



# First Record of the Hammer-Headed Worm (*Bipalium* spp) along with Checklist of Invertebrate Fauna from Patna, Bihar, India

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## Authors' contributions

This work was carried out in collaboration among all authors. All authors read and approved the final manuscript.

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## ABSTRACT

There are records of hammerhead flatworms from many parts of India, but no information from Bihar. The hammer-headed worm was first recorded in the campus of Patna Science College in August 2022. Hammer-headed worms (*Bipalium* spp.) are known for their unique appearance and behavior, which make them fascinating to researchers and nature enthusiasts alike. These worms have a distinct hammer-shaped head, which contains two eyes and sensory organs that help them detect prey. The authors noted that the spread of exotic land planarians in the region is likely due to human activities such as trade and transportation, and recommended further studies to assess their impact on native soil-dwelling invertebrates. This study emphasizes the importance of conducting regular surveys to document the biodiversity including the soil invertebrates.

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**Keywords:** Hammerhead flatworms; land planarians; *Bipalium* spp.; human activities; biodiversity.

## 1. INTRODUCTION

Hammer-headed worms belong to the family Geoplanidae of the phylum Platyhelminthes and are native to tropical and subtropical regions around the world [1]. They have also been accidentally introduced to several countries around the globe, where they are considered invasive [2,3]. Now, they are found everywhere [4]. Recently, there have been numerous reports of occurrence of the invasive predatory flatworms (Geoplanidae) across the world. New records of the hammerhead flatworms *Bipalium kewense* Moseley, 1878 and *Bipalium vagum* Jones & Sterrer, 2005 (Platyhelminthes, Geoplanidae, Bipaliinae) have been reported from several states in Mexico [2,5,6], Italy [7,8], Canada [9], Cuba [10], Barbados, Colombia, Costa-Rica, El Salvador, Indonesia, Madagascar, Malaysia, Mauritius, Mexico, Puerto Rico, Tahiti, Taiwan and Zimbabwe [2,11]. Brown et al. [12] reported the occurrence of *Bipalium vagum* as well as other exotic terrestrial flatworms from Jamaica. Gadwe [13] reported the occurrence of *Bipalium* spp in Eastern Vidarbha, Maharashtra, India. The authors noted that the spread of exotic land planarians in the region is likely due to human activities such as trade and transportation, and recommended further studies to assess their impact on native soil-dwelling invertebrates.

These worms are carnivorous and feed on other invertebrates such as snails, slugs, and earthworms [14,15]. Ducey et al. [15] tested and reported that while *Bipalium adventitium* preyed upon all the species of earthworms, it was preyed upon by only 2% of salamanders. Therefore, they constitute a threat to the native soil fauna wherever they are introduced [16].

Hammer-headed worms (*Bipalium* spp.) are known for their unique appearance and behavior, which make them fascinating to researchers and nature enthusiasts alike. These worms have a distinct hammer-shaped head, which contains two eyes and sensory organs that help them detect prey. Hammer-headed worms are also known for their ability to regenerate their bodies, which has made them a popular research subject in the field of regenerative medicine. A complete sequencing of mitogenome of *Bipalium kewense* has been done [17,18].

While there are records of hammerhead flatworms from many parts of India, there is no information on this from Bihar. The hammer-headed worm was first recorded in the campus of Patna Science College in August 2022.

## 2. METHODS

The study was conducted in Patna Science College, Patna, Bihar, India (25° 37' 4.44" N, 85° 10' 11.28" E) (Fig. 1). The survey was carried out during the monsoon season in the month of August 2022. The sampling method used was opportunistic, where the invertebrate fauna found in the college garden were recorded. The hammer-headed worms were identified using the morphological characters.

A list of invertebrate fauna found in the Patna Science College campus is presented in Table 1. Two hammer-headed worms were collected from the college garden during the survey. They were identified as *Bipalium* (spp.), based on their characteristic hammer-shaped head and two rows of eyes. Its body was long and slender, with a pointed tail region (Fig. 2). It was dark brown in color. It was noted to have slimy skin with thick mucus coating on the surface of the worm's body.

## 3. RESULTS AND DISCUSSION

The finding of this species in Bihar adds to the distribution record of this species in India. Further studies are required to understand the ecology, behavior, and distribution of *Bipalium* (spp.) in Bihar. Stokes et al (2014) have reported the presence of potent neurotoxin tetrodotoxin in flatworms of genus *Bipalium*, which is used to subdue their prey. They have also shown the presence of tetrodotoxin in egg capsules of worms. This may cause further threat to the soil ecology due to bioaccumulation. *Bipalium* is a potential threat to the soil fauna and the presence of this invasive land flatworm in different countries should be recorded [19]. This study emphasizes the importance of conducting regular surveys to document the biodiversity including the soil invertebrates. Fig. 3. shows some of the invertebrates found in the study area. Of these, the dark-bodied glass snail is also possibly reported from this area for the first time.

