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## **ANIMAL REMAINS EXCAVATED FROM NAGDA ARCHAEOLOGICAL SITE (MADHYA PRADESH) AND THEIR RELEVANCE TO THE CHALCOLITHIC CIVILIZATION OF THE PLACE**

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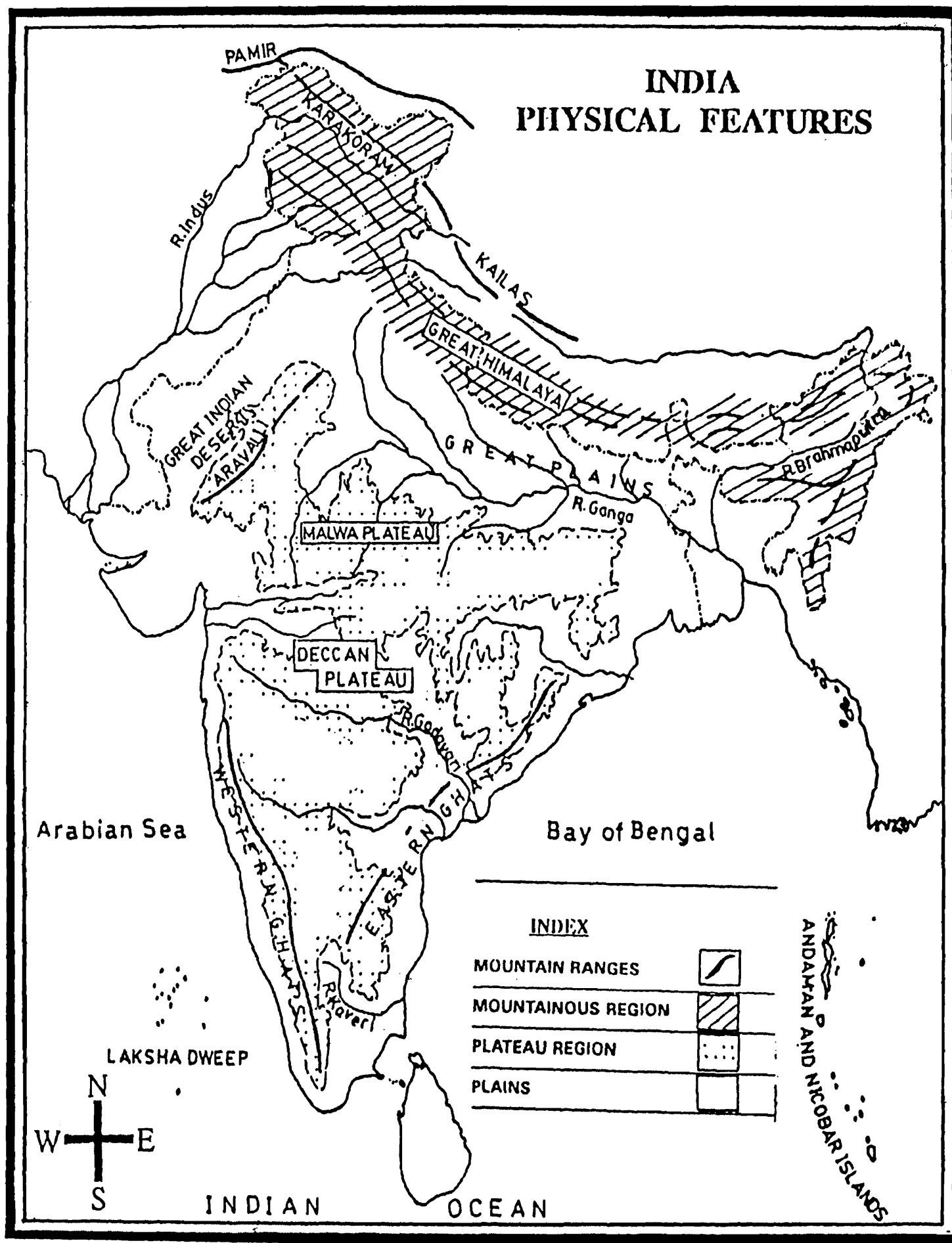
### **INTRODUCTION**

The various excavations carried out in central, western and south India for developing an understanding of the prehistoric civilization have revealed the nature of the Chalcolithic civilization that existed in past on the Indian soil. This culture had evolved almost at a time when Indus civilization in Harappa and Mohenjodaro was disappearing. This culture had a wide expanse from Jammu to Daimabad in Maharastra and from Sutkagendor in the west to Alamgirpur in the Ganga plains. On the basis of cultural objects and related items the Chalcolithic cultures of India were divided into five regional groups, viz., (I) South western Rajasthan, (II) Malwa region, fed by the rivers Chambal and Narmada and under which comes Nagda, (III) Northern Deccan, (IV) Southern India, and (V) Eastern India.

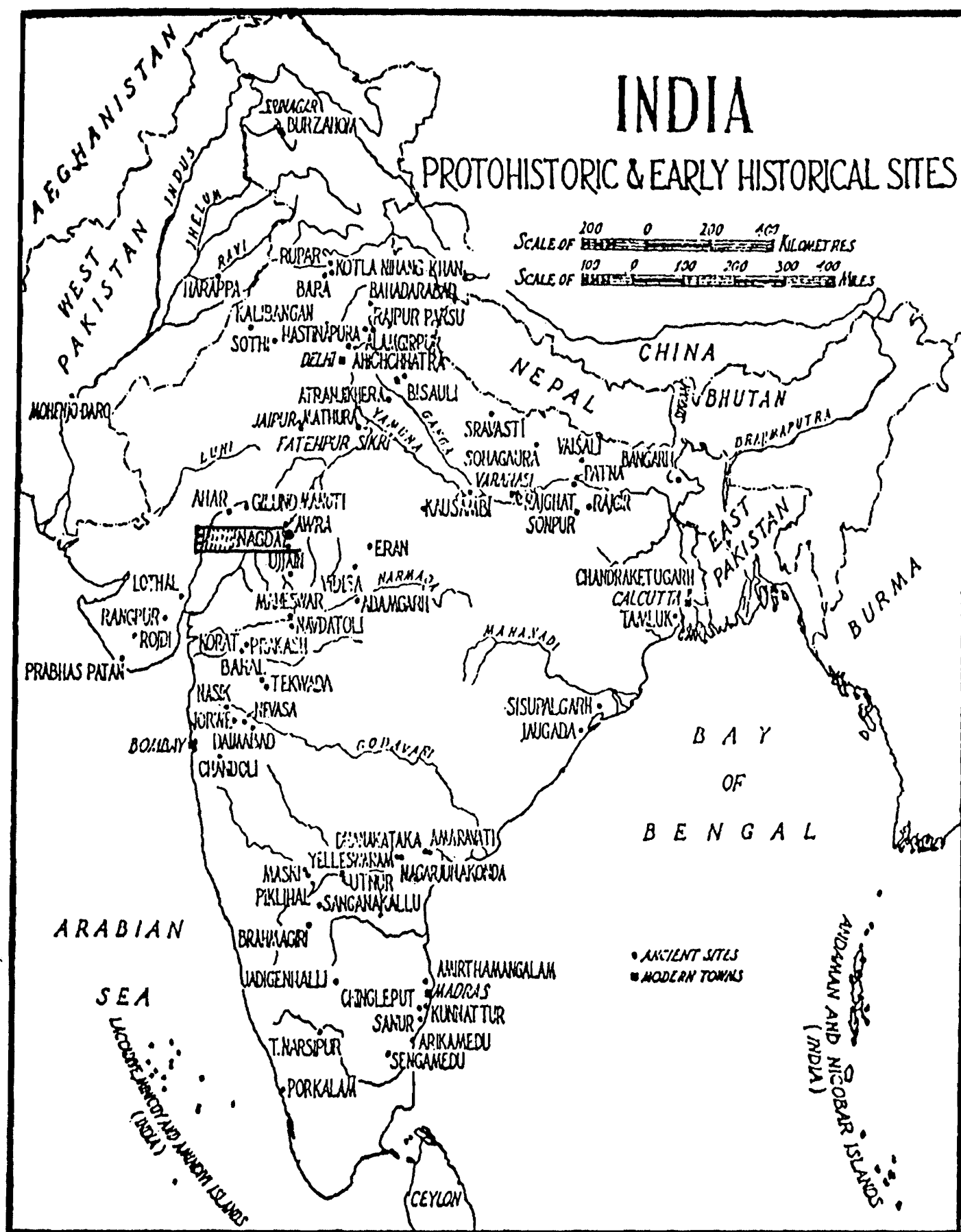
The excavations at Nagda were carried out by the Archaeological survey of India during 1955–1957. It is revealed from various objects recovered during the excavations that the post Harappan Chalcolithic people of Nagda were mainly agrarian and they also had trade practices on various items including ivory and shells. They lived in houses built mainly by mud or mud-bricks.

### **LOCATION**

The ancient cultural site at Nagda is situated at about 1.6 km. north-west of Nagda Railway station on the Western Railway, in the District of Ujjain, Madhya Pradesh (see Maps 1 and 2). The site of the culture covers an area of 0.8 sq. km. and is broadly divided into two mounds. The Village, Juna Nagda is located over the mound on northern side and which could not be excavated for archaeological purposes. The mounds rise conspicuously above the surrounding plains to a



Map 1. : Physical features of India shows the position of Malwa Region in which Chalcolithic site of Nagda is located.



**Map 2. : Location of Nagda Archaeological site [shaded block] among the Protohistoric sites of India.**

height of about 27.9 metres above the bed of river Chambal that flows north-south through the western side of the mounds. The site was first noticed in 1945, and occurrence of microliths, potteries etc. around the site indicated potentiality of the place from the archaeological viewpoint. Later on, more than twenty such sites were identified in the Chambal valley and exploration of these sites revealed that Malwa region in ancient days was an important area of settlement by the Chalcolithic people (Banerjee, 1986).

### **HISTORY OF EXCAVATIONS AND TERMINOLOGY OF SITES**

The excavations at Nagda was carried out (by the Archaeological survey of India) mainly for tracing the characteristics of the Chalcolithic culture of that site, and to trace its stratigraphic link with other known cultural sites of India. For this purpose one main trench, NGD-1, and three subsidiary trenches called respectively, NGD-2, NGD-3 and NGD-4 were laid by the Archaeological Survey of India. The main trench was excavated in 1955–1956, and the others in 1956–1957. Many animal remains along with the objects of archaeological importance were recovered from the excavations. These animal remains were sent to the Zoological Survey of India (ZSI) for examination. Earlier, Nath (1966) worked out skeletal parts of some animals obtained during the excavations. A systematic inventory of the available animal remains preserved in the ZSI, are documented here and their relevance in the ancient culture are discussed for the first time in the present account.

### **AGE OF THE CIVILIZATION**

The Carbon-14 study of various material at the Chalcolithic sites, Navdatoli near Nagda indicated a date range of 1631–1375 BC, and the beginning of the culture on the basis of available material was estimated by Sankalia (1963) to be about 1800 BC. It is thought that the culture at Nagda began little earlier than that of Navdatoli (Banerjee, 1986). The pale red ware, a ceramic painted variously in black and a black-and-red characterize the culture. The Chalcolithic culture of Nagda had three different phases *viz.*, period-I, period-II and period-III. Period-I is represented by 16 ft. (6.24 m.) of strata containing an average 23 layers; Period-II is represented by 7.5 ft. (2.92 m.) of strata containing an average 9 layers; and Period-III is represented by 8.5 ft. (3.315 m.) of strata. The above periods are dated, (i) 1500–800 BC, (ii) 750–500 BC and (iii) 500–200 BC respectively based on cultural objects and depths of deposition, by Banerjee (1986).

### **ANIMAL REMAINS RECOVERED FROM NAGDA ARCHAEOLOGICAL SITE**

The animal remains of Nagda archaeological site are worked out and the result of it is presented in Table 1.

**Table 1.** : Systematic analysis of animal remains recovered from Nagda archaeological site.**Cutting-NGD-1****Period-I**

| <b>Name of species</b>             | <b>No. of material</b> | <b>Identity of material</b>                                                                          | <b>Locus(L)/ Stratum(S)</b> | <b>Condition of material</b> |
|------------------------------------|------------------------|------------------------------------------------------------------------------------------------------|-----------------------------|------------------------------|
| <i>Sus scrofa cristatus</i> Wagner | 1                      | Fragment of right incisor tooth                                                                      | L-XXXIV-XXXV<br>S-18        | Broken                       |
| <i>Bos indicus</i> Linn.           | 1                      | Distal fragment of right tibia                                                                       | L-XLI-XLIV<br>S-25          | Broken                       |
|                                    | 1                      | Right upper 3 <sup>rd</sup> premolar tooth                                                           | "                           | "                            |
|                                    | 1                      | Fragment of distal end of right tibia                                                                | "                           | "                            |
|                                    | 1                      | Fragment of left scapula with a portion of acetabula                                                 | "                           | "                            |
|                                    | 1                      | Fragment of vertebra(7 <sup>th</sup> ) with anterior articular process and a portion of neural notch | "                           | "                            |
|                                    | 1                      | Fragment of (proximal) piece of 3 <sup>rd</sup> and 4 <sup>th</sup> metatarsal                       | "                           | "                            |
|                                    | 1                      | Fragment of left distal external of humerus with condyle                                             | L-XXXIX-XLI<br>S-21         | "                            |
|                                    | 1                      | Right portion of scapula with glenoid cavity                                                         | "                           | "                            |
|                                    | 1                      | Distal fragment of shaft of metatarsal without distal epiphysis                                      | "                           | Broken subadult              |
| <i>Bos indicus</i> Linn.           | 1                      | Proximal fragment of shaft of metacarpal                                                             | "                           | Much eroded                  |
|                                    | 1                      | Fragment of shaft of a humerus                                                                       | L-XXV-XXVII<br>S-28         | Broken                       |
|                                    | 1                      | Distal fragment of left tibia with a portion of distal extremity                                     | "                           | Broken                       |
|                                    | 1                      | Proximal fragment piece of humerus with deltoid                                                      | L-XX-XXIII<br>S-17X         | Broken                       |
|                                    | 1                      | Right upper 2 <sup>nd</sup> molar tooth                                                              | L-XXV-XXVI<br>S-27          | Subadult                     |
|                                    | 1                      | Distal end fragment of right humerus                                                                 | L-XXXIX-XLI<br>S-22         | Broken                       |
|                                    | 1                      | Left calcaneum                                                                                       | "                           | Complete                     |
|                                    | 1                      | Fragment of head of right humerus                                                                    | L-XXXIX-XLI<br>S-14         | Broken                       |

| Name of species                    | No. of material | Identity of material                                                                               | Locus(L)/ Stratum(S)   | Condition of material |
|------------------------------------|-----------------|----------------------------------------------------------------------------------------------------|------------------------|-----------------------|
| <i>Bos indicus</i> Linn.           | 2               | Fragment of the shaft of femur                                                                     | "                      | Broken                |
|                                    | 1               | Fragment of piece of ilium of the pelvis                                                           | "                      | Broken                |
|                                    | 1               | Right upper 3 <sup>rd</sup> premolar tooth                                                         | "                      | Complete              |
|                                    | 1               | Fragment of right pelvis with a portion of acetabulum and a portion of the shaft of ilium          | L-XXX-XXIX<br>S-16     | Broken                |
|                                    | 1               | Fragment of the left vertical ramus of the mandible with condyle                                   | "                      | Broken                |
|                                    | 1               | Fragment of shaft of femur                                                                         | "                      | Broken                |
|                                    | 1               | Fragment of tubercalcis of right calcaneum                                                         | L-XLII-XLIV<br>S-19    | Broken                |
|                                    | 1               | Fragment of spinous process of thoracic vertebra                                                   | "                      | Broken                |
|                                    | 1               | Fragment of left lower 3 <sup>rd</sup> molar tooth                                                 | "                      | Broken                |
|                                    | 1               | Distal fragment of the 3 <sup>rd</sup> and 4 <sup>th</sup> metacarpal                              | "                      | Broken                |
|                                    | 1               | Fragment of horizontal ramus of the mandible with 2 <sup>nd</sup> molar                            | L-XXVIII-XXXI<br>S-18N | Subadult              |
|                                    | 1               | Fragment of left calcaneum with tubercalcis and sustentaculum tali without distal facet for cuboid | "                      | Broken                |
|                                    | 1               | Fragment of the shaft of tibia                                                                     | L-XIX-XXI<br>S-15      | Broken                |
|                                    | 1               | One horn core                                                                                      | "                      | Adult                 |
|                                    | 2               | Fragment of ribs                                                                                   | S-7                    | Broken                |
| <i>Capra hircus aegagrus</i> Erxl. | 1               | Fragment of distal end of humerus with a portion of medial condyle                                 | L-XLI-XLIV<br>S-23     | Broken                |
| <i>Ovis vignei</i> Blyth           | 1               | Left horn core                                                                                     | L-?<br>S-?             | Adult                 |

**Cutting-NGD-1****Period-II**

| Name of species                    | No. of material | Identity of material                                                                  | Locus(L)/ Stratum(S) | Condition of material   |
|------------------------------------|-----------------|---------------------------------------------------------------------------------------|----------------------|-------------------------|
| <i>Pareysia favidens</i> (Benson)  | 1               | One right valve slightly broken                                                       | L-?<br>S-?           | 21 mm. breadth          |
| <i>Lamellidens</i> sp.             | 1               | Piece of valve                                                                        | L-?<br>S-?           | Broken                  |
| <i>Trionyx gangeticus</i> (Cuvier) | 1               | Fragment of epiplastron                                                               | L-NGD-1-36<br>S-11   | Broken                  |
| <i>Felis</i> sp. Linn.             | 2               | Right humerus                                                                         | L-NGD-1-40<br>S-?    | Broken pieces, complete |
| <i>Sus scrofa cristatus</i> Wagner | 1               | Proximal fragment of left scapula with glenoid cavity and tuberscapula, without blade | L-?<br>S-14          | Complete bone           |
| <i>Bos indicus</i> Linn.           | 1               | Left astragalus                                                                       | L-NGD-1-19           | Complete                |
|                                    | 1               | Fragment of distal end of right femur with medial condyle                             | "                    | Broken                  |
|                                    | 1               | Left first phalanx of the fore foot                                                   | "                    | Complete bone           |
|                                    | 1               | Body of thoracic vertebra                                                             | "                    | Broken                  |
|                                    |                 | Proximal end of left scapula with glenoid cavity                                      | "                    | Broken                  |
|                                    | 1               | Superior body of right horizontal ramus of mandible                                   | "                    | Partial bone            |
|                                    | 1               | Fragment of right horizontal ramus without teeth                                      | "                    | Broken                  |
|                                    | 3               | Fragment of ribs                                                                      | "                    | Broken                  |
|                                    | 1               | Left lower 3 <sup>rd</sup> molar tooth                                                | "                    | Complete                |
|                                    | 1               | Proximal fragment of right 3 <sup>rd</sup> and 4 <sup>th</sup> metatarsal             | "                    | Broken                  |
|                                    | 1               | Fragment of ischium of left pelvis                                                    | "                    | Broken                  |
|                                    | 1               | Fragment of shaft of ilium of left pelvis                                             | "                    | Broken                  |
|                                    | 1               | Distal fragment of right humerus with medial and lateral condyle                      | L-?<br>S-14          | Broken                  |
|                                    | 1               | Left 3 <sup>rd</sup> and 4 <sup>th</sup> metatarsal without distal portion            | "                    | Broken                  |

| Name of species          | No. of material | Identity of material                                                          | Locus(L)/ Stratum(S) | Condition of material |
|--------------------------|-----------------|-------------------------------------------------------------------------------|----------------------|-----------------------|
| <i>Bos indicus</i> Linn. | 1               | Right calcaneum with tubercalcis and a portion of sustentaculum tali          | "                    | Broken                |
|                          | 1               | Proximal fragment of left radius with a portion of distal medial end          | "                    | Broken                |
|                          | 1               | Fragment of shaft of right tibia                                              | "                    | Broken                |
|                          | 1               | Proximal fragment of left 3 <sup>rd</sup> and 4 <sup>th</sup> metatarsal      | "                    | Broken                |
|                          | 1               | Proximal fragment of shaft of right femur                                     | "                    | Broken, subadult      |
|                          | 1               | Distal fragment of the 3 <sup>rd</sup> and 4 <sup>th</sup> metacarpal         | "                    | Broken                |
|                          | 1               | Fragment of left calcaneum with a portion of tubercalcis                      | "                    | Broken                |
|                          | 1               | Proximal fragment of left scapula with glenoid cavity and a portion of neck   | "                    | Broken                |
|                          | 2               | Scapho-cuboid bone of proximal right tarsal                                   | "                    | Complete, Subadult    |
|                          | 1               | Right proximal fragment of ulna without olecranon process and semilunar notch | "                    | Broken                |
|                          | 1               | Left proximal fragment of ulna without olecranon process and semilunar notch  | "                    | Broken                |
|                          | 1               | Left upper 1 <sup>st</sup> molar tooth                                        | "                    | Complete              |
|                          | 1               | Proximal fragment of scapula with glenoid cavity                              | "                    | Broken                |
|                          | 1               | Fragment of right calcaneum without tubercalsis and sustentaculum tali        | "                    | Broken                |
|                          | 1               | Half of fragment of 3 <sup>rd</sup> and 4 <sup>th</sup> metatarsal            | "                    | Broken                |
|                          | 3               | Fragment of left pelvis with a portion of acetabulum and ischium              | "                    | Broken                |

| Name of species          | No. of material | Identity of material                                                                                       | Locus(L)/ Stratum(S) | Condition of material |
|--------------------------|-----------------|------------------------------------------------------------------------------------------------------------|----------------------|-----------------------|
| <i>Bos indicus</i> Linn. | 2               | Fragment of left pelvis with a portion of shaft of ilium and a portion of acetabulum                       | "                    | Broken                |
|                          | 1               | Proximal end of scapula with glenoid cavity                                                                | L-XXV-XXVI<br>S-9    | Broken                |
|                          | 1               | Proximal fragmentary piece of 3 <sup>rd</sup> and 4 <sup>th</sup> metacarpal                               | "                    | Broken                |
|                          | 1               | Distal fragment of left humerus with a portion of medial condyle                                           | L-XXX-XXXI<br>S-10   | Broken                |
|                          | 1               | Left calcaneum with tip of the tubercalcis                                                                 | "                    | Complete              |
|                          | 2               | Right calcaneum without the distal face for cuboid and tip of tubercalcis                                  | "                    | Broken                |
|                          | 1               | Left 3 <sup>rd</sup> phalanx of hind foot                                                                  | "                    | Complete              |
|                          | 1               | A fragment of first phalanx without proximal portion                                                       | "                    | Broken                |
|                          | 1               | A fragmentary piece of proximal end of first phalanx                                                       | "                    | Broken                |
|                          | 1               | Proximal fragment of left ulna with semilunar notch and without olecranon process                          | "                    | Broken                |
|                          | 1               | Fragment of left horizontal ramus of mandible with broken first molar tooth                                | "                    | Broken                |
|                          | 1               | Anterior end of body of first sacral vertebra                                                              | "                    | Broken                |
|                          | 1               | Fragment of cervical vertebra with neural arch and anterior and posterior articular process, without spine | "                    | Charred               |
|                          | 1               | Fragment of a rib                                                                                          | "                    | Broken                |
|                          | 1               | Fragment of a shaft of tibia                                                                               | "                    | Broken                |
|                          | 3               | Fragments of the second phalanx                                                                            | "                    | Broken                |
|                          | 1               | Fragment of temporal bone of skull with external opening of temporal canal                                 | "                    | Broken                |

