mm). It also differs from all 29 species found in India. In this paper, the author recorded the new species *Bipalium bundelensis* for the first time in Jhansi of the Bundelkhand region, Uttar Pradesh (India).

Keywords: Bipalium, Bundelkhan region, diversity, planarians, flatworms, semi-lunar head

Introduction
India is well known for its diversity of animals, as it has four hotspots of biodiversity. The diversity of land planarians is still poorly known. The highest diversity occurs in tropical forests in South America, Asia and Australia. Land Planarians are entirely free-living, carnivorous flatworms and are key predators in their microhabitats (Sluys, 2016) [22]. Worldwide, there are about 900 species of terrestrial flatworms identified, and more to be described (Winsor *et al*., 1998) [28]. Land planarians are soft, flat worms with a symmetrical body. They can be between 3 to 50 cm long and 0.2 to 0.5 cm wide. They do not have a skeleton, lungs, a heart, or an anus. Their heads can be crescent-shaped or taper to a blunt point (Esser, 1981) [8]. They thrive best in high-humidity locations and are found beneath shrubs, rocks, logs, debris, or in dark, cool places with high moisture. They can be sighted on the soil's surface after rainfall (Quadros *et al*., 2009) [19].
Bipalium is a genus of large, predatory land planarians, commonly known as "hammerhead worms" due to their unique head shape. These land planarians are distinctive for having a "creeping sole," a ciliated area on their ventral surface that allows them to move across the substrate (Curtis *et al*., 1983) [3]. Originally native to Asia, several species have become invasive in the United States, Canada, and Europe (Ogren, 1985) [16]. A highly toxic neurotoxin, Tetrodotoxin, was detected in B. adventitium and B. kewense in 2014. This marked the first recorded instance of tetrodotoxin in terrestrial invertebrates (Stokes *et al*., 2014) [23]. Recently Bipalium species from various places of India have been recorded by Bhakat (2020) [1], Gadwe (2023), Shahbaz *et al* (2024) [21].
In this paper, the author recorded the new species *Bipalium bundelensis* for the first time in Jhansi City of the Bundelkhand region, Uttar Pradesh (India).

Materials and Methods
Jhansi city, which is located on Bundelkhand region of Uttar Pradesh and is situated between the rivers Pahunj and Betwa between North longitudes 24°11´ and 25°57´and East latitudes 78°10´and 79°25´. Semi-arid climatic conditions are found in this region. Red soils with sands in higher percentage was found in the local area. The pH was around 8.26 in Jhansi District (Kumar *et al*. 2013) [14]. The place, where the live specimens were sighted and collected, had vegetation like shrubs, bushes and Neem (*Azadirachta indica*), Babool (*Acacia nilotica*), Ber (*Ziziphus mauritiana*), Peepal (*Ficus religiosa*), Palash (*Butea monosperma*) etc. The soils of this area have invertebrates like glass snails, termites, earthworms, spiders, scorpions, ants and common wolf snake (*Lycodon aulicus*) and also common Krait.
Live animals were sighted and collected from the wet soil surface of the roadside at dawn (7.00 a.m.) on October 08, 2022 after rainfall. Again, it was sighted at the same place on 24 September 2024 in the morning (8.00 a.m.) and evening (9.10 p.m.) after rainfall.
The specimens were collected at Bajrang colony (Latitude: 25.467803^{O} N, Longitude: 78.609904^{O} E), Jhansi City, Uttar Pradesh, India (Fig. 1).

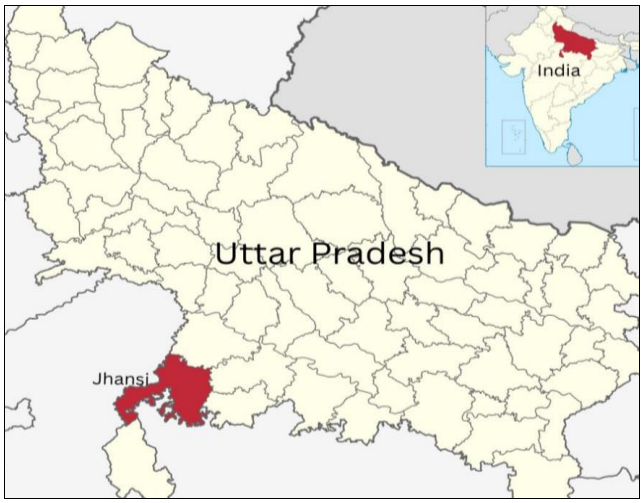

Fig 1: Location Map of Jhansi District, Uttar Pradesh, India. Source- Wikipedia

For preservation, the live specimens were placed in a tray filled with 25–30% NaCl solution, where they died within minutes. They were then rinsed with distilled water and transferred to 70% alcohol. This method caused a thin white mucous layer to separate from the body. The specimens preserved in formaldehyde become pale and whitish.