Table 1. Invertebrate fauna of Patna Science College Campus

| S. No.                 | Common Name                | Scientific Name                |
|------------------------|----------------------------|--------------------------------|
| <b>Platyhelminthes</b> |                            |                                |
| 1                      | Hammer-headed worm         | <i>Bipalium</i> spp            |
| <b>Annelida</b>        |                            |                                |
| 2                      | Earthworm                  | <i>Metaphire posthuma</i>      |
| <b>Odonata</b>         |                            |                                |
| 3                      | Slender skimmer            | <i>Orthetrum sabina</i>        |
| 4                      | Scarlet skimmer            | <i>Crocothemis servilia</i>    |
| 5                      | Wandering glider           | <i>Pantala flavescens</i>      |
| 6                      | Chalky percher             | <i>Diplacodes trivialis</i>    |
| 7                      | Common picturewing         | <i>Rhyothemis variegata</i>    |
| 8                      | Coral-tailed cloudwing     | <i>Thollymis tillarga</i>      |
| 9                      | Emerald cascader           | <i>Zygonyx iris</i>            |
| 10                     | Common bluetail            | <i>Ishchnura senegalensis</i>  |
| 11                     | Wandering midget           | <i>Agriocnemis pygmaea</i>     |
| 12                     | Marsh dancer               | <i>Onychargia atrocyana</i>    |
| <b>Orthoptera</b>      |                            |                                |
| 13                     | Ground-hopper              | <i>Euparatettix</i>            |
| 14                     | Grasshopper                | <i>Caelifera</i> (suborder)    |
| <b>Hemiptera</b>       |                            |                                |
| 15                     | Jewel bug                  | <i>Chrysocoris stollii</i>     |
| <b>Coleoptera</b>      |                            |                                |
| 16                     | Firefly                    | <i>Lampyridae</i> (family)     |
| 17                     | Lady beetle                | <i>Coccinellidae</i> (family)  |
| 18                     | Pumpkin beetle             | <i>Aulacophora indica</i>      |
| 19                     | Six-spotted zigzag ladybug | <i>Cheilomenes sexmaculata</i> |
| <b>Hymenoptera</b>     |                            |                                |
| 20                     | Red ant                    | <i>Myrmica</i> spp.            |
| 21                     | Black ant                  | <i>Formica</i> spp.            |
| 22                     | Carpenter ant              | <i>Camponotus</i> spp.         |
| 23                     | Common colletes            | <i>Colletes</i> spp            |
| 24                     | Paper wasps                | <i>Polistes</i> spp.           |
| 25                     | Giant honey bee            | <i>Apis dorsata</i>            |
| 26                     | Yellow paper wasp          | <i>Polistes versicolor</i>     |
| 27                     | Black slip wasp            | <i>Pimpla rufipes</i>          |
| <b>Lepidoptera</b>     |                            |                                |
| 28                     | Common mormon              | <i>Papilio polytes</i>         |
| 29                     | Mottled emigrant           | <i>Catopsilia pyranthe</i>     |
| 30                     | Indian silverline          | <i>Cigaritis vulcanus</i>      |
| 31                     | Indian skipper             | <i>Caltoris cormasa</i>        |
| 32                     | Grizzled skipper           | <i>Pyrgus malvae</i>           |
| 33                     | Common wanderer            | <i>Pareronia valeria</i>       |
| 34                     | Common jay                 | <i>Graphium doson</i>          |
| 35                     | Blue bottle                | <i>Graphium sarpedon</i>       |
| 36                     | Blue mormon                | <i>Papilio polymnestor</i>     |
| 37                     | Lime butterfly             | <i>Papilio demoleus</i>        |
| 38                     | Grey pansy                 | <i>Junonia atlites</i>         |
| 39                     | Peacock pansy              | <i>Junonia almana</i>          |
| 40                     | Common evening brown       | <i>Melanitis leda</i>          |
| 41                     | Psyche butterfly           | <i>Leptosia nina</i>           |