| Name of species          | No. of material | Identity of material                                                                        | Locus(L)/ Stratum(S) | Condition of material |
|--------------------------|-----------------|---------------------------------------------------------------------------------------------|----------------------|-----------------------|
| <i>Bos indicus</i> Linn. | 1               | Left calcaneum                                                                              | L-XXVII-XXX S-10     | Complete              |
|                          | 3               | Distal fragments of left humerus with medial condyle                                        | "                    | Broken                |
|                          | 2               | Proximal fragments of right 3 <sup>rd</sup> and 4 <sup>th</sup> metacarpal                  | "                    | Broken                |
|                          | 3               | Proximal fragments of left 3 <sup>rd</sup> and 4 <sup>th</sup> metacarpal                   | "                    | Broken                |
|                          | 3               | Proximal fragments of right 3 <sup>rd</sup> and 4 <sup>th</sup> metatarsal                  | "                    | Broken                |
|                          | 1               | 3 <sup>rd</sup> phalanx of hind foot                                                        | "                    | Complete              |
|                          | 1               | Fragment of tubercalcis of calcaneum                                                        | "                    | Broken                |
|                          | 1               | Distal fragment of left scapula with glenoid cavity and tubercalcis                         | "                    | Broken                |
|                          | 1               | Fragment of right pelvis with a portion of acetabulum and a shaft of ilium                  | "                    | Broken                |
|                          | 1               | Proximal fragment of 3 <sup>rd</sup> and 4 <sup>th</sup> metacarpal                         | "                    | Broken                |
|                          | 1               | Fragment of anterior portion of the left ramus of jaw                                       | "                    | Broken                |
|                          | 1               | Spine process with a piece of neural arch of thoracic vertebra                              | "                    | Partial bone          |
|                          | 1               | Fragment of axis vertebra with a portion of anterior articular surface and odontoid process | "                    | Broken                |
|                          | 1               | Proximal fragment of first phalanx of fore foot                                             | "                    | Broken                |
|                          | 2               | Phalanx of right foot                                                                       | "                    | Complete              |
|                          | 1               | Right 2 <sup>nd</sup> incisor tooth                                                         | "                    | Charred               |
|                          | 1               | Fragment of distal facet for cuboid of the calcaneum                                        | "                    | Broken                |
|                          | 1               | Fragment of the shaft of 3 <sup>rd</sup> and 4 <sup>th</sup> metatarsal                     | L-XXV-XXVI S-10B     | Broken                |

| Name of species          | No. of material | Identity of material                                                                                       | Locus(L)/ Stratum(S) | Condition of material |
|--------------------------|-----------------|------------------------------------------------------------------------------------------------------------|----------------------|-----------------------|
| <i>Bos indicus</i> Linn. | 1               | Fragment of the right calcaneum with sustentacular and a peroneal facet and without distal facet of cuboid | L-XXIII-XXV S-11N    | Broken, Subadult      |
|                          | 1               | Left astragalus                                                                                            | "                    | Complete              |
|                          | 1               | Fragment of the left pelvis with a portion of acetabulum and ischium                                       | "                    | Broken                |
|                          | 1               | Fragment of sternum of a sternal vertebrae                                                                 | "                    | Broken                |
|                          | 1               | Fragment of a molar tooth                                                                                  | "                    | Broken                |
|                          | 1               | Left astragalus                                                                                            | L-NGD-1-19 S-?       | Complete              |
|                          | 1               | Fragment of a distal end of right femur with medial condyle                                                | "                    | Broken                |
|                          | 1               | Left first phalanx of fore foot                                                                            | "                    | Complete              |
|                          | 1               | Thoracic vertebra                                                                                          | "                    | Complete              |
|                          | 1               | Proximal end of left scapula with glenoid cavity                                                           | "                    | Broken                |
|                          | 1               | Superior body of right horizontal ramus of mandible                                                        | "                    | Part bone             |
|                          | 1               | Fragment of a right horizontal ramus without teeth                                                         | "                    | Broken                |
|                          | 3               | Fragments of ribs                                                                                          | "                    | Broken                |
|                          | 1               | Left lower 3 <sup>rd</sup> molar tooth                                                                     | "                    | Complete              |
|                          | 1               | Proximal fragment of a right 3 <sup>rd</sup> and 4 <sup>th</sup> metatarsal                                | "                    | Broken                |
|                          | 1               | Fragment of ischium of left pelvis                                                                         | "                    | Broken                |
|                          | 1               | Fragment of the shaft of ilium                                                                             | "                    | Broken                |
|                          | 1               | Distal fragment of right humerus with neural and lateral condyle                                           | L-NGD-1-40           | With cutmark          |
|                          | 1               | Distal fragment of right humerus                                                                           | "                    | Sharp cutmark         |
|                          | 1               | Right astragalus                                                                                           | "                    | Subadult              |
|                          | 1               | Right astragalus                                                                                           | "                    | Adult                 |

| Name of species                    | No. of material | Identity of material                                                                                                              | Locus(L)/ Stratum(S) | Condition of material |
|------------------------------------|-----------------|-----------------------------------------------------------------------------------------------------------------------------------|----------------------|-----------------------|
| <i>Bos indicus</i> Linn.           | 1               | Proximal fragment of shaft of radius                                                                                              | "                    | Broken                |
|                                    | 1               | Fragment of left calcaneum with tubercalcis                                                                                       | "                    | Broken                |
|                                    | 2               | Left 1 <sup>st</sup> phalanx                                                                                                      | "                    | Subadult              |
|                                    | 1               | Proximal fragment of right ulna with olecranon process and semilunar notch                                                        | "                    | Broken                |
|                                    | 6               | Fragments of ribs                                                                                                                 | "                    | Broken                |
|                                    | 2               | Fragments ramus of mandible                                                                                                       | "                    | Broken                |
|                                    | 3               | Left lower molar teeth                                                                                                            | "                    | Complete              |
|                                    | 1               | Proximal fragment of right scapula with glenoid cavity                                                                            | "                    | Broken                |
|                                    | 1               | Fragment of ilium of right pelvis                                                                                                 | "                    | Broken                |
|                                    | 1               | Fragment of left calcaneum                                                                                                        | "                    | Broken                |
| <i>Bubalus bubalis</i> Linn.       | 1               | Distal fragment of right tibia                                                                                                    | L-NGD-1-20 S-14      | Broken                |
|                                    | 1               | Right 3 <sup>rd</sup> phalanx of the fore foot                                                                                    | "                    | Complete              |
|                                    | 1               | Fragment of a blade of left scapula                                                                                               | "                    | Broken                |
|                                    | 1               | Fragment of right vertical ramus of mandible with condyle                                                                         | "                    | Broken                |
| <i>Capra hircus aegagrus</i> Erxl. | 1               | Proximal fragment of right femur with head, neck, trochanter fossa without trochanter major                                       | L-NGD-1-19           | Broken                |
|                                    | 1               | Distal end fragment of left femur with lateral condyle and trochlea                                                               | "                    | Broken                |
|                                    | 1               | Fragment of left horizontal ramus of mandible with 3 <sup>rd</sup> premolar and 1 <sup>st</sup> molar                             | "                    | Part bone with teeth  |
|                                    | 1               | Fragment of the right ramus of mandible with 2 <sup>nd</sup> premolar (broken) 3 <sup>rd</sup> premolar and 1 <sup>st</sup> molar | L-NGD-1-24           | Part bone with teeth  |

| Name of species                    | No. of material | Identity of material                                                                | Locus(L)/ Stratum(S) | Condition of material |
|------------------------------------|-----------------|-------------------------------------------------------------------------------------|----------------------|-----------------------|
| <i>Capra hircus aegagrus</i> Erxl. | 1               | Fragment of right horn core (tip broken) with a piece of frontal bone               | "                    | Part bone             |
|                                    | 1               | Fragment of horn core                                                               | L-NGD-1              | Broken                |
| <i>Ovis vignei</i> Blyth           | 1               | Fragment of right horn core                                                         | L-NGD-1-40           | Broken                |
|                                    | 1               | Fragment of shaft of radius                                                         | "                    | Subadult, broken      |
|                                    | 2               | Fragments of molar teeth                                                            | "                    | Broken                |
|                                    | 1               | Proximal fragment of left ulna without olecranon process and with semilunar notch   | "                    | Broken                |
|                                    | 1               | Left first phalanx of fore foot                                                     | "                    | Complete              |
|                                    | 1               | Fragment of right pelvis with acetabulum and a portion of shaft of ilium            | "                    | Broken                |
|                                    | 1               | Fragment of shaft of right radius                                                   | L-NGD-1-20<br>S-14   | Broken                |
|                                    | 1               | Thoracic vertebra without transverse process                                        | "                    | Much eroded           |
|                                    | 1               | Proximal fragment of right scapula with glenoid cavity and a portion of tubercalcis | L-NGD-1-49           | Broken                |
|                                    | 1               | Fragment of anterior portion of right horizontal ramus of mandible with teeth       | L-XXII-XXV<br>S-11N  | Broken                |
|                                    | 1               | Right lower 2 <sup>nd</sup> molar                                                   | "                    | Complete              |
|                                    | 1               | Proximal fragment of scapula with glenoid cavity                                    | "                    | Broken                |
|                                    | 1               | Distal end fragment of left tibia                                                   | L-NGD-1-19           | Broken                |
|                                    | 1               | Fragment of a rib                                                                   | "                    | Broken                |
|                                    | 1               | Distal end fragment of right femur with medial condyle                              | "                    | Broken                |
|                                    | 1               | Fragment of shaft of femur                                                          | L-XXV-XXVI<br>S-9    | Broken                |
|                                    | 1               | Proximal fragment of scapula with glenoid cavity with a portion of neck             | "                    | Broken                |

| Name of species          | No. of material | Identity of material                                             | Locus(L)/ Stratum(S) | Condition of material |
|--------------------------|-----------------|------------------------------------------------------------------|----------------------|-----------------------|
| <i>Ovis vignei</i> Blyth | 1               | Proximal fragment of shaft of tibia without proximal extremity   | "                    | Broken                |
|                          | 1               | Distal fragment of shaft of left radius without distal epiphysis | "                    | Subadult              |
|                          | 1               | Fragment of limb bones                                           | L-XXVI-XXXI<br>S-11N | Broken                |
|                          | 1               | Fragment of ramus of mandible                                    | L-XXIII-XXV<br>S-11N | Broken                |
|                          | 1               | Tooth                                                            | "                    | Broken                |
|                          | 1               | Horn core                                                        | L-XXVII-XXX<br>S-9   | Complete              |
|                          | 4               | Pieces of bones (unidentifiable)                                 | L-XXVII-XXXI         | Broken                |
|                          | 1               | Tooth                                                            | "                    | Broken                |
|                          | 2               | Pieces of bones (unidentifiable)                                 | L-XXV-XXIX<br>S-13   | Broken                |
|                          | 3               | Pieces of bones (unidentifiable)                                 | L-XIX-XXI<br>S-15    | Broken                |
|                          | 3               | Pieces of bones (unidentifiable)                                 | L-NGD-1-20<br>S-14   | Broken                |
|                          |                 |                                                                  |                      |                       |

Cutting-NGD-1  
Period-III

|                                       |   |                                            |                     |          |
|---------------------------------------|---|--------------------------------------------|---------------------|----------|
| A Carp fish (sp. indet.)              | 1 | Abdominal vertebra                         | "                   | Complete |
| <i>Rita rita</i> (Hamilton & Bruhman) | 1 | Single spine                               | "                   |          |
| <i>Lissemys punctata</i> (Bonnaterre) | 4 | Fragmentary pieces of epiplastron          | L-XIV-XX<br>S-13A   | Broken   |
|                                       | 1 | Fragment of the epiplastron                | L-XXVII-XXX<br>S-7  | Broken   |
| <i>Crocodylus palustris</i> Lesson    | 1 | Fragment piece from lower jaw with a tooth | "                   | Broken   |
| <i>Sus scrofa cristatus</i> Wagner    | 1 | Left lower tasker canine tooth             | L-XXIX-XXX<br>S-3A  | Subadult |
|                                       | 1 | Right canine tooth                         | L-XVI-XVII<br>S-5Bs | Complete |

| Name of species                | No. of material | Identity of material                                                                                                      | Locus(L)/ Stratum(S) | Condition of material |
|--------------------------------|-----------------|---------------------------------------------------------------------------------------------------------------------------|----------------------|-----------------------|
| <i>Cervus unicolor</i> (Kerr)  | 1               | Fragment of the antler                                                                                                    | NGD-1-486            | Charred               |
|                                | 1               | Fragment of right patella                                                                                                 | L-XXVI-XXVIII S-12   | Broken                |
| <i>Cervus duvauceli</i> Cuvier | 1               | Fragment of antler                                                                                                        | NGD-1-782            | Broken                |
| <i>Bos indicus</i> Linn.       | 1               | First Incisor tooth right side                                                                                            | L-XXIV-XXV S-0       | Complete              |
|                                | 1               | Proximal fragment of left 3 <sup>rd</sup> and 4 <sup>th</sup> metatarsal                                                  | L-XXVII-XXXI S-7     | Broken                |
|                                | 1               | Right first phalanx of hind foot                                                                                          | "                    | Complete              |
|                                | 1               | Fragment of shaft of thoracic rib                                                                                         | "                    | Broken                |
|                                | 3               | Fragment of molar tooth                                                                                                   | "                    | Broken                |
|                                | 1               | Distal fragment of right metatarsal                                                                                       | L-XIX-XX S-13A       | Broken                |
|                                | 2               | Fragments of horizontal ramus of mandible                                                                                 | L-XXVIII-XXX S-7     | Broken                |
| <i>Bubalus bubalis</i> Linn.   | 1               | Fragment of extremity of left femur with a portion of trochlear crest and trochanteric fossa and without trochanter major | "                    | Cut marks on bones    |
|                                | 1               | Fragment of proximal extremity of left femur with a portion of head and a bit of shaft                                    | NGD-1-55 L-XIX-XX    | Broken                |
| <i>Capra hircus</i> Erxl.      | 1               | Proximal fragment of the left ulna with olecranon process                                                                 | NGD-1-29             | Broken                |
|                                | 1               | Distal fragment of shaft of right radius                                                                                  | NGD-1-24             | Broken                |
|                                | 1               | Fragment of left horn core                                                                                                | L-XXVII-XXX S-7      | Broken                |
| <i>Ovis vignei</i> Blyth       | 1               | Proximal and distal fragment of shaft of tibia                                                                            | "                    | Broken                |
|                                | 1               | Proximal fragment of left 3 <sup>rd</sup> and 4 <sup>th</sup> metacarpal                                                  | "                    | Broken                |
|                                | 1               | Distal end fragment of the right scapula with a glenoid cavity                                                            | "                    | Broken                |

| Name of species                 | No. of material | Identity of material                                                           | Locus(L)/ Stratum(S)  | Condition of material |
|---------------------------------|-----------------|--------------------------------------------------------------------------------|-----------------------|-----------------------|
| <i>Ovis vignei</i> Blyth        | 1               | Fragment of shaft of femur                                                     | L-XXVI-XXVIII<br>S-12 | Broken                |
|                                 | 1               | Right calcanium                                                                | "                     | Eroded                |
|                                 | 1               | Proximal end fragment of scapula with glenoid cavity                           | L-XXIV-XXV<br>S-13    | Broken                |
|                                 | 1               | Fragment of shaft of tibia                                                     | L-XXVII-XXX<br>S-7    | Broken                |
|                                 | 2               | Bone pieces (unidentifiable)                                                   | "                     | Broken                |
| <i>Lepus nigricollis</i> Cuvier | 1               | Fragment of pelvis with acetabulum and a feature of shaft of ilium and ischium | "                     | Broken                |
|                                 | 1               | Fragment of ischium of left pelvis                                             | L-XXVII-XXX<br>S-7    | Broken                |
| <i>Rattus rattus</i> Linn.      | 1               | Thoracic vertebra                                                              | L-?<br>S-?            | Complete              |
|                                 | 1               | Proximal portion of ulna                                                       |                       | Broken                |

**Nagda I**  
**Period – Not ascertained**

|                          |   |                                                                               |                   |                   |
|--------------------------|---|-------------------------------------------------------------------------------|-------------------|-------------------|
| <i>Bos indicus</i> Linn. | 1 | 3 <sup>rd</sup> phalanx of left forefoot                                      | S-12              | Complete          |
|                          | 1 | Left astragalus                                                               | L-XXV-XIX<br>S-13 | Eroded            |
|                          | 1 | Longitudinal fragment of left astragalus with proximal and distal trochlea    | "                 | Broken            |
|                          | 1 | Distal fragment of 3 <sup>rd</sup> and 4 <sup>th</sup> metacarpal             | "                 | Broken            |
|                          | 1 | Right incomplete calcanium with tip of tubercalis broken without distal facet | "                 | Broken            |
|                          | 1 | Fragment of left calcanium with tubercalcis                                   | "                 | Broken            |
|                          | 3 | Fragments of ribs                                                             | "                 | Broken            |
|                          | 1 | Left 1 <sup>st</sup> phalanx of forefoot with proximal portion                | "                 | Eroded and broken |
|                          | 1 | Fragments of blade of right ilium                                             | "                 | Broken            |

| Name of species          | No. of material | Identity of material                                                                                 | Locus(L)/ Stratum(S)  | Condition of material |
|--------------------------|-----------------|------------------------------------------------------------------------------------------------------|-----------------------|-----------------------|
| <i>Bos indicus</i> Linn. | 1               | Fragment of neural spine of thoracic vertebrate with post articulation                               | "                     | Broken                |
|                          | 1               | Fragment of anterior portion of left horizontal ramus of mandible with a portion corpus mandibularis | "                     | Young one             |
|                          | 2               | Fragments of neural arch with one spine of thoracic vertebra                                         | "                     | Broken                |
|                          | 1               | Thoracic vertebra                                                                                    | "                     | Complete              |
|                          | 1               | Fragment of rib                                                                                      | "                     | Broken                |
|                          | 1               | Fragment of neural arch of thoracic rib                                                              | "                     | Broken                |
|                          | 1               | Fragment of left ramus of mandible with 2 <sup>nd</sup> molar tooth                                  | L-XXVI-XXXI<br>S-11N  | Young one             |
|                          | 1               | Left lower 1 <sup>st</sup> molar                                                                     | "                     | Young one             |
|                          | 1               | Fragments of right ramus of mandible with 2 <sup>nd</sup> molar                                      | "                     | Young one             |
|                          | 1               | Fragment of left horizontal ramus of mandible without teeth                                          | "                     | Broken                |
|                          | 1               | Fragment of proximal end of right 4 <sup>th</sup> metacarpal                                         | "                     | Broken                |
|                          | 1               | Fragment of thoracic vertebra with a portion of articular process                                    | L-XXXVI-XXXI<br>S-11N | Broken                |
|                          | 1               | Distal fragment of shaft of left humerus                                                             | "                     | Broken                |
|                          | 1               | Fragment of shaft of tibia                                                                           | "                     | Broken                |
|                          | 1               | Proximal fragment of shaft of tibia without proximal epiphysis                                       | "                     | Young one             |
|                          | 1               | 3 <sup>rd</sup> phalanx of fore foot                                                                 | "                     | Complete              |
|                          | 1               | Fragment of rib                                                                                      | L-XIX-XXI<br>S-10     | Broken                |
|                          | 1               | Spines process of lumbar vertebra                                                                    | "                     | Eroded                |

| Name of species          | No. of material | Identity of material                                                     | Locus(L)/ Stratum(S) | Condition of material |
|--------------------------|-----------------|--------------------------------------------------------------------------|----------------------|-----------------------|
| <i>Bos indicus</i> Linn. | 1               | Proximal epiphysis of right tibia                                        | L-XXV-XXVIII<br>S-7N | Complete              |
|                          | 1               | Distal epiphysis of right radius                                         | "                    | Complete              |
|                          | 1               | Distal fragment of 3 <sup>rd</sup> & 4 <sup>th</sup> metacarpal          | "                    | Broken                |
|                          | 1               | Proximal fragment of right radius                                        | "                    | Broken                |
|                          | 1               | Proximal fragment of right scapula with a portion of glenoid cavity      | "                    | Broken                |
|                          | 1               | Body of thoracic vertebra                                                | "                    | Broken                |
|                          | 1               | Right first phalanx of hind foot                                         | "                    | Complete              |
|                          | 1               | Fragment of superior bone of left ramus of mandible with teeth           | "                    | Part bone             |
|                          | 1               | Right upper 1 <sup>st</sup> molar tooth with a fragment of upper jaw     | "                    | Part bone             |
|                          | 3               | Fragment of frontal bone of skull                                        | "                    | Broken                |
|                          | 1               | Proximal fragment of left radius                                         | "                    | Young one             |
|                          | 1               | Fragment of rib                                                          | "                    | Broken                |
|                          | 1               | Incomplete calcanium                                                     | "                    | Young one             |
|                          | 1               | Proximal fragment of tibia with condyle                                  | L-XLIV-XLVI          | Broken                |
|                          | 1               | Distal fragment of right femur with medial condyle                       | "                    | Broken                |
|                          | 3               | Fragment of scapula                                                      | "                    | Broken                |
|                          | 1               | Distal fragment of right humerus                                         | L-XXXI-XXXV<br>S-15  | Broken                |
|                          | 1               | Fragment of shaft of 3 <sup>rd</sup> metatarsal                          | "                    | Broken                |
|                          | 1               | Proximal fragment of left 3 <sup>rd</sup> and 4 <sup>th</sup> metacarpal | "                    | Broken                |
|                          | 2               | Fragments of ribs                                                        | "                    | Broken                |

| Name of species          | No. of material | Identity of material                                                | Locus(L) / Stratum(S) | Condition of material |
|--------------------------|-----------------|---------------------------------------------------------------------|-----------------------|-----------------------|
| <i>Bos indicus</i> Linn. | 1               | Fragment of left 3 <sup>rd</sup> phalanx                            | "                     | Young one             |
|                          | 1               | Fragment of temporal bone of skull                                  | "                     | Young one             |
|                          | 2               | Proximal part of left scapula with glenoid cavity and tuber scapula | L-XXXI-XXXVI<br>S-30  | Broken                |
|                          | 1               | Fragment of rib                                                     | "                     | Broken                |
|                          | 1               | Head of the femur                                                   | "                     | Charred               |
|                          | 1               | Distal fragment of 3 <sup>rd</sup> and 4 <sup>th</sup> metatarsal   | L-XXVI-XXVIII<br>S-9  | Broken                |
|                          | 1               | Distal fragment of the 3 <sup>rd</sup> metatarsal                   | "                     | Cut mark              |
|                          | 1               | Proximal fragment of right ulna with semilunar notch                | "                     | Broken                |
|                          | 1               | Fragment of head of ilium of right pelvis                           | "                     | Broken                |
|                          | 1               | Fragment of shaft of femur                                          | "                     | Charred               |
|                          | 3               | Fragments of ribs                                                   | L-XXIV-XXV<br>S-13    | Broken                |
|                          | 1               | Left lower 1 <sup>st</sup> molar tooth                              | "                     | Charred               |
|                          | 1               | Right combined external and medial cunifform of right tarsus        | "                     | Subadult              |
|                          | 1               | Fragment of shaft of humerus                                        | L-XXXV-XXXVI<br>S-10  | Broken                |
|                          | 1               | Left calcaneum with tip of tubercalcis                              | L-XL-XLII<br>S-16     | Broken                |
|                          | 3               | Fragments of ribs                                                   | "                     | Broken                |
|                          | 2               | Fragments of vertebra                                               | "                     | Broken                |
|                          | 1               | Fragment of shaft of left ulna                                      | L-XL-XLIV<br>S-20     | Broken                |
|                          | 3               | Fragments of thoracic ribs                                          | "                     | Broken                |
|                          | 1               | Fragment of vertical ramus of mandible                              | "                     | Broken                |
|                          | 1               | Distal fragment of right humerus with medial condyle                | L-XXX-XXXI<br>S-12    | Broken                |