Fig. 2- Live animal (a, b, c pictures) showing dorsal side and d-showing ventral side.

Result and Discussion

Type Material-

Holotype: 24. IX. 2024.; Jhansi (Latitude: 25.467803^{O} N, Longitude: 78.609904^{O} E), Uttar Pradesh, India; 64 mm BL; deposited at Department of Zoology, Government College, District Lalitpur-284403, Uttar Pradesh, India; Collected by Rabindra Kumar Saroniya.

Paratype: Same locality; 40-64 mm BL (n= 4); September 24-30, 2024; all other details are same as holotype.

Taxonomy

Phylum: Platyhelminthes
Class: Turbellaria
Order: Tricladida
Family: Bipaliidae von Graff, 1896
Type species: *Bipalium bundelensis* sp. n

The name Bundelensis has been taken from Bundelkhand region, the region of its occurrence.

In present study, total 5 specimens were collected and preserved. In live condition (fig. 2), the animal was showing bright brownish colour on the dorsal body. They had a dark brown colour with a whitish long groove having alimentary canal, and a gonopore on the ventral side. Eye spots were present on the semilunar head. One white band was present on the rim of the semi-lunar head, and a narrow neck was also present. There was no other band found on the body. The entire body was slimy, dorso-ventrally flattened and bilaterally symmetrical. The biometric measurements were taken as Body length (40-64 mm), Body Width (4-7mm), Head Breadth (5-6 mm), Neck Breadth (3-4 mm), and distance between anterior end to Gonopore (26-46 mm).

There are 29 species of *Bipalium* have been described by various workers and also reviewed by Bhakat S. (2020) [1] as having distinct morphological features –

Elliot (1848) [7] described *Bipalium lunata* from Assam and Madras, which has salient features of Dark brownish black, head pale with whitish border and edge pale brown.

Wright (1860) [30] described *Bipalium ferudpoorrense* from Bangar and Naga hills, with salient features of Greenish brown and a line of yellowish brown, *B. grayia* from Bengal with salient features of Triangular head lobe, brownish colour marked with yellow, 3 longitudinal narrow line.

Humbert and Glaparede (1862) [11] described *H. proserpina* from Nilgiri with salient features of Wide black band on dorsal interspersed by a white thin line, 4 lateral band running parallel to median black band, dorsal jet black.

Grube (1866) [10] described *B. univittatum* from Madras with salient features of Semicircular whitish head, dorsal violet brown, longitudinal white band on the lateral side, head with eye.

Moseley (1878) [15] described *Bipalium kewense* from Jammu & Kashmir with salient features of Light ochre with 5 black to grey long stripe, median black and narrow, head plate grayish with light ochre margin.

Von Graff (1899 and 1894) [24, 25] described *Bipalium flower* from Nilgiri, which has salient features of dark brown dorsal and two black bands with an orange stripe; *B. kirckpatricki* from India with salient features of Brown with a mid dorsal band; *B. smithi* from Darjeeling with salient features of Bluish black, sole side with bluish green tinge; *B. rigaudi* from Assam with salient features of Somber colour, parallel longitudinal band, median black line.

Whitehouse (1914 and 1919) [26, 27] described *Bipalium andrewesi* from Nilgiri hills with salient features as Dark reddish brown, 3 longitudinal black stripes, neck with narrow black transverse band; *B. brunneum* from Cochin-S. India with salient features as Rusty brown with 3 longitudinal dark stripe, sole purplish grey, ventral dull, grayish outer edge; *B. delicatum* from Rotung, Assam with salient features as Light and dark brown, 2 apparently bleached patches on the ventral surface, eyes continued upto half the length of the body; *B. dihangense* from Valley of Dihang river, Assam with salient features as Dull reddish brown, reddish tint at the sides, a mid-dorsal line, brownish pink ventral, eyes on head and neck; *B. giganteum* from Assam with salient features as Dull brown, ventral blue grey, head paler, sole form arrow head; *B. indicum* from Calcutta with salient features as Darkish dull brown and pale biscuit colour, neck with darker pigment, eyes on head and neck, broad median longitudinal band, sole white; *B. rotungense* Rotung, Assam, with salient features as Bluish grey with touches of brown, 3 longitudinal dark lines, eyes

confined to head rim. *B. sordidum* from Yem bung river, Assam with salient features as Deep brown with profuse black mottling, median narrow band, reddish brown side; *B. splendens* from Cherrapungi with salient features as 3 longitudinal jet-black lines, yellow sole with side diffused black line, eyes few; *B. sylvestre* from Cochin with salient features as Dark brown, 3 longitudinal black lines;