| <b>S. No.</b>    | <b>Common Name</b>         | <b>Scientific Name</b>          |
|------------------|----------------------------|---------------------------------|
| 42               | Lesser grass blue          | <i>Zizina otis</i>              |
| 43               | Gram blue                  | <i>Euchrysops cnejus</i>        |
| 44               | Zebra blue                 | <i>Leptotes plinius</i>         |
| 45               | Striped tiger              | <i>Danaus genutia</i>           |
| 46               | Plain tiger                | <i>Danaus chrysippus</i>        |
| 47               | Indian palm fly            | <i>Elymnias hypermnestra</i>    |
| 48               | Blue tiger                 | <i>Tirumala limniace</i>        |
| 49               | Banded peacock             | <i>Papilio crino</i>            |
| 50               | Plain cupid                | <i>Chilades pandava</i>         |
| 51               | Common crow                | <i>Euploea core</i>             |
| 52               | Common rose                | <i>Pachliopta aristolochiae</i> |
| 53               | Jezebel                    | <i>Delias eucharis</i>          |
| 54               | Tawny coster               | <i>Acraea terpsichore</i>       |
| 55               | Common sailor              | <i>Neptis hylas</i>             |
| 56               | Danaid eggfly              | <i>Hypolimnas misippus</i>      |
| 57               | Great eggfly               | <i>Hypolimnas bolina</i>        |
| 58               | Cabbage white              | <i>Pieris rapae</i>             |
| 59               | Pioneer white              | <i>Belenois aurota</i>          |
| 60               | Common pierrot             | <i>Castalius rosimon</i>        |
| 61               | Common castor              | <i>Ariadne merione</i>          |
| 62               | Angled castor              | <i>Ariadne ariadne</i>          |
| 63               | Eyed brown                 | <i>Lethe rohria</i>             |
| 64               | Common baron               | <i>Euthalia aconthea</i>        |
| 65               | Common four ring           | <i>Ypthima huebneri</i>         |
| 66               | Blue pansy                 | <i>Junonia orithya</i>          |
| 67               | Monkey-puzzled butterfly   | <i>Rathinda amor</i>            |
| 68               | Gaudy baron                | <i>Euthalia lubentina</i>       |
| 69               | Pea blue                   | <i>Lampides boeticus</i>        |
| 70               | Rice leaf-roller           | <i>Cnaphalocrocis medinalis</i> |
| 71               | Yellow-tail moth           | <i>Euproctis similis</i>        |
| 72               | Handmaiden moth            | <i>Datana integerrima</i>       |
| 73               | Owl moth                   | <i>Thysania zenobia</i>         |
| 74               | Hummingbird hawk moth      | <i>Macroglossum stellatarum</i> |
| <b>Diptera</b>   |                            |                                 |
| 75               | Oriental latrine fly       | <i>Chrysomya megacephala</i>    |
| 76               | House fly                  | <i>Musca domestica</i>          |
| 77               | Hover fly                  | <i>Syrphidae (family)</i>       |
| 78               | Green Soldier fly          | <i>Chloromyia formosa</i>       |
| 79               | Black Soldier fly          | <i>Hermetia illucens</i>        |
| <b>Myriapoda</b> |                            |                                 |
| 80               | Soil centipede             | <i>Geophilomorpha (order)</i>   |
| 81               | Millipede                  | <i>Diplopoda (class)</i>        |
| 82               | Centipede                  | <i>Chilopoda (class)</i>        |
| <b>Arachnida</b> |                            |                                 |
| 83               | Two-tailed spider          | <i>Hersilia bifurcata</i>       |
| 84               | Lynx spider                | <i>Oxyopes spp.</i>             |
| 85               | Long-jawed orbweaver       | <i>Tetragnatha spp.</i>         |
| 86               | Ground mouse spider        | <i>Scotophaeus blackwalli</i>   |
| 87               | Two-striped telamonia      | <i>Telamonia dimidiata</i>      |
| 88               | Signature spider           | <i>Argiope anasuja</i>          |
| 89               | Pantropical jumping spider | <i>Plexippus paykulli</i>       |

| S. No.          | Common Name              | Scientific Name              |
|-----------------|--------------------------|------------------------------|
| 90              | Daddy longlegs           | <i>Pholcus phalangioides</i> |
| 91              | Giant huntsman spider    | <i>Heteropoda maxima</i>     |
| 92              | Adanson's house jumper   | <i>Hasarius adansoni</i>     |
| 93              | Indian red scorpion      | <i>Hottentotta tamulus</i>   |
| <b>Mollusca</b> |                          |                              |
| 94              | Giant African snail      | <i>Achatina achatina</i>     |
| 95              | Dark -bodied glass snail | <i>Oxychilus draparnaudi</i> |