| Name of species          | No. of material | Identity of material                                                 | Locus(L)/ Stratum(S) | Condition of material |
|--------------------------|-----------------|----------------------------------------------------------------------|----------------------|-----------------------|
| <i>Bos indicus</i> Linn. | 1               | Proximal epiphysis of first phalanx                                  | "                    | Broken                |
|                          | 2               | Fragments of distal end of ulna                                      | "                    | Broken                |
|                          | 1               | Fragment of right calcaneum without tubercalcis                      | L-XXV-XXVIII S-15    | Broken                |
|                          | 1               | Fragment of right 3 <sup>rd</sup> phalanx                            | "                    | Broken                |
|                          | 1               | Left 2 <sup>nd</sup> phalanx of hind foot                            | "                    | Complete              |
|                          | 1               | Distal fragment of left 1 <sup>st</sup> phalanx                      | "                    | Broken                |
|                          | 1               | Longitudinal half of fragment of 1 <sup>st</sup> phalanx             | "                    | Broken                |
|                          | 1               | Longitudinal half of 2 <sup>nd</sup> phalanx                         | "                    | Broken                |
|                          | 1               | Caudal vertebra                                                      | "                    | Complete              |
|                          | 1               | Proximal fragment of scapula with glenoid cavity                     | "                    | Broken                |
|                          | 1               | Distal condyle of the 3 <sup>rd</sup> and 4 <sup>th</sup> metatarsal | "                    | Broken                |
|                          | 1               | Fragment of rib                                                      | "                    | Broken                |
|                          | 1               | Fragment of shaft of humerus                                         | "                    | Broken                |
|                          | 1               | Right lower 1 <sup>st</sup> molar tooth                              | "                    | Young one             |
|                          | 1               | Left lower 3 <sup>rd</sup> molar tooth                               | "                    | Young one             |
|                          | 1               | Fragment of molar tooth                                              | "                    | Young one             |
|                          | 1               | The right ramus of mandible without teeth                            | L-XXV-XXVII S-10     | Broken                |
|                          | 1               | Fragment of upper jaw without teeth                                  | "                    | Sharp cut on bone     |
|                          | 1               | Fragment of blade of scapula                                         | "                    | Broken                |
|                          | 1               | Fragment of rib                                                      | "                    | Broken                |
|                          | 1               | Fragment of right calcaneum with a portion of tubercalcis            | "                    | Broken                |
|                          | 1               | Fragment of molar tooth                                              | "                    | Broken                |
|                          | 1               | Fragment of proximal portion of left metacarpal                      | L-XLII-XLIV S-15     | Broken                |
|                          | 1               | Fragment of occipital condyle                                        | "                    | Broken                |

| Name of species          | No. of material | Identity of material                                                                   | Locus(L) / Stratum(S) | Condition of material    |
|--------------------------|-----------------|----------------------------------------------------------------------------------------|-----------------------|--------------------------|
| <i>Bos indicus</i> Linn. | 1               | Right lower 3 <sup>rd</sup> molar tooth                                                | "                     | Broken                   |
|                          | 1               | Fragment of right pelvis with a portion of ischium and acetabulum                      | "                     | Broken                   |
|                          | 1               | Left calcaneum                                                                         | L-XIX-XXI<br>S-10     | Young one                |
|                          | 1               | Fragment of shaft of calcaneum                                                         | "                     | Broken                   |
|                          | 1               | 3 <sup>rd</sup> phalanx                                                                | "                     | Young one                |
|                          | 1               | Fragment of 3 <sup>rd</sup> phalanx                                                    |                       | Broken                   |
|                          | 1               | Left first phalanx of the fore foot                                                    | L-XXXIV-XXV           | Young one                |
|                          | 2               | Fragment of limb bone                                                                  | L-XXV-XXXI<br>S-14    | Broken                   |
|                          | 14              | Fragments of different regional bone piece                                             | L-XXX-XXXI<br>S-7A    | Broken (un-identifiable) |
|                          | 1               | Head of limb bone                                                                      | L-XXVIII-XXIX<br>S-13 | Broken                   |
|                          | 5               | Pieces of limb bone                                                                    | L-XXX-XXXI<br>S-7     | Broken                   |
|                          | 1               | Left lower 3 <sup>rd</sup> molar tooth                                                 | L-XIX-XX<br>S-13      | Complete                 |
|                          | 2               | Fragments of ribs                                                                      | "                     | Broken                   |
|                          | 1               | Fragment of left metacarpal without distal portion                                     | L-XXXIX-XLI<br>S-17   | Broken                   |
|                          | 1               | Fragment of thoracic rib                                                               | "                     | Broken                   |
|                          | 1               | Fragment of epiphysis of the medial condyle of right femur                             | NGD 1-36<br>S-11      | Young one                |
|                          | 2               | Distal fragments of 3 <sup>rd</sup> and 4 <sup>th</sup> metatarsal with single condyle | "                     | Broken                   |
|                          | 1               | Caudal vertebra                                                                        | "                     | Complete                 |
|                          | 1               | Fragment of calcaneum with a facet for cuboid                                          | "                     | Broken                   |
|                          | 1               | Fragment of sacral bone                                                                | "                     | Young one                |
|                          | 1               | Fragment of tarsal condyle of right femur                                              | "                     | Broken                   |

| Name of species              | No. of material | Identity of material                                                                   | Locus(L)/ Stratum(S)  | Condition of material |
|------------------------------|-----------------|----------------------------------------------------------------------------------------|-----------------------|-----------------------|
| <i>Bos indicus</i> Linn.     | 1               | Right lunate bone                                                                      | "                     | Broken                |
|                              | 1               | Fragment of scaphoid bone                                                              | "                     | Broken                |
|                              | 1               | Distal fragment of 2 <sup>nd</sup> phalanx                                             | "                     | Broken                |
|                              | 1               | Fragment of rib                                                                        | "                     | Broken                |
|                              | 1               | Fragment of 7th cervical vertebra                                                      | "                     | Broken                |
|                              | 1               | Fragment of condyle of femur                                                           | "                     | Broken                |
|                              | 1               | Left incomplete calcanium                                                              | "                     | Young one             |
|                              | 1               | Right 1st phalanx of fore foot                                                         | L-XL-XLIII<br>S-18    | Complete              |
|                              | 1               | Piece of blade of scapula with broken spine                                            | "                     | Broken                |
|                              | 1               | Caudal vertebra                                                                        | "                     | Young one             |
|                              | 1               | Right astratgalus                                                                      | L-XXX-XXXI<br>S-6 A   | Young one             |
|                              | 1               | Left astragalus                                                                        | L-XXV-XXVIII<br>S-12  | Young one             |
|                              | 1               | Distal fragment of right scapula with glenoid cavity and a portion of notch            | "                     | Broken                |
|                              | 1               | Fragment of left pelvis with acetabulam                                                | "                     | Broken                |
| <i>Bubalus bubalis</i> Linn. | 1               | Proximal fragment of left ulna with olecranon process and a portion of semilunar notch | L-XXV-XXVIII<br>S-7 N | Broken                |
|                              | 1               | Distal fragment of right humerus with medial condyle                                   | "                     | Broken                |
|                              | 1               | Proximal fragment of left radius with medial articular surface                         | "                     | Broken                |
|                              | 1               | Fragment of distal shaft of right radius without distal epiphysis                      | "                     | Young one             |
|                              | 1               | Body of vertebra                                                                       | L-XXV-XXVIII<br>S-15  | Broken                |

| Name of species                    | No. of material | Identity of material                                                           | Locus(L)/ Stratum(S) | Condition of material    |
|------------------------------------|-----------------|--------------------------------------------------------------------------------|----------------------|--------------------------|
| <i>Bubalus bubalis</i> Linn.       | 1               | Left upper 2 <sup>nd</sup> premolar tooth                                      | "                    | Complete                 |
|                                    | 1               | Proximal fragment of 1st phalanx                                               | NGD-1-36 S-11        | Broken                   |
|                                    | 1               | Distal fragment of left humerus                                                | L-XXX-XXXI S-6A      | Broken                   |
|                                    | 2               | Limb bones                                                                     | L-XXV-XXVIII S-7N    | Broken                   |
|                                    | 1               | Tooth                                                                          | "                    | Broken                   |
|                                    | 5               | Pieces of bones                                                                |                      | Broken (un-identifiable) |
|                                    | 4               | Pieces of bones                                                                | L-XXV-XXVIII S-7N    | Broken (un-identifiable) |
| <i>Capra hircus aegagrus</i> Erxl. | 1               | Fragment of left horizontal ramus of mandible with 3 <sup>rd</sup> molar tooth | L-XX-XXII S-17X      | Broken                   |
|                                    | 1               | Distal epiphysis of the right femur                                            | L-III S-11           | Young one                |
|                                    | 1               | Lumber vertebra without spine and transverse process and a part of neural arch | "                    | Broken                   |
|                                    | 1               | Distal fragment of right tibia                                                 | "                    | Broken                   |
|                                    | 1               | Proximal fragment of left radius                                               | "                    | Broken                   |
|                                    | 1               | Distal fragment of 3 <sup>rd</sup> metatarsal                                  | "                    | Broken                   |
|                                    | 1               | Horn core                                                                      | NGD 1-24             | Complete                 |
|                                    | 1               | Distal fragment of left radius without epiphysis                               | NGD-1-11 S-12        | Young one                |
|                                    | 1               | Proximal fragment of left radius without epiphysis                             | "                    | Young one                |
|                                    | 1               | Fragment of rib                                                                | "                    | Broken                   |
|                                    | 1               | Proximal fragment of left tibia                                                | L-XXX-XXVIII S-7N    | Broken                   |
|                                    | 1               | Distal fragment of right femur with lateral condyle                            | NGD 1-36 S-11        | Broken                   |

| Name of species                    | No. of material | Identity of material                                                                            | Locus(L)/ Stratum(S) | Condition of material    |
|------------------------------------|-----------------|-------------------------------------------------------------------------------------------------|----------------------|--------------------------|
| <i>Capra hircus aegagrus</i> Erxl. | 1               | Fragment of shaft of tibia                                                                      | "                    | Broken                   |
|                                    | 1               | Distal fragment of left humerus                                                                 | L-XXV-XXVIII S-12    | Broken                   |
|                                    | 1               | Distal fragment of shaft of right femur                                                         | "                    | Broken                   |
|                                    | 1               | Proximal fragment of scapula with glenoid cavity                                                | "                    | Broken                   |
|                                    | 1               | Proximal fragment of right femur with head, neck and trochanteric fossa                         | NGD1-19              | Broken                   |
|                                    | 1               | Distal fragment of left femur with lateral condyle and trochlea                                 | "                    | Broken                   |
|                                    | 1               | Fragment of left horizontal ramus of mandible with 3 <sup>rd</sup> premolar and 1st molar teeth | "                    | Broken                   |
|                                    | 1               | Ramus of mandible with teeth                                                                    | "                    | Broken                   |
|                                    | 2               | Pieces of bones                                                                                 | L-XXVII-XXX S-10     | Broken (un-identifiable) |
| <i>Ovis vignei</i> Blyth           | 1               | Limb bone                                                                                       | L-XXV-XXXIV S-7N     | Broken (un-identifiable) |
|                                    | 3               | Limb bones                                                                                      | L-XXV-XXVIII S-12    | Broken (un-identifiable) |
|                                    | 1               | Piece of horn core                                                                              | L-XXVIII-XXX S-8     | Young ones               |
|                                    | 9               | Pieces of different bones                                                                       | L-XXVI-XXVIII S-12   | Unidentifiable           |
|                                    | 1               | Distal fragment of left tibia                                                                   | NGD-1                | Broken                   |
|                                    | 1               | Fragment of rib                                                                                 | "                    | Broken                   |
|                                    | 1               | Distal fragment of right femur with medial condyle                                              | "                    | Broken                   |
|                                    | 1               | Distal end fragments of the left humerus with medial and lateral condyle                        | L-XXV-XXIX S-13      | Broken                   |
|                                    | 1               | Left astragalus                                                                                 | "                    | Young one                |
|                                    | 1               | Fragment of sacrum                                                                              | "                    | Broken                   |

| Name of species          | No. of material | Identity of material                                                            | Locus(L)/ Stratum(S)  | Condition of material |
|--------------------------|-----------------|---------------------------------------------------------------------------------|-----------------------|-----------------------|
| <i>Ovis vignei</i> Blyth | 1               | Fragment of shaft of tibia                                                      | L-XXVI-XXXI<br>S11N   | Broken                |
|                          | 1               | Cervical vertebra incomplete                                                    | L-XXVII-XXVIII<br>S-9 | Young one             |
|                          | 1               | Body of cervical vertebra                                                       | "                     | Broken                |
|                          | 1               | Right incomplete calcaneum without distal facet for cuboid                      | "                     | Broken                |
|                          | 1               | Fragment of left calcaneum                                                      | "                     | Broken                |
|                          | 1               | Fragment of left pelvis with a portion of acetabulum and ischium                | "                     | Broken                |
|                          | 1               | Fragment of ischium of left pelvis                                              | "                     | Broken                |
|                          | 1               | Fragment of distal condyle of 3 <sup>rd</sup> metatarsal                        | "                     | Broken                |
|                          | 1               | Fragment of right horizontal ramus of mandible without teeth                    | L-XXXV-XXXVI<br>S-10  | Broken                |
|                          | 1               | Body of lumbar vertebra                                                         | L-XXV-XXVIII<br>S-15  | Broken                |
|                          | 1               | Fragments of right pelvis with a portion of acetabulum and ischium              | "                     | Broken                |
| <i>Axis axis</i> Erxl.   | 1               | Proximal end fragment of left scapula with glenoid cavity and a portion of neck | "                     | Broken                |
|                          | 1               | Fragment of tooth without crown                                                 | "                     | Broken                |
|                          | 1               | Fragment of shaft of femur                                                      | "                     | Charred               |
|                          | 1               | Fragment of head of scapula without spine                                       | L-XXV-XXVIII<br>S-10  | Broken                |
|                          | 1               | Fragment of shaft of radius and ulna                                            | "                     | Broken                |
|                          | 1               | Proximal fragment of shaft of femur                                             | L-XXV-XXVI<br>S-16    | Broken                |
|                          | 1               | Fragment of left pelvis with a portion of shaft of ilium                        | "                     | Broken                |

| Name of species                    | No. of material | Identity of material                                                                        | Locus(L)/ Stratum(S)   | Condition of material    |
|------------------------------------|-----------------|---------------------------------------------------------------------------------------------|------------------------|--------------------------|
| <i>Axis axis</i> Erxl.             | 1               | Lumber vertebra without spine, transverse processes and without posterior articular process | L-XXVII-XXIX<br>S-13   | Broken                   |
|                                    | 1               | Fragment of cervical vertebra without neural arch and with portion of body                  | "                      | Broken                   |
|                                    | 1               | Fragment of rib                                                                             | "                      | Broken                   |
|                                    | 1               | Fragment of bone piece                                                                      | L-XXV-XXVIII<br>S-15   | Charred                  |
|                                    | 1               | Fragment of bone piece                                                                      | L-XXVII-XXVIII<br>S-9  | Broken                   |
|                                    | 2               | Distal fragment of right tibia                                                              | L-XX-XXI<br>S-10       | Broken                   |
| <i>Cervus unicolor</i> (Kerr)      | 1               | Left astragalus                                                                             | NGD-1-43               | Young one                |
|                                    | 1               | Right 1 <sup>st</sup> phalanx                                                               | L-XXV-XXIX<br>S-16     | Young one                |
|                                    | 1               | Right 2 <sup>nd</sup> phalanx                                                               | L-XXV-XXIX<br>S-16     | Young one                |
|                                    | 2               | Left side of horn core and a fusion of pedicel                                              | NGD 11-7               | Cut marks present        |
| <i>Sus scrofa cristatus</i> Wagner | 1               | Left tusker canine tooth                                                                    | L-XXI-XXIV<br>S-8A     | Adult                    |
| <i>Felis</i> sp.                   | 1               | Right humerus                                                                               | NGD-40                 | Young one                |
| Unidentified mammal                | 10              | Pieces of bones                                                                             | L-XXV-XXVII<br>S-3     | Broken (un-identifiable) |
|                                    | 20              | Fragments of bone piece                                                                     | L-XXVII-XXX<br>S-10    | Broken (un-identifiable) |
|                                    | 14              | Fragments of bone piece                                                                     | NGD1-6<br>S-19         | Broken (un-identifiable) |
|                                    | 13              | Fragments of bone piece                                                                     | L-XXV-XXVI<br>S-5      | Broken (un-identifiable) |
|                                    | 13              | Fragments of bone piece                                                                     | L-XXXIII-XXXIV<br>S-15 | Broken (un-identifiable) |

**Table 2.** : Animal forms recovered from Nagda excavations and their present state of distribution.

| Group                                | Scientific name                       | Common name                      | Present natural distribution                                                                                                                                               |
|--------------------------------------|---------------------------------------|----------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Mollusca :<br>Pelecypoda             | <i>Parreysia favidens</i> (Benson)    | Bivalve(fresh water)             | Assam, Andhra Pradesh, Tamil Nadu, Maharastra, Orissa, Uttar Pradesh; Bangladesh.                                                                                          |
|                                      | <i>Lamellidens</i> sp.                | Bivalve(fresh water)             | India, Bangladesh, Myanmar.                                                                                                                                                |
| Pisces :<br>Telostei                 | <i>Rita rita</i> (Ham.Bach.)          | Rita fish                        | Most rivers of northern India; Nepal; Bangladesh; Myanmar; Afganistan; Pakistan; Indus plain and adjoining hilly areas.                                                    |
|                                      | sp. indet.                            | Carp fish                        |                                                                                                                                                                            |
| Reptilia :<br>Chelonia               | <i>Trionyx gangeticus</i> (Cuvier)    | Indian soft shelled Turtle       | Ganga, Sind and Mahanadi river systems; common in N.W. Pakistan, Bangladesh and foothills of Nepal.                                                                        |
|                                      | <i>Chitra indica</i> (Gray)           | Narrow-headed softshelled Turtle | India (U. P., Bihar, West Bengal), Nepal, Pakistan, Malaysia and Thailand.                                                                                                 |
| Reptilia :<br>Crocodilia             | <i>Lissemys punctata</i> (Bonnaterre) | Mud or Flap-shell Turtle         | Indo-Gangetic plain and eastward to Akyab in Myanmar.                                                                                                                      |
|                                      | <i>Crocodilus palustris</i> Lesson    | Mugger, Kumir                    | Throughout Indian subcontinent from Baluchistan in the West to Assam in the east and from Nepal in the north to Tamil Nadu in the south; also Sri Lanka, Myanmar and Iran. |
| Mammalia :<br>Carnivora :<br>Felidae | <i>Felis</i> sp.                      | Domestic cat                     | Worldwide due to transshipment by human.                                                                                                                                   |
| Artiodactyla :<br>Cervidae           | <i>Cervus unicolor</i> Kerr.          | Sambar                           | Forests of India, Myanmar, Sri Lanka, Nepal, Sumatra, Borneo, Java, Malaysia; introduced to Australia and New Zealand.                                                     |

Table 2. (Cont'd.).

| Group                      | Scientific name                         | Common name                            | Present natural distribution                                                                                                                                                                                                               |
|----------------------------|-----------------------------------------|----------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Artiodactyla :<br>Cervidae | <i>Cervus duvauceli</i> Cuvier          | Swamp deer /<br>Barasingha             | Restricted to India; north of<br>Ganges from Kumaon to<br>Assam and south of Ganges<br>principally in M. P.                                                                                                                                |
|                            | <i>Axis axis</i> Erxl.                  | Chital or<br>Spotted deer              | Peninsular India, Bengal,<br>Sikkim northwards to Kumaon<br>Himalaya, Nepal, Sri Lanka.                                                                                                                                                    |
| Artiodactyla :<br>Suidae   | <i>Sus scrofa cristatus</i> Wagner      | Indian wild<br>boar                    | India, Pakistan, Sri Lanka,<br>Nepal, Bangladesh, Myanmar,<br>Indonesia, Malayasia and<br>Vietnam.                                                                                                                                         |
| Artiodactyla :<br>Bovidae  | <i>Bos indicus</i> Linn.                | Domestic cattle                        | Distributed worldwide through<br>human agency.                                                                                                                                                                                             |
|                            | <i>Bubalus bubalis</i> ( Linn. )        | Indian buffalo                         | Terai and plains of Brahma-<br>putra valley in Assam, Orissa,<br>Bastar district of Madhya<br>Pradesh in India; Jungles of<br>Nepal.                                                                                                       |
|                            | <i>Ovis</i> sp. (? <i>vignei</i> Blyth) | Domestic sheep<br>(?Shapu or<br>Urial) | Wild forms range from Gilgit,<br>Astor and Ladak in Kashmir,<br>eastward to northern Tibet,<br>Punjab, Sind, Baluchistan, and<br>southern Persia. Domestic<br>forms distributed in many<br>parts of world through human<br>agency.         |
|                            | <i>Capra hircus aegagrus</i> Erxl.      | Wild goat                              | India, Baluchistan, Iraq, Iran,<br>Asia minor.                                                                                                                                                                                             |
| Lagomorpha<br>Leporidae    | <i>Lepus nigricollis</i> Cuvier         | Indian hare                            | Peninsular India, Central<br>India (Vidharbha region and<br>Madhya Pradesh), Cutchh<br>and Kathiawar of Gujarat,<br>Rajasthan, Punjab, Sikkim,<br>Duars area of Bengal, Assam<br>Plains; Nepal; Bhutan; Sri<br>Lanka and Sind of Pakistan. |
| Rodentia :<br>Muridae      | <i>Rattus rattus</i> Linn.              | House rat                              | Original home was India and<br>Myanmar; presently distri-<br>buted worldwide through<br>shipment of commodities.                                                                                                                           |

## DISCUSSION

The Malwa region, situated almost in the centre of India, forms a unique geographical unit from the view point of physiography, human culture and economy (Dhavalikar, 1979). The region forms the link between the Indo-Gangetic plain and the peninsular part of India. It may further be considered as a part of the northernmost tip of peninsula. The region is drained by two river systems *viz.*, (i) rivers Narmada, Tapti and Mahi which fall on the Arabian Sea, and (ii) rivers Chambal and Bewa which join the river Yamuna. The climate of the region is tropical monsoonal type, and its black soil is well known for its fertility. Dhavalikar (*loc. cit.*) presumed that the earliest settlers of Malwa were attracted by the fertility of the region. He also commented that the Chalcolithic people seem to have selected this spot obviously because of the environment, which must have been quite congenial to them.

It is revealed that the past inhabitants or Chalcolithic folk of Nagda during the period-I had certain degree of diversity in their livelihood and culture, but the extent of which were not as wide and developed as were seen in the Harappan cultures. The people lived most probably in the mud or mud bricks houses and seldom in the shelters on rubble base. The design of the houses suggests their group structure and living jointly in large numbers. In fact, the presence of large size kitchens (c. 20 ft. x 6 ft. or 11.7 sq. m.) with multiple ovens are clear indications of this assumption. The finds of grains like, wheat, rice, gram, peas, pulses etc. are quite suggestive of the vegetable diet of the folk (Sankalia, Subbarao & Deo, 1958). These also point out to their skill in farming and agriculture. The presence of sharply cut bones of animals indicates consumption of animal proteins by this ancient folk. Ornaments made up of molluscan shells and ivories have been recovered. It appears from the microliths recovered from the excavations, that the tools of this Chalcolithic folk comprised microlithic blades, knives, crescents and trapezes for cutting vegetables, fruits, crops and animals (Banerjee 1986).

Animals with hard exoskeletons (molluscs, turtles) and endoskeletons (vertebrates) have been recovered from the excavations (vide Table 1). The presence of molluscan shells, turtles and even the marsh crocodile reveal that river Chambal had enough flow on those days and was well connected with the river system of south of this zone. It was also navigable and was utilized by the people for movement to other places. Among the three turtles, *Chitra indica* still in these days are found in the river system in wide area of India, and *Lissemys punctata* occurs in Indo-gangetic plain; the marsh crocodile, *Crocodylus porosus* had a wider distribution but now-a-days it has disappeared from many parts of India. The river Chambal, flowing from the central highland of India, merges into Yamuna and eventually into the Gangetic drainage system. It is presumed that the highland area had substantial vegetation cover and the drainage had increased flow due to higher precipitation. Many riverine animals, which in these days are not naturally occurring

in western parts of India, had a wider distribution in the past. The occurrence of turtles and crocodiles in western India support these presumptions. The turtles have been recorded from Mahenjodaro (Sewell & Guha, 1931), Harappa (Prashad, 1936) and Lothal (Saha *et al.*, 2004) archaeological sites. Increased anthropogenic pressure along the riverine system of India had greatly influenced the vegetative and climatic features and distribution patterns of many animals.

Most of the remains of mammals belonged to domestic humped cattle (*Bos indicus* Linn.), goat (*Capra hircus aegagrus* Exrl.), sheep (*Ovis* sp. ?*vignei* Blyth.), pig (*Sus scrofa cristatus* Wagner). and buffalo (*Bubalus bubalis* Linn.). Three members of deer family (Cervidae) viz., Sambar (*Cervus unicolor* Kerr.), Baringha (*Cervus duvauceli* Cuvier) and Spotted deer (*Axis axis* Exrl.) were also noticed in the excavated remains. They were no doubt wild forms and the past habitats in the place were suitable for holding these animals. Sankalia (1974) noted that this area was once forested but almost suitable for agriculture. Sewell & Guha (1931) recorded most of these animals in the excavated animal remains of Mohenjodaro, and Prashad (1936) recorded them in Harappa. Recently, animal remains of Lothal excavations have been worked out by Saha *et al.* (2004) and above animals were also represented in that site.