Kaburaki (1925) [13] described *B. vinosum* from Andaman with salient features of Non-sexual, uniform vinous red, pharyngeal region pale buff, eye one or two rows on head margin.

Beauchamp (1930) [4] described *Humbertium core* from Palnis Pumbarai, Tamil Nadu, with salient features of Dorsal brown, a longitudinal band in the middle of the body; *B. depressum* from Attakatti with salient features of Longitudinal band in the middle, eyes on head and neck; *H. dodabettae* from Nilgiri with salient features of 2 longitudinal band, eyes on head and neck; *H. palnisia* from Palni Hills with salient features of Brown, semicircular head, a broad longitudinal band, sole brown; *Bipalium* sp. from Darjeeling with salient features of 3-5 prominent yellow or black stripe, small eyes on head margin.

Ramkrishna & Chauhan (1960) [20] described *Bipalium roonwali* from Nilgiri, which has salient features of Dorsal dark grey with thick median blue-black stripe, deep median line prominent at mouth, ventral creamy white.

Ogren & Kawakatsu (1987) [18] described *B. whitehousei* from Rotung, Assam with salient features of 3 longitudinal stripe, head with 2 semicircular bands, outer black inner pale buff, sole white.

Somnath Bhakat (2020) [1] described the new Bipaliid land planarian, *Bipalium bengalensis*, from Suri, West Bengal, India, which was uniformly jet black without any bands or lines, featuring a thin, indistinct mid-dorsal groove. In its live state, the semilunar head margin appears pinkish and is lined with numerous eyes. The body length ranges from 19.00 to 45.00 mm, with a width varying between 9.59% and 13.16% of the total body length (BL). The mouth is positioned between 51.47% and 60.00% BL from the anterior end, while the gonopore is located between 67.40% and 75.00% BL 6. He has reviewed the key characteristics, distribution, and biometric data of all 29-known species of Indian Bipaliid land planarians. He also examined ongoing Bipaliid taxonomy and a revised classification is proposed, suggesting only two genera: *Bipalium* and *Humbertium*.

As Land planarians thrive best in high temperature and humidity, they are widely distributed in tropical and subtropical areas. They feed mostly on earthworms, slugs, and insect larvae and are cannibalistic. They are rarely fed by other animals as surface secretions appear distasteful (Esser, 1981) [8]. As the planarians have no hard parts to aid penetration of soil, it seems likely that they use existing interstices, including ant and termite tunnels and earthworm burrows (Winsor *et al*., 2004) [29]. *Bipalium adventitium* Hyman and *Bipalium kewense* Moseley have been found to feed upon earthworms and also feed upon gastropods and they are considered as a pest in Earthworm farms (Hymen, 1943; Ducey *et al*. 1999; Boag and Yeates, 2001; Zaborski, 2002) [2, 6, 31]. This indicates that they are enemies to earthworms and potential threats to local biodiversity. Awareness about them may lead to saving economic loss to earthworm farmers and protection of biodiversity to the local ecosystem. Species identification also plays very important role in biodiversity conservation.

Conclusion

In the present study, *Bipalium bundelensis* was showing striking features of Bright White Band at the rim of Semi-lunar Head, Brownish colour and no median groove at dorsal body as described by Bhakat (2020) [1] in *B. bengalensis*. It also differs from all the above-given species found in India. Some workers like Gadwe (2023), Shahbaz *et al* (2024) [21] also recorded Bipalium species from Vidharbh, Maharashtra and Patna, Bihar, respectively, but no biometric details were given to make any similarity with this species. All workers recorded the new species based on morphological features as they differ in all described species. So, following the same criteria, this new species has been named and described. Further investigation on histological, chromosomal, and molecular markers may be appropriate for their phylogenetic relationship and any ambiguity that may arise in the future.

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