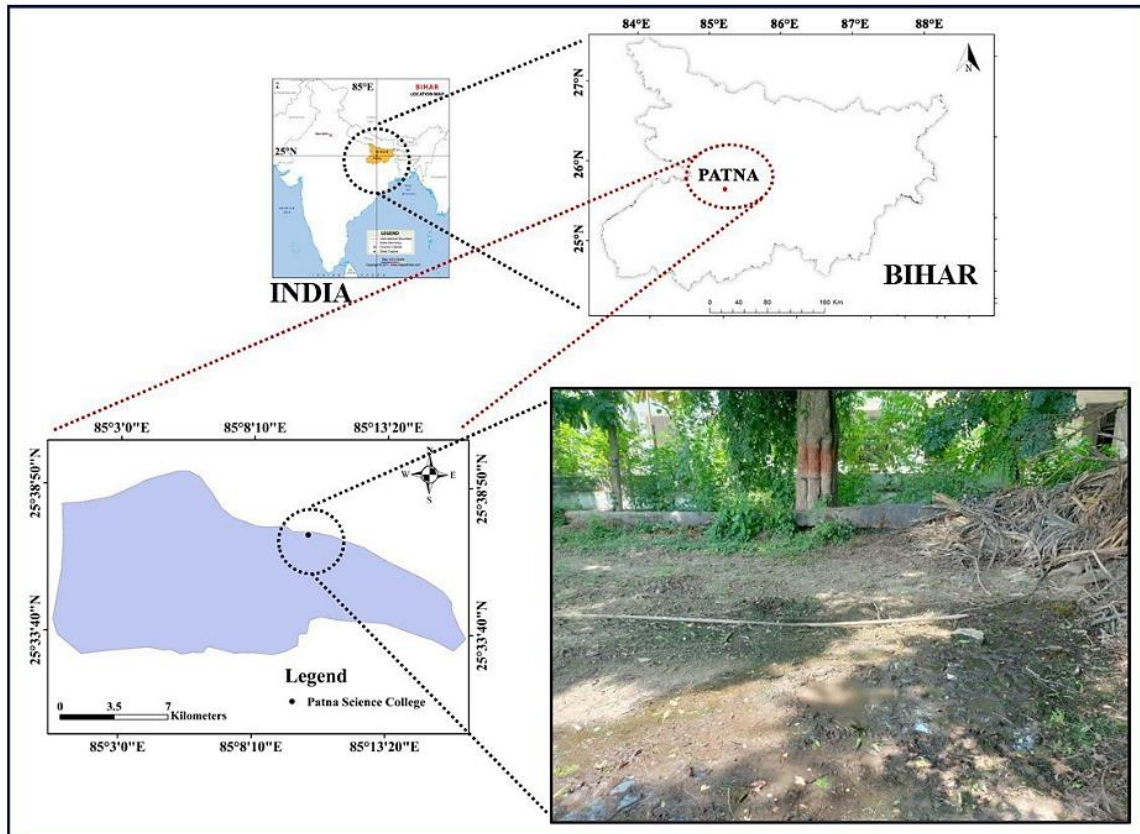


Fig. 1. Map of study area

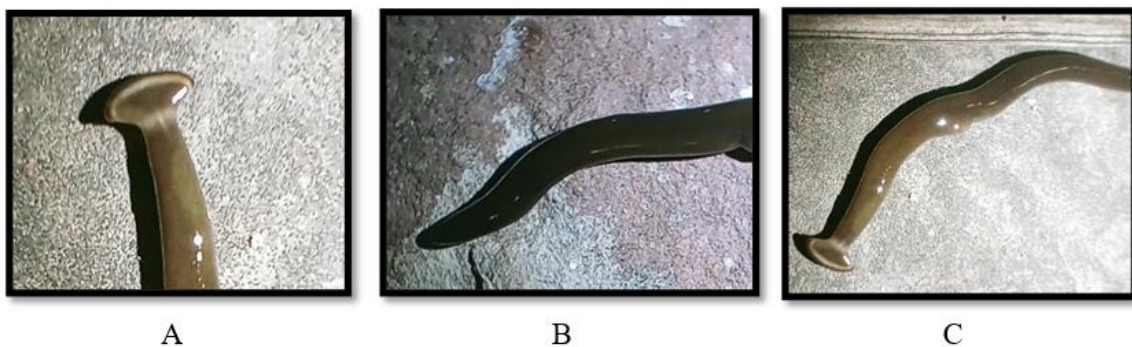
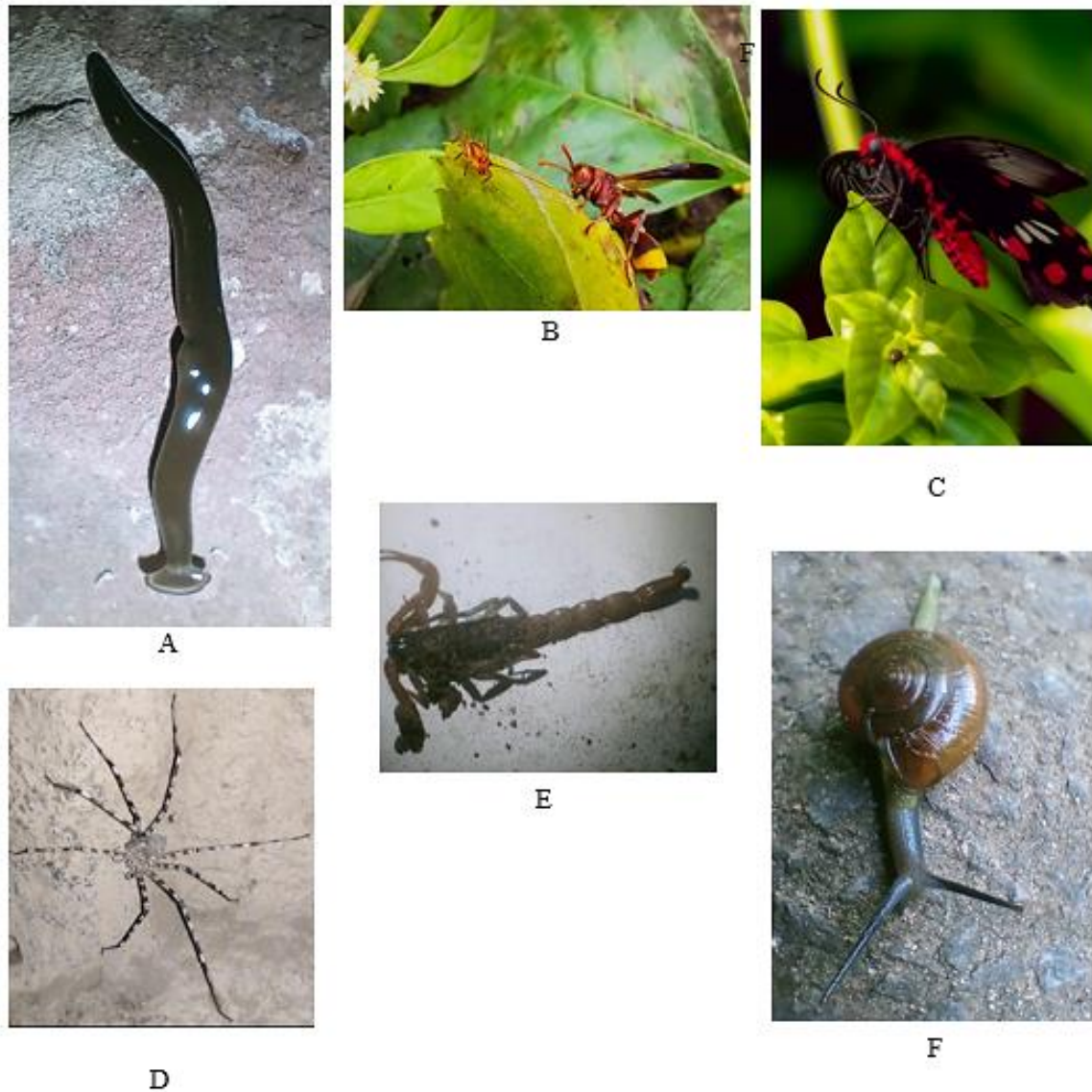


Fig. 2. Morphological details of the specimen of *Bipalium* spp. obtained from Patna

- A. Showing hammer head of the worm
- B. Showing pointed tail
- C. Showing the thick slime film on worm's body





**Fig. 3. Some invertebrates found in the study area**

- A — Hammer-headed worm, *Bipalium* spp  
B — Paper wasp, *Polistes* spp  
C — Common rose, *Pachliopta aristolochiae*  
D — Giant huntsman spider, *Heteropoda maxima*  
E — Indian red scorpion, *Hottentotta tamulus*  
F — Dark-bodied glass snail, *Oxychilus draparnaudi*

#### 4. CONCLUSION

The observation of Hammer-headed flatworm (*Bipalium* spp.) in the campus of Patna Science College marks the first recorded presence of this species in Bihar, highlighting the importance of documenting and understanding the local biodiversity. With their unique morphology and behaviour, hammer-headed flatworms represent both a fascinating subject for scientific inquiry and a potential ecological concern. Therefore,

ongoing surveys and research are crucial for monitoring the distribution and impact of these exotic planarians. Such efforts will contribute to better conservation strategies and the maintenance of ecological balance in the region.

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## COMPETING INTERESTS

Authors have declared that no competing interests exist.

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