By studying the objects and animal remains, it has been possible to throw some light on the lifestyle and food patterns of the past people of Nagda. However, the identity of the Chalcolithic people and where they came from still remained an unresolved query. Sankalia *et al.* (1974) stated the following probabilities about their identity : (i) people from West Asia or Iran, (ii) the Bhils and other aboriginal tribes; (iii) a hitherto unidentified people; and (iv) yet another group of primitive people. Dhavalikar (1979) who made an in-depth study on Malwa Chalcolithic people, presumed that they had come from outside India. The study of the skeletal remains of these folk may enable in establishing the racial type to which they belong. Incidentally, no human skeletal remains have so far been found at any Chalcolithic sites in Malwa. It would also indicate the possible source and direction of their advent. Such a study may throw light also on the cultural interregnum between the end of the Harappan culture and the beginning of the Chalcolithic civilization in India.

## SUMMARY

The Chalcolithic civilization of bygone era on Indian landmass evolved almost at a closing stage of Indus civilization of Harappa and Mohenjodaro and it had a wide expanse. The culture of the archaeological site of Nagda on the bank of river Chambal, belonged to Malwa Regional Group.

The people of Nagda were mainly agrarian; lived probably in mud-brick residences, jointly in large numbers. They had large size kitchens with multiple ovens. They consumed mainly the vegetable diet, supplemented by animal proteins. Many objects of archaeological significance and animal remains recovered from the excavations are suggestive of an age of 1631–1375 B.C. for the civilization. The analysis of animal remains (586 examples / fragments), comprising mostly hard exoskeletons of molluscs and turtles and endoskeletons of vertebrates, revealed the presence of 2 species of Mollusca, 2 species of Pisces, 4 species of Reptilia, and 11 species of Mammalia. The presence of molluscan shells, turtles and marsh crocodile are indicative of good flow in river Chambal and convenient for navigation. The presence of some wild animals are suggestive of past natural habitat that was conducive for holding a sizeable fauna.

### ACKNOWLEDGEMENTS

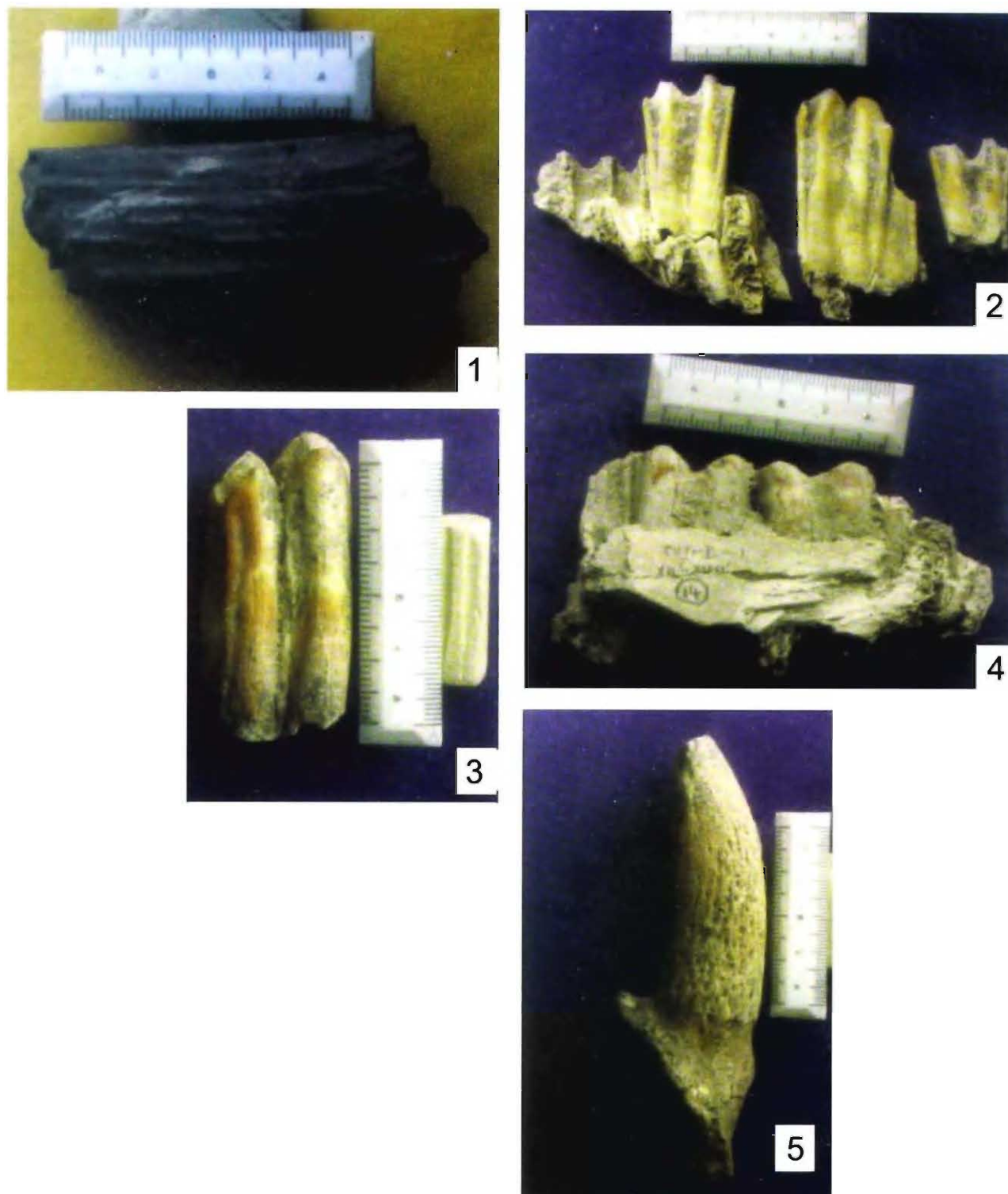
The authors are indebted to the Director, Zoological Survey (ZSI) of India for providing all necessary facilities for carrying out the study. The Director-General, Archaeological Survey of India (ASI) had placed the animal remains of the excavations from Nagda in the repository of ZSI, which is gratefully acknowledged. They owe to Shri T. J. Baidya, Deputy Superintending Archaeologist, ASI, Kolkata for providing them with pertinent literature and extending generous support in the study. They acknowledge their debt to the reviewer of the paper who has critically gone through it to offer valuable suggestions and to point out useful changes for improvement of the paper.

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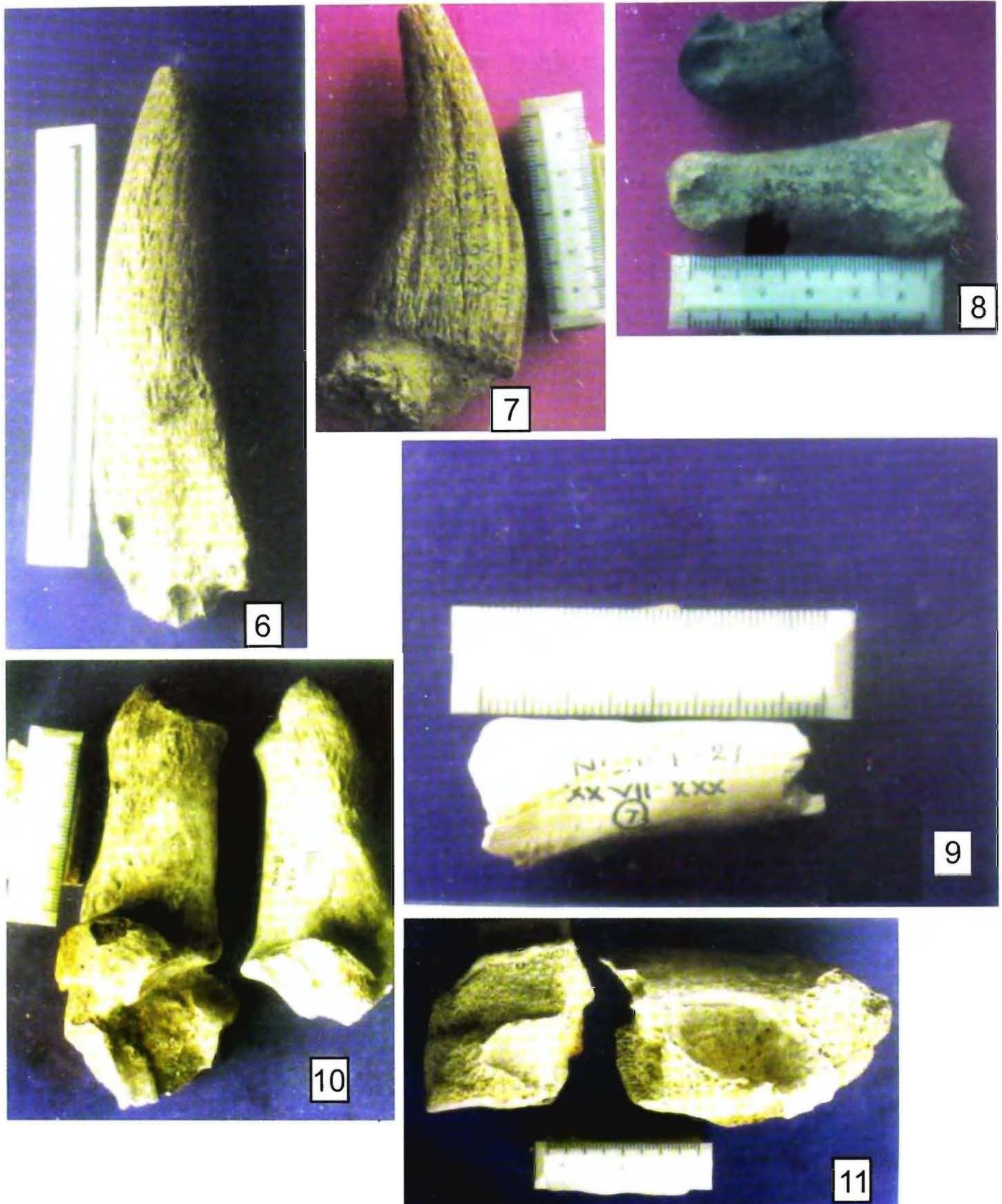
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# PLATE I

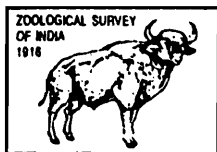


**Figs. 1-5. :** Skeletal remains recovered from Nagda archeological site : 1. *Cervus unicolor* (Kerr), fragment of antler, charred; 2. *Bos indicus* Linn., fragments of left ramus of mandible with second molar tooth, fragment of right ramus of mandible with second molar, left lower first molar teeth; 3. *Bos indicus*, right upper second molar tooth of a young animal; 4. *Bubalus bubalis* Linn., mandible with teeth; 5. *Capra hircus aegagrus* Erxl., fragment of right horn core (tip broken) with part of frontal lobe.

PLATE II



**Figs. 6-11. :** Skeletal remains recovered from Nagda archeological site : 6. *Bos indicus* Linn., Horn core; 7. *Ovis vignei* Blyth, left horn core with part of frontal lobe; 8. *Cervus unicolor* Kerr, right first phalanx, right second phalanx, charred; 9. *Capra hircus aegagrus*, distal fragment of shaft of right radius; 10. *Bos indicus*, left calcaneum and right calcaneum; 11. *Bos indicus*, trochanter crest of left femur, proximal part of left femur.



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## PHYTOPHAGOUS AND PREDATORY MITE FAUNA OF SUNDARBANS BIOSPHERE RESERVE : II. SOME PREDATORY MITES OCCURRING ON MANGROVE VEGETATION AND AGRI-HORTICULTURAL CROPS

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### INTRODUCTION

This paper is based upon collection made during 1.8.2000 to 31.3.2002 in connection with the study of phytophagous and predatory mite fauna occurring on mangrove and agri-horticultural crops of Sundarban Biosphere Reserve (SBR). This forms Part-II of this study while Part-I dealing with phytophagous mites belonging to 21 species under 10 genera and 4 families has been published separately (Gupta *et al.*, 2003).

### MATERIALS AND METHODS

The Materials and Methods adopted for this study are same as described earlier in Part-I of this study dealing with phytophagous mites (Gupta *et al.*, 2003).

#### Family I. PHYTOSEIIDAE Berlese

1952. Phytoseiidae Baker & Wharton, *An introduction to Acarology*, McMillan Company, New York, p. 87.  
1959. Phytoseiidae, Chant, *Can. Ent.*, 91(Suppl-12) : 48.  
1986. Phytoseiidae, Gupta, *Fauna of India (Acari Mesostigmata) Family Phytoseiidae*, p. 31.

#### Key to the Subfamilies, Genera and Subgenera known to occur in Sundarbans Biosphere Reserve (SBR)

1. Prolateral setae 4 pairs, in all 6–9 pairs of lateral setae; preanal setae 3 pairs .....  
..... Subfamily AMBLYSEIINAE, 2
- Prolateral setae 5 or more pairs, in all 9–12 pairs of setae, preanal setae 3–4 pairs .....  
..... Subfamily PHYTOSEIINAE, 7

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2. Ventrianal shield absent or indistinctly demarcated; only preanal setae distinctly present .... Genus *Indoseiulus*  
 – Ventrianal shield distinctly present ..... 3
3. Lateral integument sclerotized so that  $r_3$  and  $R_1$  though on usual lateral position appear to be on lateroventral extension of dorsal shield ..... Genus *Iphiseius*  
 – Lateral integument not sclerotized as above ..... Genus *Amblyseius*, 4
4. Dorsal shield with 5 pairs of post lateral setae ..... 5  
 – Dorsal shield with less than 5 pairs of post lateral setae ..... Subgenus *Paraphytoseius*
5. Setae  $Z_5$ ,  $s_4$  long and whip like, longer than distance between their bases. Leg IV with macro setae on genu & erect seta on tarsus-I ..... Subgenus *Amblyseius*  
 – Setae  $Z_5$  shorter, almost as long as distance between their bases; leg I with no macro setae or only one on genu, no erect setae on tarsus-I ..... 6
6. Sternal shield distinct and straight or concave posteriorly, ventrianal shield approximately shield shaped or pentagonal ..... Subgenus *Neoseiulus*  
 – Sternal shield indistinct may be trilobate posteriorly, ventrianal shield elongate, vase shaped or concave laterally ..... Subgenus *Euseius*
7. Seta  $r_3$  on dorsal shield, genu II with 7 setae, genu III with 6 setae ..... Genus *Phytoseius*, 8  
 – Seta  $r_3$  on lateral integument, genu II with 6 setae, genu III with 6 or 7 setae ..... Genus *Typhlodromus*, 9
8. Seta  $R_1$  present ..... Subgenus *Pennaseius*  
 – Seta  $R_1$  absent ..... Subgenus *Phytoseius*
9.  $Z_5$  and  $Z_4$  normally serrate and the former usually knobbed ..... Subgenus *Amblydromella*  
 –  $Z_5$  and  $Z_4$  never serrate,  $Z_5$  always smooth ..... Subgenus *Typhlodromus*

#### Subfamily AMBLYSEIINAE Muma

1961. Amblyseiinae Muma, *Bull. Fla. St. Mus.*, 5(7) : 273.

1986. Amblyseiinae, Gupta, *Fauna of India (Acari : Mesostigmata) Family Phytoseiidae*. p. 32.

#### Genus I. *Amblyseius* Berlese

1914. *Amblyseius* Berlese, *Redia.*, 10 : 43.

1986. *Amblyseius*, Gupta, *Fauna of India (Acari : Mesostigmata) Family Phytoseiidae*. p. 32.

#### 1. *Amblyseius (Amblyseius) largoensis* (Muma)

1955. *Amblyseiopsis largoensis* Muma, *Ann. Ent. Soc. Amer.*, 48 : 266

1986. *Amblyseius (Amblyseius) largoensis*, Gupta, *Fauna of India (Acari : Mesostigmata) Family Phytoseiidae*. p. 51-55.

**Collection records** : 10 (F), 5 (M), Bamankhali, ex. several plants like *Hibiscus rosa-sinensis*, *Nayantara*, *Heritiera fomes*, *Psidium guajava*, *Avicennia alba*, 5.8.2000; 5 (F), 2 (M), *Heritiera fomes*, *Psidium guajava*, *A. alba*, 15.9.2000; 4 (M), 10 (F), Chemaguri, ex. betel vine, *Rhizophora*, neem, 25.9.2000; 3 (F), Bhagabatpur, ex. *Rhizophora* sp., *Avicennia* sp., 17.10.2000.

**Distribution** : INDIA : Arunachal Pradesh, Assam, Nagaland, Manipur, Meghalaya, Tripura, Himachal Pradesh, Bihar, West Bengal, Orissa, Punjab, Gujarat, Uttar Pradesh, Andhra Pradesh, Karnataka, Kerala,, Pondicherry, Tamil Nadu, Andaman-Nicobar Isls. *Elsewhere* : Philippines, Taiwan, Thailand, Hong Kong, Israel, Iran, Japan, New Zealand, South Africa, Kenya, U. S. A, Brazil, Costa Rica, Guatemala, Honduras, Jamaica, Puerto Rico, Trinidad.

**Remarks** : This predatory mite was found to be most abundant in various places of Sundarbans Biosphere Reserve (SBR) occurring on both mangrove plants and agri-horticultural crops. The Phytophagous mites on which this was found to feed upon were eggs and nymphal stages of *Tetranychus urticae*, *Tetranychus neocaledonicus*, *Schizotetranychus* sp. Since this is widely distributed and was found to be voracious feeder, it may turn out to be a good bio-controlling agent.

#### Subgenus *Euseius* Wainstein

1962. *Amblyseius* (*Amblyseius*) section *Euseius* Wainstein, *Acarologia*, 4 : 14.

1986. *Euseius*, Gupta, *Fauna of India* (Acari : Mesostigmata) Family Phytoseiidae, p. 73.

#### Key to the species of *Euseius* known to occur in SBR

1. All setae on dorsal shield minute excepting j<sub>1</sub> and Z<sub>5</sub> ..... *ovalis*  
 – Besides j<sub>1</sub>, Z<sub>5</sub> some other setae also long ..... 2
2. Setae j<sub>3</sub> longer than j<sub>1</sub> ..... *alstoniae*  
 – Setae j<sub>3</sub> and j<sub>1</sub> equal ..... 3
3. Spermatheca bell shaped ..... *coccineae*  
 – Spermatheca elongated ..... *pruni*

#### 2. *Amblyseius* (*Euseius*) *alstoniae* Gupta

1975. *Amblyseius alstoniae* Gupta, *Internat. J. Acarol.* 1(2) : 31-32.

1986. *Amblyseius* (*Euseius*) *alstoniae*, Gupta, *Fauna of India* (Acari : Mesostigmata) Family Phytoseiidae, p. 74-76.

**Collection records** : 2 (F) Bhagabatpur island, ex. *Terminalia arjuna*, 18.10.2000.

**Distribution** : INDIA : Arunachal Pradesh, Assam, Nagaland, Manipur, Meghalaya, Tripura, Himachal Pradesh, Bihar, West Bengal, Orissa, Punjab, Gujarat, Uttar Pradesh, Andhra Pradesh, Karnataka, Kerala,, Pondicherry, Tamil Nadu, Andaman-Nicobar Isls.

### 3. *Amblyseius (Euseius) ovalis* (Evans)

1953. *Typhlodromus ovalis* Evans, *Ann. Mag. nat. Hist.*, 6 : 458-461.

1986. *Amblyseius (Euseius) ovalis*, Gupta, *Fauna of India (Acari : Mesostigmata) Family Phytoseiidae*, p. 92-94.

1987. *Amblyseius (Euseius) ovalis*, Gupta, *Rec. zool. Surv. India, Occ. Pap No. 95*, p. 27-28.

*Collection records* : 3 (F), 7 (M), Namkhana, ex. china rose, 25.9.2000; 3 (F), Bhagabatpur island, ex. betel vine, 18.10.2000; 7 (F), 1 (M), Chandanpiri, ex. chili, 20.10.2000.

*Distribution* : INDIA : Arunachal Pradesh, Assam, Nagaland, Manipur, Meghalaya, Tripura, Bihar, West Bengal, Orissa, Himachal Pradesh, Punjab, Gujarat, Uttar Pradesh, Karnataka, Kerala, Pondicherry, Andhra Pradesh Tamil Nadu, Andaman-Nicobar Isls.

### 4. *Amblyseius (Euseius) coccineae* Gupta

1975. *Amblyseius coccineae* Gupta, *Internat. J. Acarol.*, 1(2) : 33.

1986. *Amblyseius (Euseius) coccineae*, Gupta, *Fauna of India (Acari : Mesostigmata) Family Phytoseiidae*, p. 78-80.

*Collection records* : 4 (F), 1 (M) Namkhana, ex. *Mangifera indica*, 25.9.2000.

*Distribution* : INDIA : Meghalaya, West Bengal, Bihar, Orissa, Madhya Pradesh, Gujarat, Uttar Pradesh, Punjab, Himachal Pradesh, Jammu & Kashmir, Andhra Pradesh, Pondicherry, Tamil Nadu.

*Remarks* : This is another very important predatory species and a voracious feeder of *Tetranychid* mite. In the present study, it was found to feed on all stages of *Oligonychus mangiferus* infesting mango tree.

### 5. *Amblyseius (Euseius) pruni* Gupta

1986. *Amblyseius (Euseius) pruni*, Gupta, *Fauna of India (Acari : Mesostigmata) Family Phytoseiidae*, p. 94-96.

*Collection records* : 3 (F), 2 (M), Bamankhali, Sagar Island, ex. Chalta, 15.11.2000.

*Distribution* : INDIA : Assam, Meghalaya, Tripura, West Bengal, Himachal Pradesh, Jammu & Kashmir.

*Remarks* : This was found feeding upon *Eotetranychus* sp. infesting Chalta tree. It mostly attacked nymphs and adults.

### Subgenus *Neoseiulus* Hughes

1948. *Neoseiulus* Hughes, *The mites associated with stored food products. Minst. Fish. Food. London. H.M. Stationary Office*, p. 141.

1986. *Neoseiulus* Gupta, *Fauna of India (Acari : Mesostigmata) Family Phytoseiidae*, p. 100.

### 6. *Amblyseius (Neoseiulus) fallacis* (Garman)

1948. *Iphidulus fallacis* Garman, *Bull. Conn. Agr. Exp. Sta.*, **520** : 13.  
1958. *Amblyseius fallacis*, Athias-Henriot, *Bull. Soc. Hist. nat. Afr. Nord.*, **49** : 34.  
1986. *Amblyseius (Neoseiulus) fallacis*, Gupta, *Fauna of India (Acari : Mesostigmata) Family Phytoseiidae*, p. 109-111.

*Collection records* : 7 (F), 1 (M), Bhagabatpur Island, ex. *Oryza sativa*, 18.10.2000; 3 (F), Chandanpiri, ex. *Terminalia arjuna*, Mehagani, 20.10.2000; 5 (F), Gosaba, ex. *Oryza sativa*, 8.11.2000.

*Distribution* : INDIA : Assam, Meghalaya, Tripura, West Bengal, Bihar, Himachal Pradesh, Jammu & Kashmir, Punjab, Tamil Nadu, *Elsewhere* : Algeria, Australia, North and Central America, Canada, Caribbean Isls.

*Remarks* : This mite was found to feed effectively on all the stages of *Schizotetranychus andropogoni* and an undetermined species of *Steneotarsonemus* sp. infesting paddy. This appears to be a good biocontrolling agent of paddy mites. The earlier reports also confirm this observation.

### Subgenus *Paraphytoseius* Swirski & Shechter

1961. *Paraphytoseius* Swirski & Shechter, *Israel J. agric. Res.*, **11** : 113.  
1986. *Paraphytoseius*, Gupta, *Fauna of India (Acari : Mesostigmata) Family Phytoseiidae*, p. 122.

### 7. *Amblyseius (Paraphytoseius) multidentatus* (Swirski & Shechter)

1960. *Typhlodromus (Amblyseius) orientalis* Narayanan, Kaur & Ghai, *Proc. Nat. Inst. Sci.*, **26B**(6) : 394.  
1986. *Amblyseius (Paraphytoseius) multidentatus*, Gupta, *Fauna of India (Acari : Mesostigmata) Family Phytoseiidae*, p. 123-126.

*Collection records* : 2 (F), 1 (M), Sajnakhali, ex. Sundari (*Heritiera fomes*), Garjan (*Rhizophora* sp.), 8.11.2001; 1 (F), Gosaba, ex. papaya, 8.11.2001.

*Distribution* : Arunachal Pradesh, Assam, Manipur, Nagaland, West Bengal, Orissa, Bihar, Gujarat, Himachal Pradesh, Punjab, Andaman Nicobar Isls.

*Remarks* : Though it is a very important predatory species and occurs on mostly vegetables (Brinjal) but in the present study this species appeared to be scarce.

### Genus 2. *Indoseiulus* Ehara

1969. *Indoseius* Ghai & Menon, *Oriental Ins.*, **3** : 348.  
1982. *Indoseiulus* Ehara, *Appl. ent. Zool.*, **17** : 42-43.

### 8. *Indoseiulus ricini* (Ghai & Menon)

1969. *Indoseiulus ricini*, Ghai & Menon, *Oriental Ins.*, **3** : 348.

1986. *Indoseiulus ricini*, Gupta, *Fauna of India (Acari : Mesostigmata) Family Phytoseiidae*, p. 195-196.

*Collection records* : 3(F), Sajnakhali, ex. *Avicennia alba*, 8.11.2001.

*Distribution* : INDIA : Arunachal Pradesh, West Bengal, Bihar, Himachal Pradesh, Delhi, Gujarat, Uttar Pradesh, Tamil Nadu.

*Remarks* : This is a very voracious feeder of Tetranychid mites but in the present study such behaviour of this species was not recorded as because the host was free of Tetranychid mites.

### Genus 3. *Iphiseius* Berlese

1916. *Iphiseius* Berlese, *Redia*, **12** : 33.

1921. *Iphiseius*, Berlese, *Redia*, **14** : 95.

### 9. *Iphiseius andamanicus* Gupta

1980. *Iphiseius andamanicus* Gupta, *Entomologists' mon. Mag.*, **115** : 213-214.

1986. *Iphiseius (Iphiseius) andamanicus*, Gupta, *Fauna of India (Acari : Mesostigmata) Family Phytoseiidae*, p. 198-200.

*Collection records* : 1(F), Sajnakhali, ex. Banana, 8.11.2001; 2(F), Lothian Island, ex. *Acanthus* sp. and *Avicennia alba*, 26.1.2002.

*Distribution* : INDIA : West Bengal, Karnataka, Andaman and Nicobar Isls.

### Subfamily PHYTOSEIINAE Berlese

1916. Phytoseiinae Berlese, *Redia*, **112** : 11.

1961. Phytoseiinae, Muma, *Bull. Fla. St. Mus.*, **5**(7) : 292.

### Genus 4. *Phytoseius* Ribaga

1904. *Phytoseius* Ribaga, *Riv. Path. Veg.*, **10** : 177.

1951. *Phytoseius* Nesbitt, *Zool. Verh.*, **12** : 16.

### Subgenus *Pennaseius* Pritchard & Baker

1962. *Pennaseius* Pritchard & Baker, *Hilgardia*, **33** : 223.

### 10. *Phytoseius (Pennaseius) kapuri* Gupta

1969. *Phytoseius (Pennaseius) kapuri* Gupta, *Israel J. agric. Res.*, **19** : 115-117.

1986. *Phytoseius (Pennaseius) kapuri*, Gupta, *Fauna of India (Acari : Mesostigmata) Family Phytoseiidae*, p. 221-223.

*Collection records* : 3 (F), Chemaguri, ex. brinjal, 15.9.2000; 7 (F), Chandanpiri, ex. *Terminalia arjuna*, 20.10.2000.

*Distribution* : INDIA : Arunachal Pradesh, Assam, Manipur, Meghalaya, Nagaland, West Bengal, Bihar, Orissa, Himachal Pradesh, Punjab, Gujarat, Uttar Pradesh, Andhra Pradesh, Pondicherry, Tamil Nadu, Karnataka, Kerala, Andaman and Nicobar Isls.

### ***Phytoseius* Ribaga**

1904. *Phytoseius* Ribaga, *Riv. Path. Veg.*, **10** : 177.

#### **11. *Phytoseius (Phytoseius) corniger* Wainstein**

1959. *Phytoseius (Dubininellus) corniger* Wainstein, *Zool. Zh. Ukr.*, **38** : 1362-1364.

1986. *Phytoseius (Phytoseius) corniger*, Gupta, *Fauna of India (Acari : Mesostigmata) Family Phytoseiidae*, p. 230-232.

*Collection records* : 2 (F), Sagar Island, Bamankhali, ex. *Tabernaemontana coronaria*, brinjal, 5.8.2000.

*Distribution* : INDIA : West Bengal. *Elsewhere* : Pakistan, U.S.S.R.

#### **12. *Phytoseius (Phytoseius) macropilis* (Banks)**

1909. *Sejus macropilis* Banks, *Proc. Ent. Soc. Wash.*, **11** : 135.

1986. *Phytoseius (Phytoseius) macropilis*, Gupta, *Fauna of India (Acari : Mesostigmata) Family Phytoseiidae*, p. 240-242.

*Collection records* : 2 (F), 1 (M) Bamankhali, Sagar Island, ex. brinjal, *Avicennia* sp., 5.8.2000.

*Distribution* : INDIA : Arunachal Pradesh, Orissa, West Bengal, Delhi. *Elsewhere* : Caribbean Isls., Mexico, British West Indis, Panama canal zone, U.S.A., U.S.S.R., U.K., Australia, Canary Isls., New Burnswick.

#### **13. *Phytoseius (Phytoseius) indicus* Bhattacharyya**

1969. *Phytoseius (Phytoseius) indicus* Bhattacharyya, *J. Bom. Nat. Hist. Soc.*, **65**(3) : 679-680.

*Collection records* : 1 (F), Bhagabatpur Isls., ex. banana, 17.10.2000.

*Distribution* : INDIA : West Bengal.

#### **14. *Phytoseius (Phytoseius)* sp.**

*Collection records* : 6 (F), Chandanpiri, ex. guava, 17.10.2000.

Genus 5. *Typhlodromus* Scheuten

1857. *Typhlodromus* Scheuten, *Arch. Naturges*, **23** : 111.

15. *Typhlodromus (Amblydromella) homalii* Gupta

1970. *Typhlodromus homalii* Gupta, *Oriental Ins.*, **4** : 188-189.

1986. *Typhlodromus (Amblydromella) homalii*, Gupta, *Fauna of India (Acari : Mesostigmata) Family Phytoseiidae*, p. 278-280.

*Collection records* : 2 (F), 1 (M), Sajnakhali, ex. *Xylocarpus* sp., 8.11.2001.

*Distribution* : INDIA : West Bengal, Himachal Pradesh, Punjab, Rajasthan.

16. *Typhlodromus (Typhlodromus) communis* Gupta

1980. *Typhlodromus communis* Gupta, *Entomologists' mon. Mag.*, **115** : 209.

1986. *Typhlodromus (Typhlodromus) communis*, Gupta, *Fauna of India (Acari : Mesostigmata) Family Phytoseiidae*, p. 316-318.

*Collection records* : 1 (F), Bhagabatpur, ex. brinjal, 17.10.2000.

*Distribution* : INDIA : West Bengal, Arunachal Pradesh, Karnataka, Tamil Nadu.

## Family II ASCIDAE Voigts &amp; Oudemans

1979. Ascidae Voights & Oudemans, In : *Evans & Till, Trans. Zool. Soc. Lond.*, **135** : 196.

Key to the Genera of *Ascidæ* known to occur in SBR

1. Corniculi slender, approximating, rows of hypognathal denticles narrow, each with few denticles, female with humeral setae ( $r_3$ ), lying off holodorsal shield..... *Blattisocius*
- Corniculi of normal length, well separated, parallel rows of hypognathal denticles wider, multidenticulate, females with humeral setae ( $r_3$ ) situated on dorsal shield\*

\* Adult with 3–9 pairs of R setae on membrane lateral to holodorsal shield, male with sternogenital and ventroanal shields, genu II with 8 or 9 setae ..... *Lasioseius*

Genus 6. *Lasioseius* Berlese

1916. *Lasioseius* Berlese, *Redia*, **12** : 34.

1963. *Lasioseius*, Chant, *Can. J. Zool.*, **41** : 272.

17. *Lasioseius mcgregori* Chant

1963. *Lasioseius mcgregori* Chant, *Can. J. Zool.*, **41** : 276.

1999. *Lasioseius mcgregori*, Dhooria, *J. Acarol.*, **14** : 88-89.

**Collection records** : 2 (F), West Bengal, Gosaba, Tagore Society Agricultural Farm, ex. coconut and *Hibiscus rosa-sinensis*, 8.11.2001.

**Distribution** : INDIA : West Bengal, Punjab. *Elsewhere* : U.S.A.

#### Genus 7. *Blattisocius* Keegan

1944. *Blattisocius* Keegan, *J. Parasitol.*, **30** : 181.

#### 18. *Blattisocius keegani* Fox

1961. *Blattisocius keegani* Fox, 1947, Hughes, *The mites of stored food and houses*, London, p. 328-329.

**Collection records** : 3 (F), Sajnekhali, ex. *Rhizophora* sp., *Heritiera* sp., 8.11.2001.

**Distribution** : INDIA : West Bengal. *Elsewhere* : Poland, Mexico, South America, U.S.A. Hawaii, Malayasia, West Africa, Isreal.

#### Family III TYDEIDAE Karmer

1877. Tydeidae Karmer, *Naturlg.*, **43** : 232, 246.

#### Key to the Genera of Tydeidae known to occur in SBR

1. Femora III & IV each with a prominent forked setae ..... *Parapronematus*
- Setae normal on femora III & IV ..... *Pronematus*

#### Genus 8. *Parapronematus* Baker

1965. *Parapronematus* Baker, *Advances in Acarology*, **2** : 115-116.

#### 19. *Parapronematus* sp.

**Collection records** : 6 (F), Chandanpiri, ex. *Citrus*, Ladys' finger, 17.10.2000.

#### Genus 9. *Pronematus* Canestrini

1886. *Pronematus* Canestrini, *Att. 1<sup>a</sup> Veneto, Sev.*, **6**, **4** : 698.

1965. *Pronematus*, Baker, In : *Advances in Acarology*, **2** : 114.

#### 20. *Pronematus fleschneri* Baker

1962. *Pronematus fleschneri* Baker, *Ann. Ent. Soc. Amer.* **61** : 1092-1093.

1974. *Pronematus fleschneri*, Gupta & Dhooi, *Proc. Ind. Sci. Congr.*, **16** : 69.

**Collection records** : 1 (F), Bamankhali, ex. *Avicennia alba*, 5.8.2000.

**Distribution** : INDIA : Tripura, Sikkim, West Bengal, Bihar, Delhi, Punjab, Uttar Pradesh, Andaman Nicobar Isls.

21. *Pronematus* sp.

*Collection records* : 1 (F), Bamankhali, ex. papaya, 5.8.2000; 6 (F), Chandanpiri, ex. brinjal, papaya, 17.10.2000.

## Family IV BDELLIDAE Duges

1834. Bdellei Duges, *Ann. Sci. nat.* 8(2) : 1(Zool) : 21.

1959. Bdellidae, Meyer & Ryke, *Ann. Mag. nat. Hist.*, (13)2 : 372.

Genus 10. *Bdella* Latreille

1765. *Bdella* Latreille, *Magasin encyclopedique on journal does letters et des Arts. Paris*, Vol. 4 : 18.

22. *Bdella maldahensis* Gupta

1992. *Bdella maldahensis* Gupta, In : *State Fauna Series 3, Fauna of West Bengal, Part-3*, p. 12.

1999. *Bdella maldahensis*, Gupta & Chatterjee, *Sci. & Cult.*, 65 : 161.

*Collection records* : 1 (F), Bamankhali, ex. Cashew nut, 5.8.2000; 2 (F), Chemaguri, ex. papaya, 25.9.2000; 1 (M), Lothian Isls., ex. banana, 17.10.2000.

*Distribution* : INDIA : West Bengal.

## Family V CUNAXIDAE Thor

1902. Cunaxidae Thor, *Verh. Zool. Bot. Ges. Wien.*, 159-164.

1992. Cunaxidae, Smiley, In : *Cunaxidae of the World*. p. 21.

Genus 11. *Cunaxa* Von Heyden

1826. *Cunaxa* Von Heyden, *ISIS of Oken*, 18(6) : 609.

1992. *Cunaxa* Smiley, In : *Cunaxidae of the World*, p. 153.

Key to the species of *Cunaxa* known to occur in SBR

1. Propodosomal shield smooth\*

\* Spine like setae on palp tibiotarsus long and slender ..... *cynodonae*

– Propodosomal shield reticulate/striate\*\*

\*\* Telofemur inner surface with elongate apophysis and dorso median simple setae. *setirostris*

23. *Cunaxa cynodonae* Gupta & Ghose

1980. *Cunaxa cynodonae* Gupta & Ghose, *Rec. zool. Surv. India*, 77 : 196-198.

1992. *Cunaxa cynodonae*, Smiley, In : *Cunaxidae of the World*, p. 166-167.

*Collection records* : 2 (F), 1 (M), Sajnakhali, ex. coconut, cashwe nut, 8.11.2001.

*Distribution* : INDIA : West Bengal, Andaman and Nicobar Islands.

#### 24. *Cunaxa setirostris* Hermann

1804. *Scirus setirostris* Hermann, *Apterologique*, p. 60-62.

1826. *Cunaxa setirostris*, Von Heyden, In : *ISIS of Oken*, 18(6) : 608.

1999. *Cunaxa setirostris*, Gupta & Chatterjee, *Sci. & Cult.*, 65(5-6) : 161.

*Collection records* : 1 (F), Bamankhali, ex. brinjal, 18.8.2000; 1 (M), Lothian Isls., ex. *Avicennia alba*, 17.10.2000.

*Distribution* : INDIA : Arunachal Pradesh, West Bengal, Tripura, Sikkim, Punjab, Andaman Isls., Lakshadwip Isls. *Elsewhere* : Cosmopolitan.

#### Family VI. STIGMAEIDAE Oudemans

1931. Stigmaeidae Oudemans, *Ent. Ber.*, 7(158) : 252.

1992. Stigmaeidae Gupta, In : *State Fauna Series 3, Fauna of West Bengal, Part-3*, p. 117.

#### Genus 12. *Agistemus* Summers

1960. *Agistemus* Summers, *Proc. Ent. Soc. Wash.*, 62 : 234.

#### 25. *Agistemus industani* Gonzalez-Rodriguez

1965. *Agistemus industani* Gonzalez-Rodriguez, *Univ. Calif. Pub. Ent.*, 41 : 40.

1991. *Agistemus industani*, Gupta, *Rec. zool. Surv. India*, 81 : 215.

*Collection records* : 1 (F), Sagar Island, Bamankhali, ex. chilli, 8.8.2000.

*Distribution* : INDIA : Arunachal Pradesh, Mizoram, Nagaland, U. P., Punjab, Tamil Nadu, Karnataka.

*Remarks* : Rai & Singh (1999) reported this as an important predator feeding voraciously on eggs of *Tetranychus ludeni* and they also studied its biology. In the present study, the predatory behaviour of this species was not noticed in the field.

#### Family VII. EUPODIDAE Koch

1842. Eupodidae Koch, *Hept.*, 1-40.

1991. Eupodidae Gupta, *Rec. zool. Surv. India*, 88 : 237.

#### Genus 13. *Eupodes* Koch

1842. *Eupodes* Koch, *Hept.*, 1-40.

1934. *Eupodes*, Thor, *Das. Tierreich.*, 71 : 541.

1992. *Eupodes*, Gupta, In : *State Fauna Series 3, Fauna of West Bengal, Part-3*, p. 144.

### 26. *Eupodes sigmoidensis* Strandtmann & Goff

1978. *Eupodes sigmoidensis* Strandtmann & Goff, *Pacific insects*, **19** : 123-124.

1992. *Eupodes sigmoidensis*, Gupta, In : *State Fauna Series 3, Fauna of West Bengal, Part-3*, p. 144.

*Collection records* : 1 (F), 1 (M), Bamankhali, Sagar Island, ex. chili, betel vine, 14.12.2000.

*Distribution* : INDIA : Sikkim, Mizoram, West Bengal, Lakshadwip Isls.

### Family VIII. CHEYLETIDAE Leach

1815. Cheyletidae Leach, *Trans. Linn. Soc. Lond.*, **11** : 399.

1970. Cheyletidae, Summers & Price, *Univ. Calif. Pub. Ent.*, **61** : 1-153.

1997. Cheyletidae, Gupta & Chatterjee, In : *State Fauna Series 6, Fauna of Delhi*, p. 516-517.

### Genus 14. *Cheletogenes* Oudemans

1905. *Cheletogenes* Oudemans, *Ent. Ber. Nad. Ver.*, **1**(21) : 208.

1970. *Cheletogenes*, Summers & Price, *Univ. Calif. Pub. Ent.*, **61** : 53.

### 27. *Cheletogenes ornatus* (Canestrini & Fanzago)

1878. *Cheyletus ornatus* Canestrini & Fanzago, *Atti. Soc. Vent. Trentene.*, p. 106.

1941. *Cheletogenes ornatus*, Womersley, *Rec. S. Aust. Mus.*, **7**(1) : 85.

1985. *Cheletogenes ornatus*, Gupta, *Handbk. Plant mites of India*, p. 300.

1997. *Cheletogenes ornatus*, Gupta & Chatterjee, In : *State Fauna Series 6, Fauna of Delhi*, p. 516-517.

*Collection records* : 4 (F), Sajnakhali, ex. mango, banana, 8.11.2001.

*Distribution* : INDIA : West Bengal, Uttar Pradesh, Delhi, Rajasthan, Cosmopolitan.

*Remarks* : Narayanan *et al.*, 1960 and Sharma & Kushwaha, 1983 reported this mite feeding upon mango bud mite, ber gall mite, respectively, and the latter workers studied the bioecology of this species. In the present study no predatory behavior of this species was noticed in the field.

### Family IX. ERYTHRAEIDAE Robineau-Desvoidy

1828. Erythraeidae Robineau-Desvoidy, *K.H.O.A.*, **IIID** : 144.

1970. Erythraeidae, Meyer, *Koedoe*, **13** : 32.

### Genus 15. *Sphaerolophus* Berlese

1885. *Rhyncholophus* Berlese, *AMS.*, **18** : 7.

1914. *Sphaerolophus*, Oudemans, *ARC. Naturgesch.*, **79A** : 1.

## 28. *Sphaerolophus gigas* Khot

1965. *Sphaerolophus (Cavannae) gigas* Khot, *Acarologia*, 7 : 64.

1997. *Sphaerolophus gigas*, Gupta & Chatterjee, In : *State Fauna Series 6, Fauna of Delhi*, p. 520.

*Collection records* : 2 (F), 1 (M), Sajnakhali, Sundarban, ex. *Rhizophora* sp. and *Heritiera* sp., 8.11.2001.

*Distribution* : INDIA : Delhi, West Bengal.

## SUMMARY

This paper provides for the first time a detailed taxonomic account of 28 species under 15 genera and 9 families of predatory mites occurring on mangrove and agri-horticultural crops of Sundarbans Biosphere Reserve (SBR), among these the occurrence of 18 species are reported for the first time in SBR. This includes 6 species found to be voracious feeders of phytophagous mites and were abundantly available indicating that their conservation and proper utilisation may prove to be profitable in biological control.

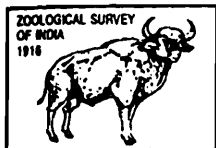
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## A POPULATION SURVEY OF HANUMAN LANGURS IN THE DISTRICT OF PURULIA, WEST BENGAL

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### INTRODUCTION

Field studies on the non-human primates of West Bengal has been done was by Southwick *et al.* (1964); Oppenheimer (1973, 1977); Bhuinya *et al.* (1993); Mandal (1964); Mukherjee & Gupta (1965); Mukherjee *et al.* (1986, 1995). This report deals with the information regarding distribution, abundance, social composition and status of Hanuman langur of the Purulia district, West Bengal. Two species of monkeys have been recorded from Purulia district of West Bengal; the rhesus macaque, *Macaca mulatta* and Hanuman langur, *Semnopithecus entellus*. The rhesus macaque is restricted in its distribution exclusively in the forest areas of the southwestern part of the district (Ajodhya hill), while the Hanuman langur is widely distributed in the villages, urban and semi-urban areas of the entire district. These two common primate species are found in many parts of India in almost all types of habitat, ranging from open land, high montane forest region to arid zone.

### STUDY AREAS

Purulia, the southwestern district of West Bengal lies between 20°43'–23°12' N and 85°49'–86°54' E. The total area of the district is about 6259 km<sup>2</sup>. Metalloid or non-metalloid motorable roads connect majority of the villages in the district. The topography and general characteristics of the district are those of upland on the west and swelling ridges of laterite soil in the rest of the district. Traditional agricultural could not develop due to inhospitable edaphic and climatic conditions as well as poor natural resources. Purulia is well known as a drought prone district and falls within the sub tropical, semi-arid region of the state of West Bengal and is characterized by high evaporation and low precipitation. The atmospheric temperature varies from 7°C to 46°C from winter to summer respectively. Rainfall in the district is erratic in nature, average rainfall during last 10 years is 1270 mm. Subarnarekha, Silabati, Kasai, Kumari are the main non-perennial rivers which dry up in summer.

The vegetation of the district is tropical dry deciduous in nature. The common trees are dhaw, *Anogeissus latifolia*; jam, *Syzygium cumini*; palash, *Buta monosperma*; amloki, *Phyllanthus emblica*; babla, *Acacia nilotica*; mohua, *Madhuca indica*; “sidha”, “kend”, “kusum”, “asan” etc. The sal (*Shorea robusta*) gains supremacy on the fallers lands and foot of the hills, in the plateau. The rocks and rugged steep slopes are devoid of any vegetation. The district is known for the lac production in the state.

## METHODS

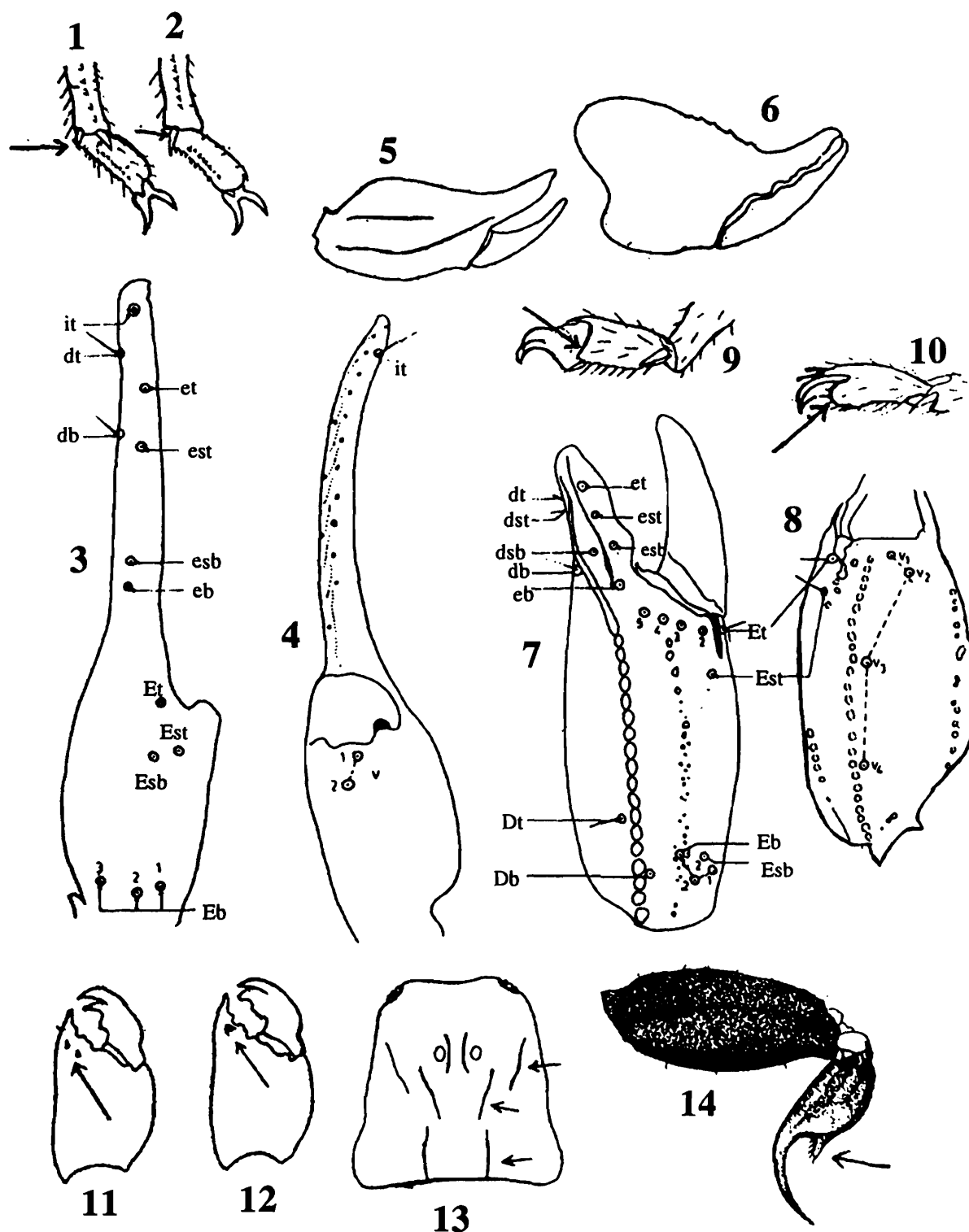
The survey techniques used here involved slow driving vehicle along open roads at an average speed of 20 km per hour. Motorable roads link almost majority of the villages of Purulia district. The surveys were done from 0700 to 1130 hours and from 1500 to 1800 hours, with four observers. The survey trips were made during September 2002, February 2003 and repeated the entire area in September 2003. A total of 300 hours were spent in the census work. About 1200 km road with 500 m stretch on either side of the road including villages, markets, fields, orchards, gardens, towns etc were surveyed. Thus one-kilometer linear distance survey is equivalent to 1 sq. km. Total count and sweep sampling methods were used to estimate the population.

The visual and auditory signals were utilized for locating the groups and villagers were also inquired about the presence of monkey groups. On locating the group, notes on their social composition, habitat and interactions with human were recorded. Individuals were classified into 4 broad categories based on the morphological differences and age, viz., adult males > 4 years, adult females > 3 years, juveniles 18–24 months and infants < 18 months. In some groups individuals could not be sexed due to quick disappearance in the undulating forest terrain.

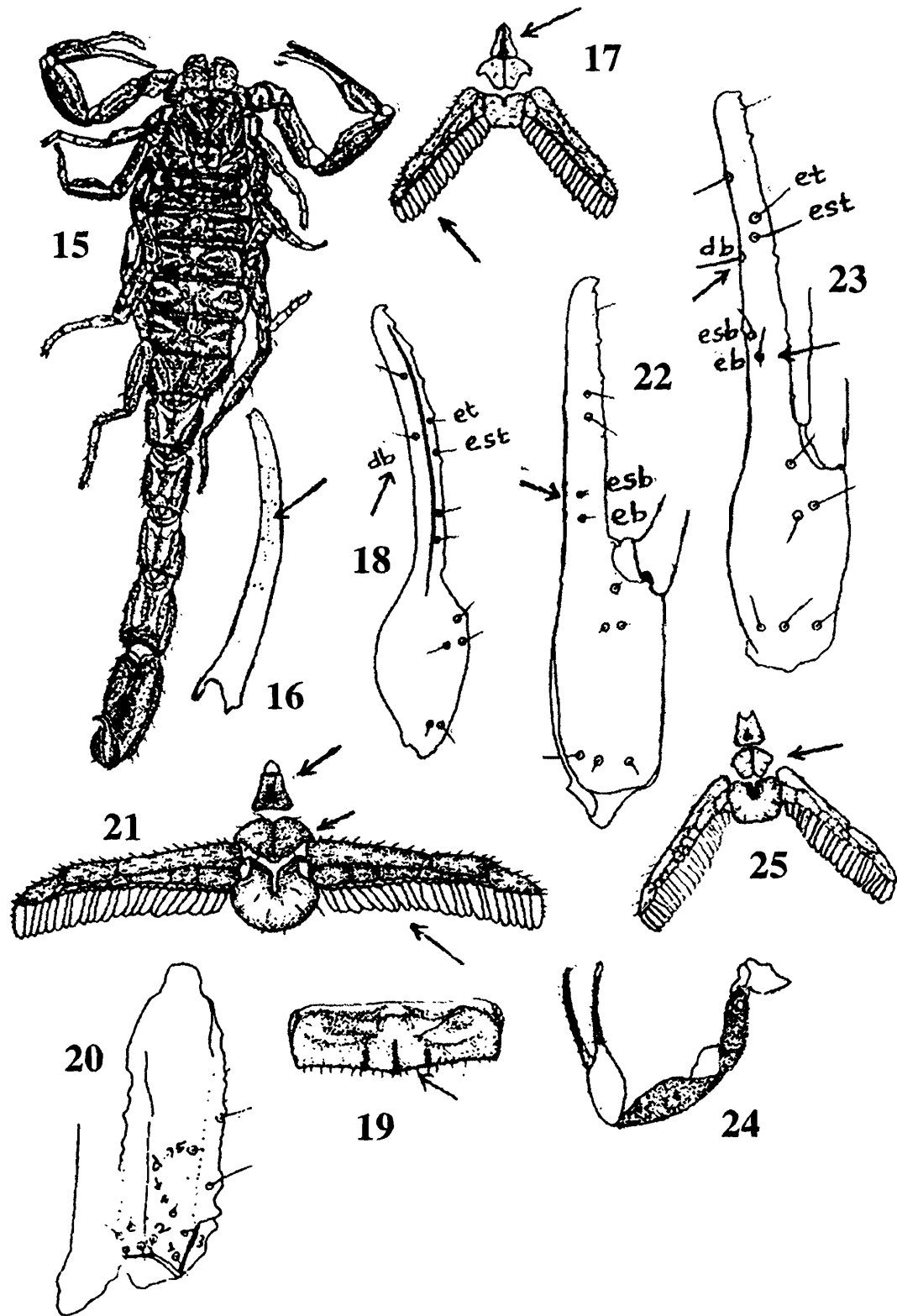
## RESULTS

Results from the survey revealed the sighting of 56 groups of hanuman langur, of which 7 were all male groups, 2 groups of unclassified sexes and rests 47 were bisexual groups. The 56 groups contained 839 langurs, of which 120 adult males. 387 adult females; 149 juveniles; 163 infants and 20 unclassified sexes. The group size varied from 2 to 36. The distribution of hanuman langur is shown in Fig. 3. This gives a population estimate of 0.046 groups per sq. km and 0.70 individuals per sq. km respectively.

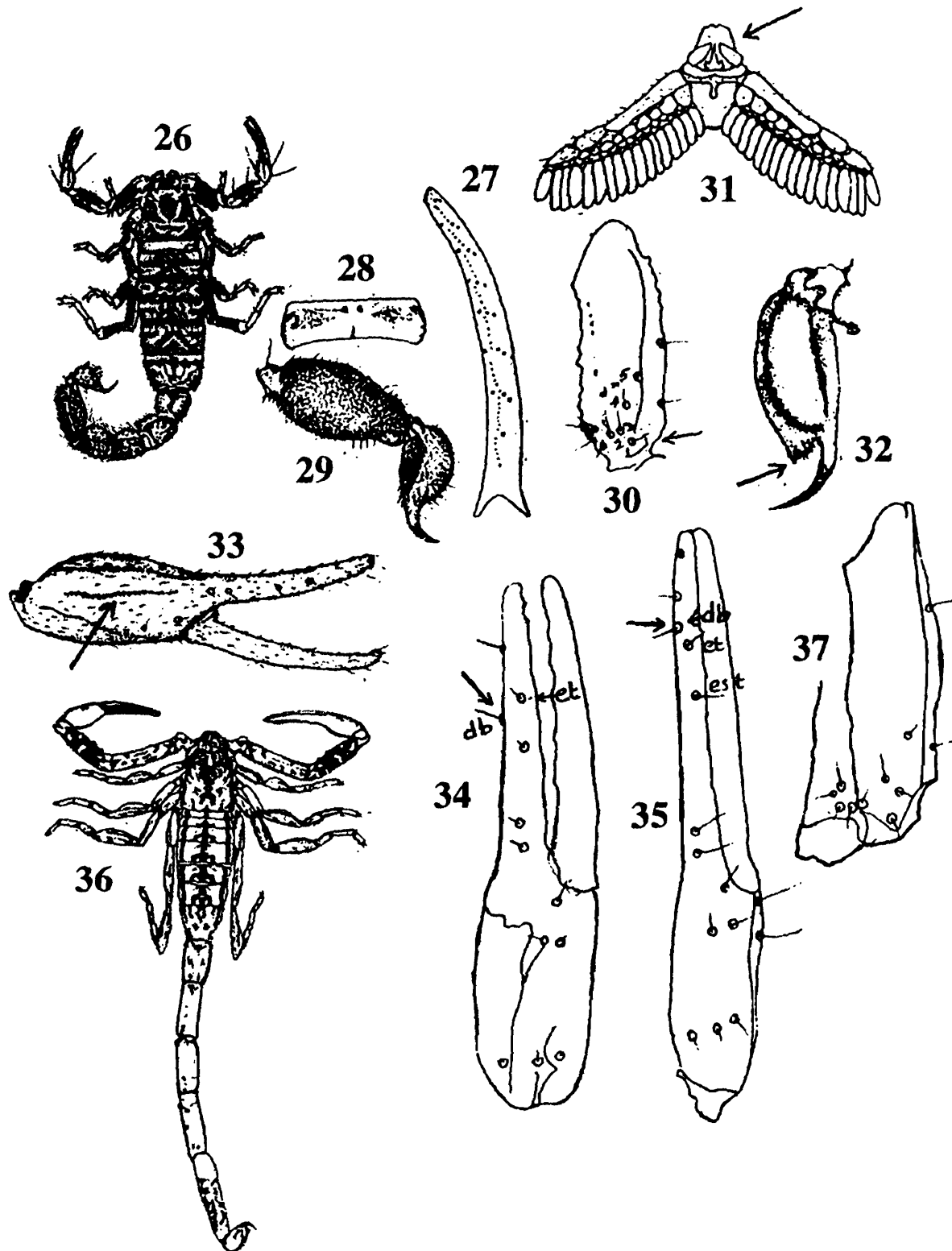
The 7 all male group contained 41 monkeys. Of the 7 all male group, 5 groups containing 33 langurs inhabited on the northern part of the districts remaining 2 groups with 8 langurs inhabited on the southern part. These langurs found inhabiting the northern parts were found close to the bisexual groups in the villages. The 2 unclassified groups of 20 individuals were recorded at the northeastern part of the district. The individual counts were not possible due to rapid disappearance.



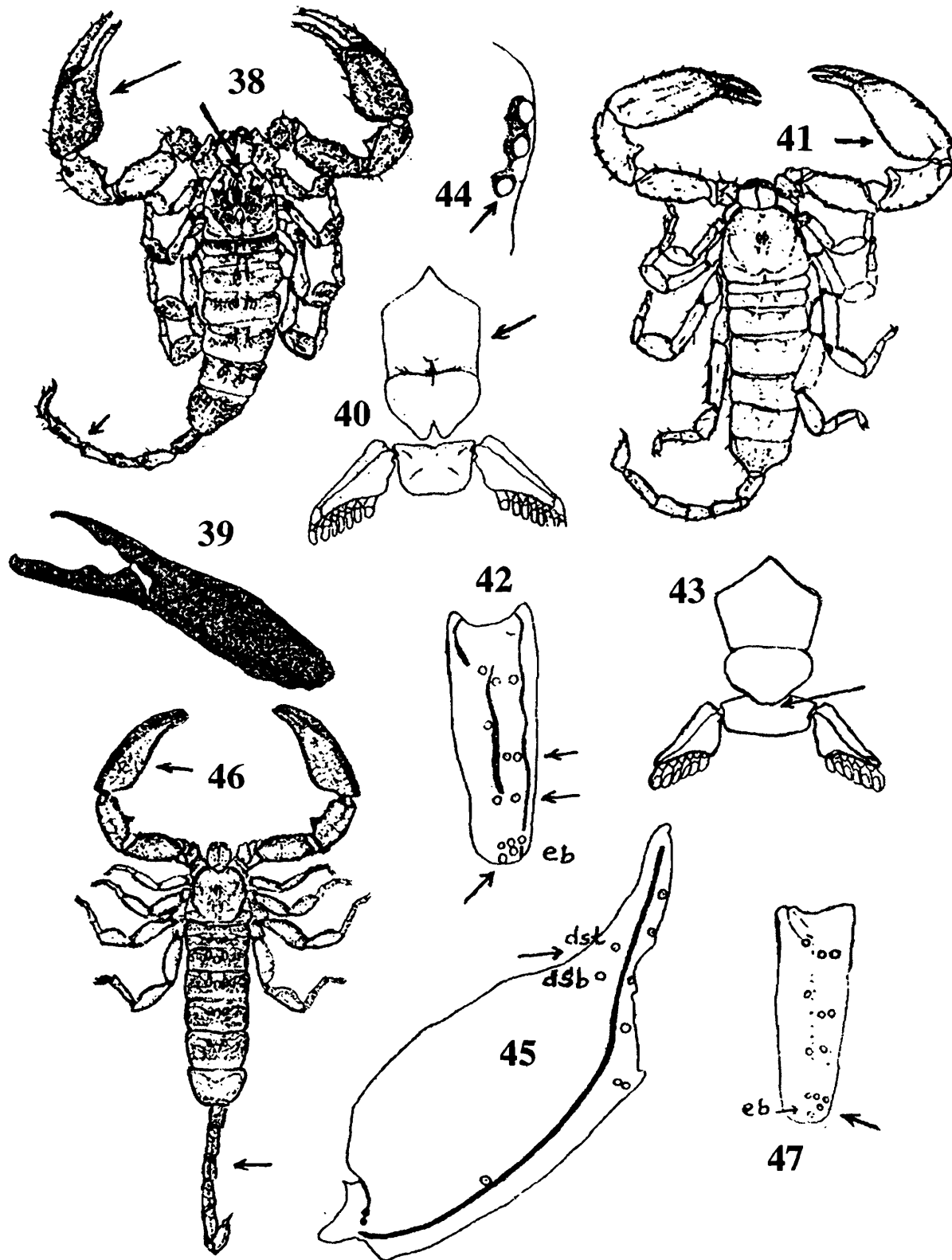
**Figs. 1-14.** Distal portion of tarsomere I. 1. with a pair of pedal spurs (family Buthidae); 2. with single pedal spur (families Ischnuridae and Scorpionidae). 3-4. Manus and immovable finger of pedipalp with 'A' type trichobothrial pattern (family Buthidae) 3. dorsal view; 4. ventral view. 5-6. Manus and hand of pedipalp : 5. flat, in Ischnuridae 6. not flat in Scorpionidae. 7-8. Manus and immovable finger of pedipalp with 'C' type trichobothrial pattern (families Ischnuridae and Scorpionidae) 7. dorsal view; 8. ventral view. 9-10. Lateral view of tarsomere II of leg : 9. family Ischnuridae, 10. family Scorpionidae. 11-12. Ventral view of chelicera : 11. with two teeth on immovable finger, 12. with single tooth on immovable finger. 13. Carapace of *Lychas* dorsal view 14. *Lychas* (*Alterotrichus*) *hendersoni* : Telson and anal rim of metasomal segment V lateral view



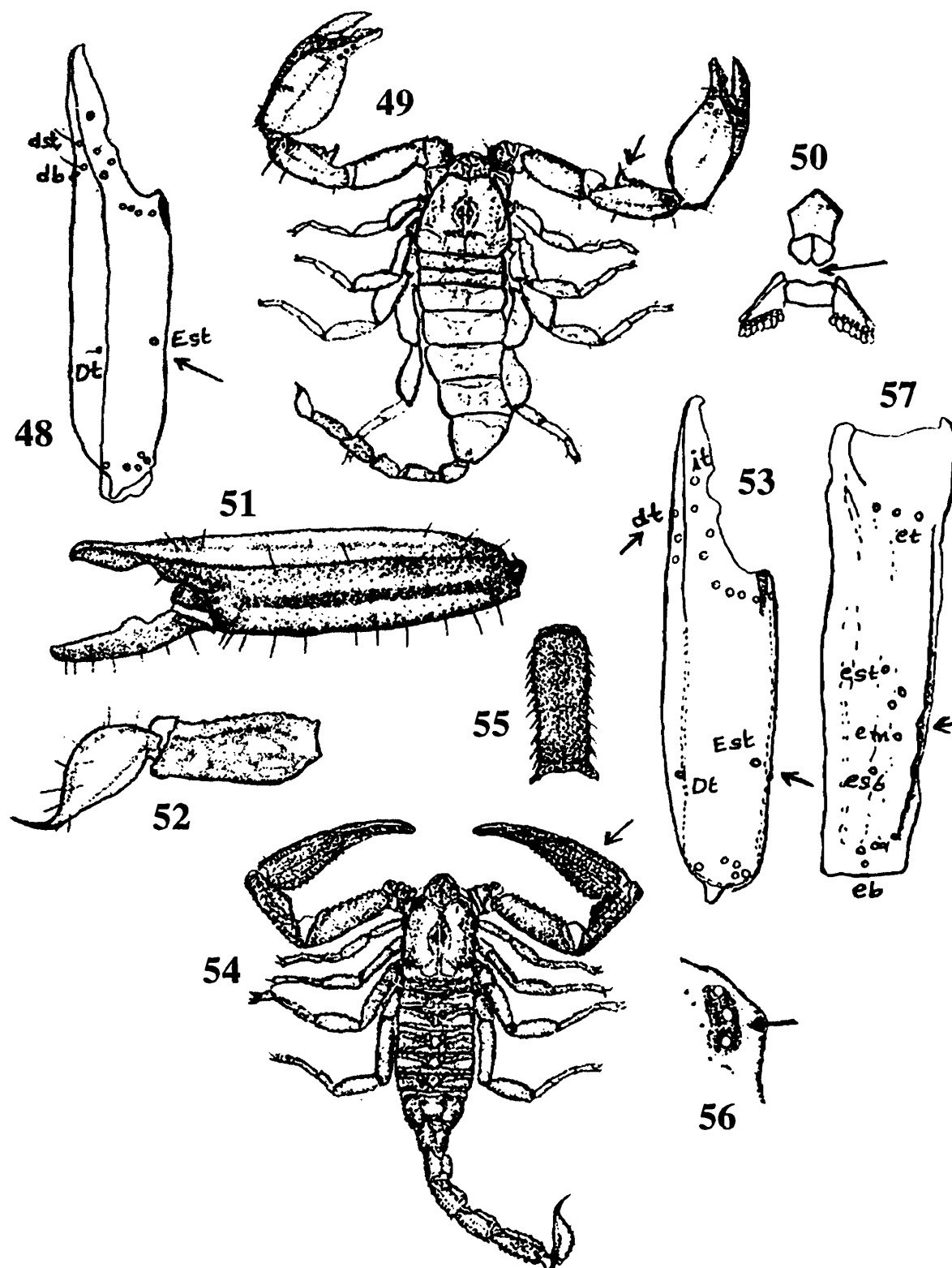
**Figs. 15-25.** *Lychas (Alterotrichus) hendersoni* female : 15. dorsal view; 16. movable finger of pedipalp dorsal view; 17. pectines, genital operculum and cephalothoracic sternum ventral view, 18. manus and immovable finger of pedipalp dorso-exterior view. showing trichobothria 19-22. *Lychas (Endotrichus) tricarinatus* female; 19. tergite dorsal view; 20. femur of pedipalp dorsal, interior and exterior views showing trichobothria; 21. pectines, genital operculum and sternum ventral view. 23-25. *Lychas (Endotrichus) albimanus* female : 23. manus and immovable finger of pedipalp dorsal view showing trichobothria; 24. pedipalp dorsal view; 25. pectines, genital operculum and sternum ventral view.



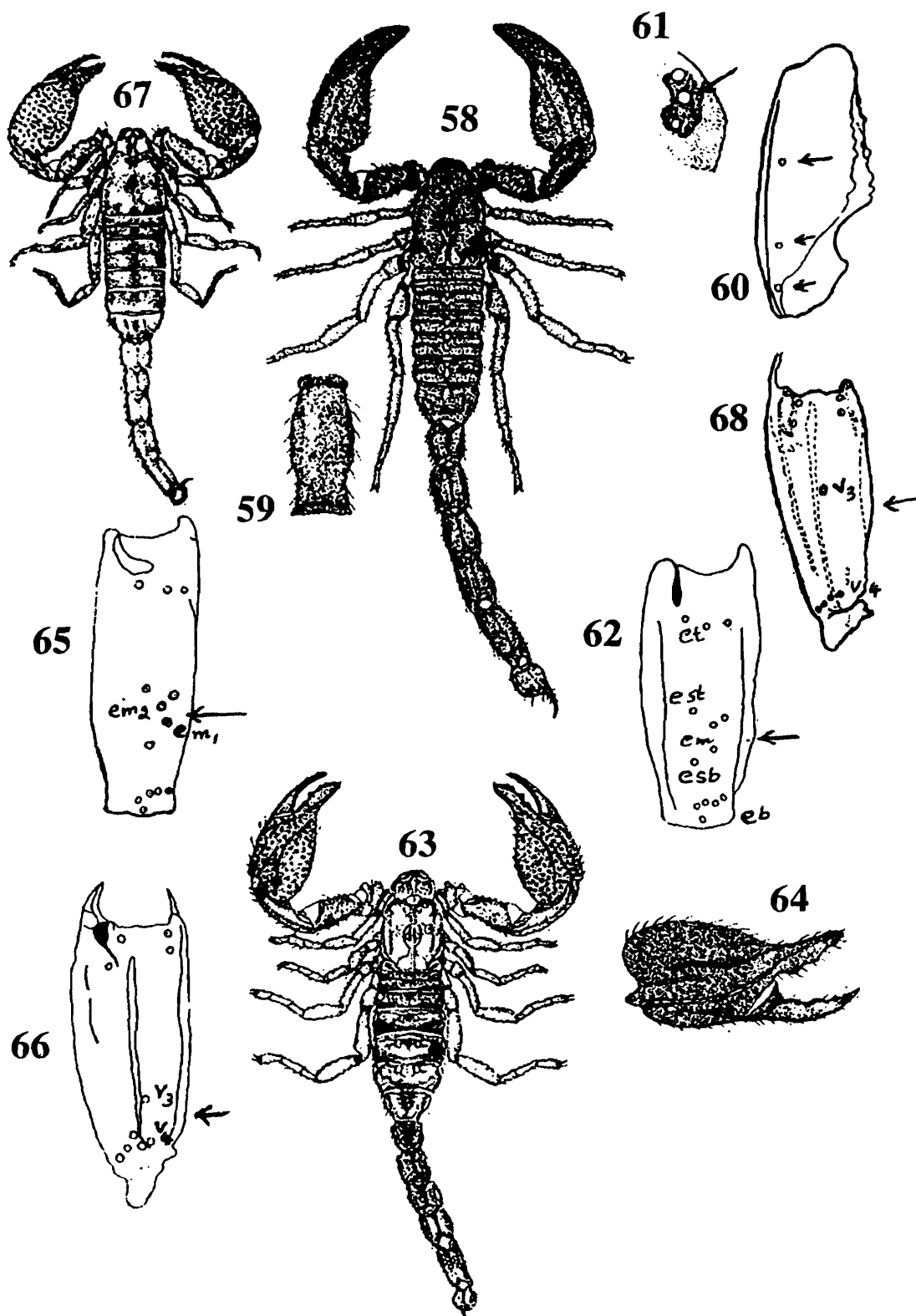
**Figs. 26-37.** *Charmus indicus* male : 26. dorsal view; 27. movable finger of pedipalp dorsal view; 28. tergite dorsal view; 29. telson and metasomal segment V lateral view; 30. femur of pedipalp dorsal, interior and exterior views showing trichobothria; 31. pectines, genital operculum and sternum, ventral view. 32-34. *Isometrus (Reddyanus) brachycentrus* female : 32. telson and anal rim of metasomal segment V lateral view; 33. manus and fingers of pedipalp exterior view; 34. manus and fingers of pedipalp exterior view showing trichobothria. 35-37. *Isometrus (Closotrichus) sankeriensis* female; 35. manus and fingers of pedipalp exterior view showing trichobothria; 36. body dorsal view; 37. femur of pedipalp dorsal, interior and exterior views showing trichobothria.



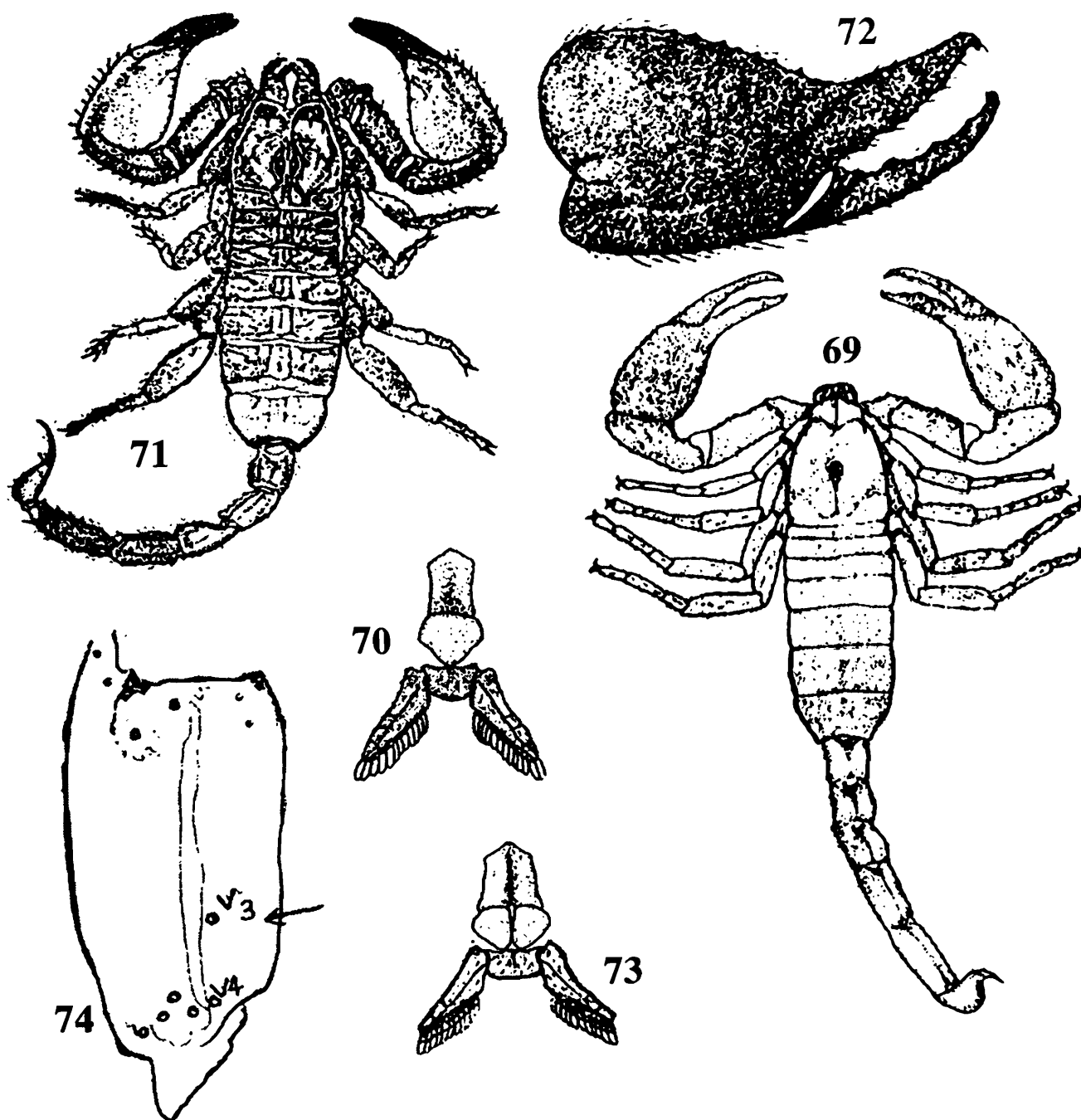
**Figs. 38-47.** *Chiromachetes fergusonii* female : 38. dorsal view; 39. manus and fingers exterior view; 40. pectines, genital operculum and sternum ventral view. 41-45. *Liiocheles laeviceps laeviceps* female : 41. dorsal view; 42. patella of pedipalp exterior view showing trichobothria; 43. pectines, genital operculum and sternum ventral view; 44. lateral eyes lateral view; 45. manus and immovable finger of pedipalp dorsal view showing trichobothria. 46-47. *Liiocheles laeviceps malabarensis* female : 46. dorsal view; 47. patella of pedipalp exterior view showing trichobothria.



**Figs. 48-57.** *Liocheles laeviceps malabarensis* female, manus and immovable finger of pedipalp exterior view. 49-53. *Hormurus australasiae* male : 49. dorsal view; 50. pectines, genital operculum and sternum ventral view; 51. manus and fingers exterior view; 52. telson and metasomal segment V lateral view; 53. manus and immovable finger of pedipalp exterior view showing trichobothria. 54-57. *Heterometrus (Heterometrus) keralaensis* male : 54. dorsal view; 55. metasomal segment V ventral view; 56. lateral eyes lateral view; 57. patella of pedipalp exterior view showing trichobothria.



**Figs. 58-68.** *Heterometrus (Heterometrus) malapuramensis* male : 58. dorsal view; 59. metasomal segment V ventral view; 60. patella of pedipalp ventral view showing trichobothria; 61. lateral eyes lateral view; 62. patella of pedipalp exterior view showing trichobothria. 63-66. *Heterometrus (Srilankametrus) gravimanus* male : 63. dorsal view; 64. manus and fingers exterior view; 65. patella of pedipalp exterior view showing trichobothria; 66. manus of pedipalp ventral view showing trichobothria. 67-68. *Heterometrus (Chersonesometrus) granulomanus* male : 67. dorsal view; 68. manus of pedipalp ventral view showing trichobothria.



**Figs. 69-74.** *Heterometrus (Chersonesometrus) scaber* female; 69. dorsal view; 70. pectines, genital operculum and sternum ventral view. 71-74. *Heterometrus (Chersonesometrus) kanaraensis* male : 71. dorsal view; 72. manus and fingers exterior view; 73. pectines, genital operculum and sternum ventral view; 74. manus of pedipalp ventral view showing trichobothria.

## INTERESTING SPECIES RECORDS OF SCORPIONS FROM KERALA

### Family ISCHNURIDAE

#### 1. *Chiromachetes fergusonii* Pocock

1899. *Chiromachetes fergusonii* Pocock. *J. Bombay nat. Hist. Soc.* **12** : 744.

*Material examined* : 1 Female, 5 young ones, Kerala : Quilon district : Thenmala range forest, Kazhuthurutti, 9.viii.1997. Coll. P. M. Sureshan (Reg. No. 10439).

*Distribution* : India : Kerala : Trivandrum (Type locality), Quilon.

*Remarks* : The species is endemic to Kerala and reported from the state from a place very near to the type locality after the original description in 1899.

### Family SCORPIONIDAE

#### 2. *Heterometrus (Chersonesometrus) kanaraensis* (Pocock)

1900. *Palamnaeus scaber kanaraensis* Pocock, *Fauna Brit. India Arachn.* 93.

1981. *Heterometrus (Chersonesometrus) phipsoni kanaraensis*. *Couzijn. Zool. Verln.* **184** : 151.

*Material examined* : Kerala : Parambikulam Wildlife Sanctuary : 1 male, Parambikulam, 24.iii.1997, 1 male, Pezhakunnu, 27.iii.1997. Coll. K. C. Gopi (Reg. No. 10664 & 10075); 5 young ones, Kamathalachi, 30.x.1995, 1 female, 1 male, Anchupoolai, 3.ii.1995, 1 female, 1 male, Pulikkal, 1.xi.1995, 3 young ones, Sirkarpathi, 29.x.1995, 1 female, Venkoli, 27.x.1995, Coll. P. M. Sureshan (Reg. Nos. 8450, 8451, 8454, 8456, 8457).

*Distribution* : India : Karnataka : Kanara (Type locality); Maharashtra : Bombay; Kerala.

*Remarks* : Though the species is reported for the first time from Kerala it seems commonly distributed in the forested tracts of southern Western Ghats since represented by good numbers in the present collection.

## SYSTEMATIC LIST

### Family BUTHIDAE

#### Subfamily BUTHINAE

#### 1. *Lychas (Alterotrichus) hendersoni* Pocock

1897. *Lychas hendersoni* Pocock. *J. Bombay nat. Hist. Soc.*, **11** : 111.

#### 2. *Lychas (Endotrichus) tricarinatus* Simon

1884. *Lychas tricarinatus* Simon. *Ann. Mus. civ. sto. nat. Genova* **20** : 371.

3. *Lychas (Endotrichus) albimanus* Henderson  
1919. *Lychas albimanus* Henderson. *Rec. Indian Mus.* **16**(5) : 379-381.
4. *Charmus indicus* Hirst.  
1915. *Charmus indicus* Hirst. *Ann. Mag. nat. Hist.*, **15**(8) : 224-225.

#### Subfamily CENTRURINAE

5. *Isometrus (Reddyanus) brachycentrus* Pocock  
1899. *Isometrus brachycentrus* Pocock. *J. Bombay nat. Hist. Soc.* **12** : 263.
6. *Isometrus (Closotrichus) sankeriensis* Tikader & Bastawade  
1983. *Isometrus (Closotrichus) sankeriensis* Tikader & Bastawade. *Fauna India. Scorpions.* III. 311.

#### Family ISCHNURIDAE

7. *Liocheles laeviceps laeviceps* (Pocock)  
1890. *Iomachus laeviceps* Pocock. *Ann. Mag. nat. Hist.*, **5**(6) : 242.
8. *Liocheles laeviceps malabarensis* (Pocock)  
1900. *Iomachus laeviceps malabarensis* Pocock. *Fauna Brit. India. Arachn.* : 82.
9. *Hormurus australasiae* (Fabr.)  
1775. *Scorpio australasiae* Fabr., *Syst. Ent.*, : 399.  
1990. *Hormurus australasiae* : Pocock, *Fauna Brit. India, Arachn.*, : 79.
10. *Chiromachetes fergusonii* Pocock  
1899. *Chiromachetes fergusonii* Pocock. *J. Bombay nat. Hist. Soc.* **12** : 744.

#### Family SCORPIONIDAE

##### Subfamily SCORPIONINAE

11. *Heterometrus (Heterometrus) keralaensis* Tikader and Bastawade  
1983. *Heterometrus (Heterometrus) keralaensis* Tikader and Bastawade. *Fauna of India. Scorpions.* III. 528.
12. *Heterometrus (Heterometrus) malapuramensis* Tikader and Bastawade  
1983. *Heterometrus (Heterometrus) malapuramensis* Tikader and Bastawade. *Fauna of India. Scorpions.* III. 533.

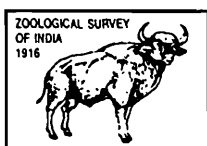
13. *Heterometrus (Srilankametrus) gravimanus* (Pocock).  
 1894. *Scorpio gravimanus* Pocock. *Ann. Mag. nat. Hist.* **13**(6) : 75  
 1900. *Palamnaeus gravimanus* Pocock. *Fauna Brit. India. Arachn.* 90.  
 1981. *Heterometrus (Srilankametrus) indus indus* Couzijn. *Zool. Verln.* **184** : 121.
14. *Heterometrus (Chersonesometrus) granulomanus* Couzijn  
 1981. *Heterometrus (Chersonesometrus) granulomanus* (Couzijn). *Zool. Verln.* **184** : 142.
15. *Heterometrus (Chersonesometrus) scaber* (Thorell)  
 1877. *Pandinus scaber* Thorell. *Atti. Soc. Ital.* **19** : 202.  
 1981. *Heterometrus (Chersonesometrus) scaber scaber* Couzijn. *Zool. Verln.* **184** : 144.
16. *Heterometrus (Chersonesometrus) kanaraensis* (Pocock)  
 1900. *Palamnaeus scaber kanaraensis* Pocock. *Fauna Brit. India. Arachn.* : 93.  
 1981. *Heterometrus (Chersonesometrus) phipsoni kanaraensis* Couzijn. *Zool. Verln.* **184** : 151.

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- Tikader, B. K. and D. B. Bastawade, 1983. Fauna of India. Scorpions. III. Calcutta. i-xiii & 1-671.
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*Rec. zool. Surv. India* : **103** (Part 1–2) : 59-66, 2004

## **ADDITIONS TO THE ECHINODERM FAUNA OF GREAT NICOBAR ISLAND, BAY OF BENGAL**

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### **INTRODUCTION**

Great Nicobar is the southernmost island of the Andaman and Nicobar Islands located in the Bay of Bengal. Sastry (1999) gave an account of 18 species of echinoderms known till then from this Island. During the recent intensive explorations one of us (SP) collected material of 33 species of asteroid, ophiuroid, echinoid and holothurian. Of these, only six species namely, *Dactylosaster cylindricus* (Asteroidea), *Ophiocoma dentata*, *Ophiocoma erinaceus*, *Ophiocoma scolopendrina*, *Ophiomastix annulosa* (Ophiuroidea), and *Echinometra mathaei* (Echinoidea), have been reported earlier. The present report adds 27 species to the echinoderm fauna of the Great Nicobar Island. Thus the echinoderm fauna of the Great Nicobar Island comprises of 45 species. Clark and Rowe (1971) gave details of distribution in the Indo-West Pacific region and keys for the identification (up to genus only in case of holothurians). Details of description, distribution and keys for the holothurians reported herein can be found in James (1987a,b,c, 1995a,b). Since all the species are already known from other islands, these have been briefly listed below, with details of localities of collection. The material is deposited in the collections of the Centre of Advanced Study in Marine Biology, Annamalai University, Parangipettai-608 502. Though all the species are already known from Andaman and Nicobar Islands, with only a few new to Nicobar group, the present report is considered necessary keeping in view the requirement of faunal diversity of individual islands for declaration and management of Protected Areas.

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\* Zoological Survey of India, Port Blair-744 102

Phylum ECHINODERMATA

Class ASTEROIDEA

Order PAXILLOSIDA

Family ASTROPECTINIDAE

1. *Astropecten polyacanthus* Mueller and Troschel

*Material* : Poonam Nalla, 22.02.2002, one spec.

*Remark* : The species is newly recorded from Nicobar group of islands.

Order VALVATIDA

Family ARCHASTERIDAE

2. *Archaster typicus* (Mueller and Troschel)

*Material* : Chingen, 02.02.2003, one spec.; Pigeon Island, 12.02.2003, one spec.

Family OPHIDIASTERIDAE

3. *Dactylosaster cylindricus* (Lamarck)

*Material* : Trinket Choplong Bay, 28.02.2002, one spec.; Indira Point, 03.02.2003, one spec.

4. *Linckia guildingi* Gray

*Material* : Galathea Bay, 11–13.02.2002, one spec.; Vijaya Nagar, 02.03.2002, one spec.

*Remark* : The species is newly recorded from Nicobar group of islands.

5. *Linckia laevigata* (Linnaeus)

*Material* : Trinket Choplong Bay, 28.02.2002, one spec.; Pigeon Island, 17.03.2002, one spec.

*Remark* : The species is newly recorded from Nicobar group of islands.

6. *Linckia multifora* (Lamarck)

*Material* : Alexandra Bay, 17.02.2003, one spec.

Family ASTEROPSEIDAE

7. *Asteropsis carinifera* (Lamarck)

*Material* : Prem Nalla, 20.02.2002, one spec.

*Remark* : The species is newly recorded from Nicobar group of islands.

## Class OPHIUROIDEA

## Family OPHIOTHRICIDAE

8. *Macrophiothrix longipeda* (Lamarck)

**Material** : Swarup Nalla, 27.01.2003, one spec.

**Remark** : The species is newly recorded from Nicobar group of islands.

## Family OPHIOCOMIDAE

9. *Ophiarthrum elegans* Peters

**Material** : Alexandra Bay, 17.02.2003, one spec.; Inhengloi, 14.02.2003, one spec.; Kopenheat, 17.02.2003, four specs.; Pilo Bet, 16.02.2003, arm bits; Pilo Bhabi, 17.02.2003, one spec.; Sastry Nagar, 27.01.2003, four specs.

**Remark** : The species is newly recorded from Nicobar group of islands.

10. *Ophiarthrum pictum* Mueller and Troschel

**Material** : Sastry Nagar, 27.01.2003, one spec.

11. *Ophiocoma dentata* Mueller and Troschel

**Material** : Poonam Nalla, 26.01.2003, one spec.

12. *Ophiocoma erinaceus* Mueller and Troschel

**Material** : Chingen, 02.02.2003, arm bits, Indira Point, 03.02.2003, two specs.; Inhengloi, 14.02.2003, one spec.; Keechad Nalla, 16.02.2003, two specs.; Lakshmi Nagar, 07.03.2002, one spec.; Pigeon Island, 17.03.2002, one spec.; Pilo Bet, 16.02.2003, one spec.; Poonam Nalla, 22.02.2002, four specs.; Sastry Nagar, 27.01.2003, three specs.; Vijaya Nagar, 25.01.2003, two specs.

13. *Ophiocoma scolopendrina* (Lamarck)

**Material** : Alexandra Bay, 17.02.2003, seven specs.; Chingen, 02.02.2003, four spec.; Dongi Nalla, 20.01.2003, one spec.; Galathea Bay, 11–13.02.2002, two specs.; Galathea Bay, 01.02.2003, seven specs.; Indira Point, 03.02.2003, eight specs.; Inhengloi, 14.02.2003, one spec.; Keechad Nalla, 16.02.2003, two specs.; Kopenheat, 17.02.2003, one spec.; Magar Nalla, 21.01.2003, three specs.; Pigeon Island, 17.03.2003, one spec.; Pigeon Island, 12.02.2003, three specs.; Pilo Bet, 16.02.2003, two spec.; Pilo Bhabi, 17.02.2003, three specs.; Poomam Nalla, 26.01.2003, four specs.; Prem Nalla, 20.02.2002, one spec.; Prem Nalla, 23.01.2003, three spec.; Sastry Nagar, 27.01.2003, one spec.; Sippy Nalla, 22.01.2003, three specs.; Swarup Nalla, 27.01.2003, one spec.; Vijaya Nagar, 25.01.2003, three specs.

**14. *Ophiomastix annulosa* (Lamarck)**

**Material :** Chingen, 02.02.2003, one spec.; Indira Point, 03.02.2003, two specs.; Inhengloi, 14.02.2003, one spec.; Keechad Nalla, 16.02.2003, one spec.; Kopenheat, 17.02.2003, one spec.; Lakshmi Nagar, 07.03.2002, one spec.; Pigeon Island, 17.03.2002, an arm only; Pilo Bet, 16.02.2003, one spec.; Poonam Nalla, 22.02.2002, one spec.; Prem Nalla, 20.02.2002, one spec.; Prem Nalla, 23.01.2003, arm bits; Sastry Nagar, 27.01.2003, one spec.; Swarup Nalla, 27.01.2003, one spec.; Vijaya Nagar, 02.03.2002, one spec.; Vijaya Nagar, 25.01.2003, one spec.

Family OPHIURIDAE

Subfamily OPHIOLEPIDINAE

**15. *Ophioplocus imbricatus* (Mueller and Troschel)**

**Material :** Galathea Bay, 11–13.02.2002, one spec.; Sippy Nalla, 22.01.2003, one spec.

**Remark :** The species is newly recorded from Nicobar group of islands.

Class ECHINOIDEA

Order DIADEMATOIDA

Family DIADEMATIDAE

**16. *Diadema savignyi* Michelin**

**Material :** Galathea Bay, 11–13.02.2002, one spec.; Magar Nalla, 21.01.2003, one spec.; Poonam Nalla, 22.02.2002, one spec.; Prem Nalla, 20.02.2002, one spec.; Vijaya Nagar, 02.03.2002, one spec.; Vijaya Nagar, 25.01.2003, one spec.

**Remarks :** The defferentiating characters of *Diadema savignyi* and *D. setosum* are not easy to observe in presserved specimens. The tridentate pedicellariae are very few and presence or absence of a red ring around anal region cannot be ascertained in preserved specimens. As such, the material of *D. setosum* reported earlier (Sastry, 1999) could belong to the species reported here or *vice versa*.

**17. *Echinothrix calamaris* (Pallas)**

**Material :** Pigeon Island, 17.03.2002, one spec.; Prem Nalla, 20.02.2002, two specs.

**Remark :** The species is newly recorded from Nicobar group of islands.

**18. *Echinothrix diadema* (Linnaeus)**

**Material :** Lakshmi Nagar, 07.03.2002, two specs.; Poonam Nalla, 22.02.2002, one spec.

## Order ECHINOIDA

## Family ECHINOMETRIDAE

19. *Echinometra mathaei* (de Blainville)

**Material** : Galathea Bay, 11–13.02.2002, two specs.; Prem Nalla, 20.02.2002, two specs.; Poonam Nalla, 22.02.2003, two specs.; Vijaya Nagar, 02.03.2002, two specs.; Lakshmi Nagar, 07.03.2002, one spec.; Pigeon Island, 17.03.2002, one spec.; Alexandra Bay, 17.02.2003, one spec.; Dongi Nalla, 20.01.2003, one spec.; Keechad Nalla, 16.02.2003, one spec.; Magar Nalla, 21.01.2003, three specs.; Pigeon Island, 12.02.2003, one spec.; Poonam Nalla, 26.01.2003, one spec.; Prem Nalla, 23.01.2003, three specs.; Sippy Nalla, 22.01.2003, one spec.; Swarup Nalla, 27.01.2003, one spec.; Vijaya Nagar, 25.01.2003, two specs.

20. *Echinostrephus molaris* (de Blainville)

**Material** : Vijaya Nagar, 25.01.2003, one spec.

**Remark** : The species is newly recorded from Nicobar group of islands.

## Order CLYPEASTEROIDA

## Family ARACHNOIDIDAE

21. *Arachnoides placenta* (Linnaeus)

**Material** : Campbell Bay, 12.01.2003, three specs.

**Remark** : The species is newly recorded from Nicobar group of islands.

## Class HOLOTHUROIDEA

## Order ASPIDOCHIROTIDA

## Family HOLOTHURIIDAE

22. *Actinopyga echinites* (Jaeger)

**Material** : Sastry Nagar, 31.12.2000, two specs.; Near Dillon Nalla, 06.01.2001, one spec.; Indira Point, 15.01.2001, one spec.

**Remark** : The species is newly recorded from Nicobar group of islands.

23. *Holothuria (Acanthotrapeza) pyxis* Selenka

**Material** : Galathea Bay, 12.01.2001, one spec.; Vijaya Nagar, 24.01.2001, three specs.

**Remark** : The species is newly recorded from Nicobar group of islands.

24. *Holothuria (Lessonothuria) pardalis* Selenka

**Material** : Near Prem Bahadur Nalla, 04.02.2001, two specs.

**25. *Holothuria (Metriatyla) scabra* Jaeger**

*Material* : Sastry Nagar, 31.12.2000, one spec.

*Remark* : The species is newly recorded from Nicobar group of islands.

**26. *Holothuria (Microthele) nobilis* (Selenka)**

*Material* : Vijaya Nagar, 24.01.2001, two specs.

*Remark* : The species is newly recorded from Nicobar group of islands.

**27. *Holothuria (Platyperona) difficilis* Semper**

*Material* : Near Prem Bahadur Nalla, 02.02.2001, two specs.

**28. *Holothuria (Thymiosycia) arenicola* Semper**

*Material* : Near Dillon Nalla, 06.01.2001, two specs.

**29. *Holothuria (Thymiosycia) hilla* Lesson**

*Material* : Galathea Bay, 14.01.2001, two specs.

*Remark* : The species is newly recorded from Nicobar group of islands.

**Family LABIDODEMATIDAE****30. *Labidodemas rugosum* (Ludwig)**

*Material* : Near Magar Nalla, 05.01.2001, three specs.

*Remark* : The species is newly recorded from Nicobar group of islands.

**Family STICHOPODIDAE****31. *Stichopus variegatus* Semper**

*Material* : Near Magar Nalla, 23.01.2001, two specs.; Vijaya Nagar, 24.01.2001, two specs.; Indira Point, 15.01.2001, three specs.

**Order DENDROCHIROTIDA****Family PHYLLOPHORIDAE****32. *Afrocucumis africana* (Semper)**

*Material* : Near Magar Nalla, 23.01.2001, two specs.

*Remark* : The species is newly recorded from Nicobar group of islands.

## Order APODIDA

## Family SYNAPTIDAE

33. *Synapta maculata* (Sluiter)

*Material* : Sastry Nagar, 31.12.2000, one spec.; Near Dillon Nalla, 24.01.2001, one spec.

## SUMMARY

Recent collections from the Great Nicobar Island consisted of 33 species of echinoderms including seven species of Asteroidea, eight species of Ophiuroidea, six species of Echinoidea and 12 species of Holothuroidea. Of these, only six species, namely *Dactylosaster cylindricus* (Asteroidea), *Ophiocoma dentata*, *Ophiocoma erinaceus*, *Ophiocoma scolopendrina*, *Ophiomastix annulosa* (Ophiuroidea), and *Echinometra mathaei* (Echinoidea), are among the 18 species known from earlier reports. The total number of echinoderm species is 45. The 33 species collected recently have been briefly reported with details of localities. Some of these are recorded for the first time from Nicobar group of islands.

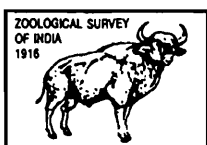
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## **SOME BEE-FLIES (BOMBYLIIDAE : DIPTERA) FROM THAR DESERT**

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### **INTRODUCTION**

The members of the family Bombyliidae known as, bee-flies are usually dominant in the tropics and subtropics. They are one of those economically important group of the suborder Brachycera, and act as pollinators in forests, and of agricultural crops.

The Great Indian desert popularly known as Thar desert covers part of the four Indian states viz. Punjab, Haryana, Rajasthan and Gujarat. The present account on Bombyliidae fauna pertains to the state of Rajasthan and Gujarat as this is the area which has been best explored and studied faunistically.

Our knowledge of the bee-fly fauna of the Thar desert is limited. Kumar & Kumar (1996) have reported only 2 species under 2 genera from this area, and recently Parui and Mitra (2000) also reported another 3 species under 2 genera.

The present study revealed 10 species of bee-flies under 8 genera of 4 subfamilies. Of them 5 species (\* marked) under 4 genera of 4 subfamilies are reported for the first time from the Indian part of Thar desert area. Comprehensive keys to the subfamilies, genera and species of Bombyliidae treated here are given.

### **LIST OF SPECIES**

#### **A. Subfamily TOXOPHORINAE**

- \*1. *Toxophora javana* Wiedemann

#### **B. Subfamily BOMBYLIINAE**

- \*2. *Bombylius maculatus* Fabricius

## C. Subfamily ANTHRACINAE

3. *Petrorossia albofulva* (Walker)
4. *Petrorossia nigrofemorata* (Brunetti)
5. *Anthrax bipunctatus* Fabricius
- \*6. *Argyromoeba duvaucelii* (Macquart)

## D. Subfamily EXOPROSOPINAE

7. *Thyridanthrax (Exhylanthrax) absalon* (Wiedemann)
8. *Exoprosopa (Exoprosopa) collaris* (Wiedemann)
- \*9. *Ligyra aurantiaca* (Guérin-Méneville)
- \*10. *Ligyra oenomaus* (Rondani)

## SYSTEMATIC ACCOUNT

## Key to the subfamilies

1. Praefurca comparatively long; 2<sup>nd</sup> longitudinal vein originating (in knee-shaped form) from it approximately opposite anterior cross vein (at almost half way between origin of praefurca and the cross vein, and this only in some species of *Argyromoeba*); antenna widely separated at base; frons in ♂ nearly as wide as in ♀ ..... 2
  - Praefurca comparatively short, 2<sup>nd</sup> longitudinal vein originating acutely (not in knee-shaped form) always much nearer to origin of praefurca than of anterior cross vein; antennae nearly always approximate at base; eyes in ♂ normally contiguous or nearly so, sometimes distinctively separated; frons in ♂ always much narrower than ♀ ..... 3
2. Antennal style with a pencil of hairs at end; metapleura bare; squamae with a hairy fringe. .... *Anthracinae*
  - Antennal style devoid of hairs at end; metapleura hairy; squamae with scaly fringe ..... *Exoprosopinae*
3. Head as wide as or a little wider than thorax; abdomen more or less cylindrical, bare or with bristly hairs; antennae very long, especially 1<sup>st</sup> joint; thorax more or less humped, generally with conspicuous bristle; 2<sup>nd</sup> longitudinal vein with loop ..... *Toxophorinae*
  - Head generally narrower than thorax; abdomen short and rounded; frequently with dense furry pubescence; antennae approximate at base; thorax generally arched; 2<sup>nd</sup> longitudinal vein never with a strong loop near tip ..... *Bombyliinae*

## A. Subfamily TOXOPHORINAE

Genus *Toxophora* Meigen

*Toxophora* Meigen, 1803, *Magazin InsektKde.*, 2 : 270. Type-species : *Toxophora maculata* Meigen

**\*1. *Toxophora javana* Wiedemann**1821. *Toxophora javana* Wiedemann, *Dipt. exot.*, : 179.

**Material examined** : 1 ♂, Ghata village, Balaram-Ambaji wildlife sanctuary, 13.viii.2000, Coll. P. Parui.

**Diagnosis** : Antennae very long, prominent, horizontal, approximate at the base; vertex very small, black with a pair of strong ocellar bristles; thorax black, humped with a coating of very small, oblong, brownish scales lying flat on the surface; abdomen black, long narrow, with a layer of small brownish scales as on the thorax; three posterior cells.

**Distribution** : Gujarat, Tamil Nadu, Uttar Pradesh; Jawa, Krakatau.

**Remarks** : This is the first report from the Indian part of Thar Desert.

**B. Subfamily BOMBYLIINAE****Genus *Bombylius* Linnaeus**

1758. *Bombylius* Linnaeus, *Syst. Nat. Ed.*, 10 : 606. Type-species : *Bombylius major* Linnaeus.

**\*2. *Bombylius maculatus* Fabricius**1775. *Bombylius maculatus* Fabricius, *Syst. Ent.*, : 803.

**Material examined** : 1 ♂, 1 ♀, Iswania hill, Balaram-Ambaji wildlife sanctuary, 8.viii.2000, Coll. P. Parui.

**Diagnosis** : Head in ♂ black; frons with elongate white or yellowish-white scales; antennae black; thorax black, a pair of faint bluish well-separated narrow stripes visible on the denuded surface; abdomen black, black hairs surround the tip of the abdomen; wings clear, costal cell yellowish, whole base of wing as far as humeral cross-vein dark brown.

**Distribution** : Gujarat, Orissa, Tamil Nadu.

**Remarks** : This is the first report from the Indian part of Thar Desert.

**C. Subfamily ANTHRACINAE****Key to the genera**

1. Body large, hairy; third antennal joint short, onion shaped (sometimes more conical), with styliform prolongation always bisected near tip, and bearing an apical pencil of hairs .  
..... *Argyromoeba* Schiner
- Body small, less hairy; third antennal joint forming a style-like cone with microscopic apical bristle, no pencil of hairs ..... 2
2. Body hairy; wing almost clear ..... *Anthrax* Scopoli
- Body bare; wing membrane wrinkled, not clear ..... *Petrorossia* Bezzi

Genus *Petrorossia* Bezzi

1909. *Petrorossia* Bezzi, Z. syst. Hymenopt. Dipterol., 8 : 32. Type-species : *Bibio hesperus* Rossi.

## Key to the species

1. 2<sup>nd</sup> vein originating in a knee just beyond half way between base of discal cell and anterior cross vein, upper branch of 2<sup>nd</sup> vein forming a very distinct downward loop towards its end ..... *nigrofemorata* (Brunetti)
- 2<sup>nd</sup> longitudinal vein normally with a distinct curve, followed by a distinct downward one just before tip, anterior cross vein at one third of discal cell, placed some distance beyond tip of praefurca ..... *albofulva* (Walker)

3. *Petrorossia albofulva* (Walker)

1852. *Anthrax albofulva* Walker, *Insecta Saundersiana*, 1 : 182.

*Material examined* : 'Not examined'

*Distribution* : Gujarat, Uttar Pradesh.

4. *Petrorossia nigrofemorata* (Brunetti)

1909. *Argyromoeba nigrofemorata* Brunetti, *Rec. Indian Mus.*, 3 : 219.

*Material examined* : 'Not examined'

*Distribution* : Gujarat, Uttar Pradesh.

Genus *Anthrax* Scopoli

1763. *Anthrax* Scopoli, *Ent. Carniolica* : 358. Type-species : *Musca morio* Linnaeus.

5. *Anthrax bipunctatus* Fabricius

1805. *Anthrax bipunctatus* Fabricius, *Syst. Antliat.*, : 118.

*Material examined* : 'Not examined'

*Diagnosis* : Body large; antennae blackish, 3<sup>rd</sup> joint reddish brown; vertex blackish grey, rather shining, with some brown hairs on hind margin; thorax black, moderately shining, with very sparse pubescence; abdomen black, with short sparse black pubescence and a patch of small elongate snow-white scales towards each side of dorsum of 1<sup>st</sup> segment; wings very dark, blackish brown at base, the colour diminishing distally and posteriorly, but the lightest part of the wing at least pale brown.

*Distribution* : Assam, Bihar, Gujarat, Tamil Nadu, West Bengal; Bangladesh, Pakistan.

Genus *Argyromoeba* Schiner

1860. *Argyromoeba* Schiner, *Wien. ent. Monatschr.*, 4 : 51. Type-species : *Anthrax tripunctata* Wiedemann.

\*6. *Argyromoeba duvaucelii* (Macquart)

1840. *Anthrax duvaucelii* Macquart, *Dipt. exot.*, 2(1) : 63.

*Material examined* : 1 ♂, Sambalpani, Balaram-Ambaji Wild life Sanctuary, 10.viii.2000, Coll. P. Parui.

*Diagnosis* : Body moderate; antennae black, with a slight grayish-white shimmer; vertex with a distinct but short and deep indentation; thorax dark, sides of thorax with long thick grayish-white scaly pubescence; the dorsum with sparse yellowish short hairs round the edges; abdomen blackish grey, 2<sup>nd</sup> segment distinctly but not greatly longer than the five remaining ones; venter blackish with short white hairs; wings almost clear, costa slightly darker, several isolated spots present, devoid of baso-costal oblique band, anal cell open.

*Distribution* : Gujarat, Himachal Pradesh, Uttar Pradesh, West Bengal; Pakistan.

*Remarks* : This is the first report from the Indian part of Thar Desert.

## D. Subfamily EXOPROSOPINAE

## Key to the genera

1. Ocellar tubercle a long way from vertex; antennal segment 3 like an elongated cone, with a style divided from it by a distinct suture; wing with 3 to 4 submarginal cells; claws usually with along sharp basal tooth ..... 2
  - Ocelli more or less close to vertex; antennal style mostly not divided by a suture; wing with 2 submarginal cells only; claws usually without basal tooth, or at most with a small and obtuse tubercle ..... *Thyridanthrax* Osten Sacken
2. Antennal segment 3 with a terminal style bearing a microscopic bristle; 3 submarginal cells in wing ..... *Exoprosopa* (Macquart)
  - Antennal segment 3 with a terminal style bearing a minute appendage; 4 submarginal cells in wing ..... *Ligyra* (Newman)

Genus *Thyridanthrax* Osten Sacken

1886. *Thyridanthrax* Osten Sacken, *Biologia cent.-am. (Zool.)*, : 123, Type-species : *Thyridanthrax selene* Osten Sacken.

7. *Thyridanthrax (Exhyalanthrax) absalon* (Wiedemann)

1828. *Anthrax absalon* Wiedemann, *Analecta Ent.*, : 24.

*Material examined* : 'Not examined'

**Diagnosis** : Head semicircular; proboscis short; antennae porrect, short, wide apart at base, 1<sup>st</sup> joint short, cylindrical, 2<sup>nd</sup> cup shaped, 3<sup>rd</sup> varying from elongate conical to flat onion-shaped; thorax quadrate, with rounded angles; abdomen flat, oblong; wings brown with more or less hyaline spots.

**Distribution** : Gujarat, Maharashtra, Orissa, Tamil Nadu; Sri Lanka, Malayasia.

### Genus *Exoprosopa* (Macquart)

1840. *Exoprosopa* Macquart, *Dipt. exot.*, 2(1) : 35. Type-species : *Anthrax pandora* Fabricius.

### 8. *Exoprosopa* (*Exoprosopa*) *collaris* (Wiedemann)

1828. *Anthrax collaris* Wiedemann, *Aussereurop. zweifl. Insekt.*, 1 : 271.

**Material examined** : 'Not examined'

**Diagnosis** : Frons distinctly narrower at vertex than above antennae; probosis dark, withdrawn; antennal 1<sup>st</sup> and 2<sup>nd</sup> joints ferruginous, 3<sup>rd</sup> black; thorax black, with sparse black pubescence, covered with very short depressed yellowish brown scale like hairs; abdomen black, the sides often more or less reddish; wings pale grey with the basal third dark brown, a small clear spot at upper corner of 2<sup>nd</sup> basal cell, with a small yellowish spot immediately above it, and a slight pale yellowish tinge about the middle of the 1<sup>st</sup> posterior cell.

**Distribution** : Rajasthan.

### Genus *Ligyra* Newman

1841. *Ligyra* Newman, *Entomologist*, 1 : 220. Type-species : *Anthrax bombylifformis* Macleay.

### Key to the species

1. Wing dark blackish brown, without any considerable clear or nearly clear part .....  
.....*aurantiaca* (Guérin-Méneville)
- Wing with apical part and considerable portion of posterior half practically clear .....  
.....*oenomaus* (Rondani)

### \*9. *Ligyra aurantiaca* (Guérin-Méneville)

1844. *Anthrax aurantiaca* Guérin-Méneville, *Icon., du regne anim. Dipt.*, 3 : 539.

**Material examined** : 1 ♂, Balaram nursery, Balaram-Ambaji wildlife sanctuary, 17.viii.2000, Coil. P. Parui.

**Distribution** : Gujarat, Arunachal Pradesh, Bihar, West Bengal.

**Remarks** : This is the first report from the Indian part of Thar Desert.

**\*10. *Ligyra oenomaus* (Rondani)**

1875. *Hyperalonia oenomaus* Rondani, *Annali Mus. Civ. Stor. nat. Giacomo Doria*, 7 : 453.

**Material examined** : 2 ♂, Balaram nursery, Balaram-Ambaji wildlife sanctuary, 17.viii.2000, Coil. P. Parui.

**Distribution** : Gujarat, Arunachal Pradesh, Assam, Sikkim, West Bengal; Borneo, Malaysia, Philippines.

**Remarks** : This is the first report from the Indian part of Thar Desert.

### SUMMARY

The distribution pattern of 10 species of the family Bombyliidae so far known from the Indian part of Thar desert shows that all the species are predominantly Oriental in distribution. Of them, 8 species (80%) are restricted to the Oriental region, whereas the remaining 2 species (20%) extend beyond the limit of this region. Of the 8 species distributed in the Oriental region, 6 species namely, *B. maculatus*, *P. albofulva*, *P. nigrofemorata*, *E. (E) collaris*, *L. aurantiaca* and *L. oenomaus* are endemic to India, and *E. (E) collaris* is restricted to Rajasthan.

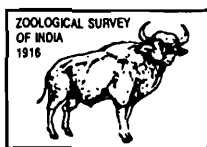
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## THREATENED AND ENDEMIC FISHES OF TRIPURA WITH COMMENTS ON THEIR CONSERVATION

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### INTRODUCTION

Tripura is a hilly state located in the sub-Himalayan region of the North-East India. It is surrounded on the North, West, South-East by Bangladesh (Erswhile East Pakistan). In the East of this state it has a common boundary with Assam and Mizoram. Physiographically, this state represents the western fringe of the typical ridge and valley structural province of the late Tertiary fold mountain belt, generally known as the Indo-Burmese Ranges or Purbachal Ranges. A perusal of the existing literature, viz., Datta (1977), Nair (1977), Lipton (1983–84), Bhattacharya (1988) and Barman (1988, 1989, 1990, 1991, 1992, 1994 & 2002) on the fish fauna of Tripura shows that this state harbours 129 species of fishes under 78 genera, 33 families and 11 orders. The diagnostic features of all these 129 species of fishes along with a short description of the state with reference to its fisheries aspect, topography and drainage pattern of the river systems of Tripura have been provided by the present author in a separate publication (Barman, 2002). The fishes of this state have been reviewed in respect of its threatened species. The threatened species of this state has been designated as per Molur and Walker (1998) and Menon (1999). Out of these 129 species this state contains 28 vulnerable, 10 endangered and 4 rare species of fishes of India. This state also contains 4 Endemic species of our country. The present paper deals only with the vulnerable, endangered, rare species and endemic species of India found in Tripura. Some comments for protection and conservation of the fish fauna of Tripura are furnished in this communication.

### 1. NAMES OF THE THREATENED SPECIES

#### A. Names of the vulnerable species

Order CLUPEIFORMES

Family CLUPEIDAE

1. *Tenualosa ilisha* (Hamilton)

## Order CYPRINIFORMES

## Family CYPRINIDAE

2. *Aspidoparia jaya* (Hamilton)
3. *Barilus barila* (Hamilton)
4. *Puntius chola* (Hamilton)
5. *P. conchoni* (Hamilton)
6. *Barbodes sarana sarana* (Hamilton) (= *Puntius sarana sarana*)
7. *Cirrhinus reba* (Hamilton)
8. *Cyprinion semiplotus* (= *Semiplotus semiplotus*) (McClelland)
9. *Labeo pangusia* (Hamilton)
10. *Chagunius chagunio* (Hamilton)
11. *Garra gotyla gotyla* (Gray)

## Family COBITIDAE

12. *Botia almora* Gray (= *Botia rostrata*)

## Family BALITORIDAE

13. *Noemacheilus scaturigina* (McClelland)

## Order SILURIFORMES

## Family BAGRIDAE

14. *Rita rita* (Hamilton)
15. *Mystus bleekeri* (Day)
16. *M. vittatus* (Bloch)
17. *Aorichthys aor* (Hamilton)
18. *Aorichthys seenghala* (Sykes)

## Family SCHILBEIDAE

19. *Ailia coila* (Hamilton)
20. *Clupisoma garua* (Hamilton)

## Family PANGASIIDAE

21. *Pangasius pangasius* (Hamilton)

## Family SISORIDAE

22. *Bagarius bagarius* (Hamilton)

Family CLARIIDAE

23. *Clarias batrachus* (Linnaeus)

Family HETEROPNEUSTIDAE

24. *Heteropneustes fossilis* (Bloch)

Order CHANNIFORMES

Family CHANNIDAE

25. *Channa orientalis* Bloch & Schneider

Order PERCIFORMES

Family MUGILIDAE

26. *Sicamugil cascasia* (Hamilton)

27. *Rhinomugil corsula* (Hamilton)

Family ANABANTIDAE

28. *Anabas testudineus* (Bloch)

**B. Names of the Endangered species**

Order ANGUILLIFORMES

Family ANGUILLIDAE

1. *Anguilla bengalensis* (Gray)

Order OSTEOGLOSSIFORMES

Family NOTOPTERIDAE

2. *Chitala chitala* (Hamilton) (= *Notopterus chitala*)

Order CYPRINIFORMES

Family CYPRINIDAE

3. *Raiamas bola* (Hamilton)

4. *Tor putitora* (Hamilton)

5. *Tor tor* (Hamilton)

Order SILURIFORMES

Family SILURIDAE

6. *Ompok bimaculatus* (Bloch)

7. *O. pabda* (Hamilton)

## Family SCHILBEIDAE

8. *Pseudeutropius atherinoides* (Bloch)
9. *Eutropiichthys vacha* (Hamilton)

## Family SISORIDAE

10. *Glyptothorax cavia* (Hamilton)

**C. Names of the Rare species**

## Order CYPRINIFORMES

## Family CYPRINIDAE

1. *Barilius nelsoni* Barman
2. *Poropuntius clavatus* McClelland (= *Puntius clavatus clavatus*)
3. *Puntius gelius* (Hamilton)
4. *Schismatorhynchus nukta* (Sykes)

**2. NAMES OF THE ENDEMIC SPECIES**

## Order CYPRINIFORMES

## Family CYPRINIDAE

1. *Barilus gatensis* (Valenciennes)\* (Found in the Peninsular India and Tripura)
2. *Barilus nelsoni* Barman (Found in Tripura only)
3. *Schismatorhynchus nukta* (Sykes)\* (Found in the Peninsular India and Tripura only)

## Family COBITIDAE

4. *Botia dario* (Hamilton) (Found in Assam, Tripura, North Bengal, Rajmahal Hills in South Bihar)

\*The presence of these two species in Tripura needs more confirmation. These two species were recorded from Tripura by earlier workers.

**CONSERVATION**

The problems of protection and conservation of the fishes of Tripura are almost common with the rest of our country particularly the North Eastern states. Tripura is small state with only 10,491 sq. km. area accounting 0.32% of the total land area of our country and occupies the 22<sup>nd</sup> position in terms of the area among the States and Union Territories of India. The maximum length and breadth of this state is 183.5 km. and 112.7 km. respectively. Hilly ranges cover almost

70% of the land area of this state. The altitude of this state varies from 780 m in the North-Eastern part to 15 m or even less in the Western part above the mean sea level. The state with 31,91,186 population (according to the census of 2001) is facing an unprecedented increase in human population since the independence of our country for various reasons. This has resulted a great pressure on the economy of this state. The increase in human population is causing extensive habitat alteration due to vast tracts of forests are cleared for agricultural, industrial and urbanization purposes consequently affecting the aquatic bodies which in turn affecting the fish population in particular. Deforestation, urbanization, water diversion, overexploitation and introduction of the exotic fishes are some of the problems threatening the fish population particularly their endangered, vulnerable and rare species of Tripura. Considering these factors some suggestions for protection and conservation of these fishes of Tripura are furnished in this paper.

Following measures can be adopted to protect and conserve the threatened fishes of Tripura :

- (i) Deforestation is one of the important problems affecting the fish population. Deforestation along the course of the river should be avoided because it causes soil instability that increases the turbidity of the water bodies. It also increases the temperature of the breeding ground of the fishes. Where the vegetation has been destroyed, replantation is desirable to stabilize the soil erosion, to maintain the clear water and to maintain the required temperature of the spawning grounds of the fishes.
- (ii) Pesticides and agricultural fertilizers along the watercourses should be used very carefully. The fishermen or the local people employed in fishing should be told to use only rapidly degradable types of pesticides.
- (iii) Increasing urbanization has led to pollution both by human activities and industrial discharges. Effluents from industrial areas should be released into the river systems after proper treatment to remove toxic materials. If this is not done it will reduce the growth of plankton and will decrease oxygen content of the water body, ultimately affect it will the aquatic animals especially the fish population as a whole.
- (iv) The threatened fish species of the degraded habitats if possible should be transferred to appropriate water bodies keeping in mind that the resident fish of those water bodies would not be adversely affected.
- (v) Water diversion is another factor affecting the fish population adversely. It is well known that if the course of a river system is diverted due to obstruction by damming, the resident fishes will be definitely affected. The Gumti Hydel Project across the river Gumti, therefore is sure to affect the fish population of that locality. Where dams are to be constructed for immediate benefits, the long-term effects have to be kept in consideration. The dams totally change the river ecosystems and causes irreversible damage to the aquatic organisms, primarily due to siltation and aquatic weed growth. It obstructs the migration of the fishes

consequently affecting their growth and reproduction. Since several fish species migrate or move upstream to spawn during the breeding period (early monsoon flood) their reproductive cycle is affected due to the construction of dams resulting the depletion of their multiplication.

- (vi) Overexploitation or indiscriminate harvesting of fishes is another menace to the whole fish population irrespective of the matured or the juvenile fishes. This should be controlled or monitored by imposing closed seasons especially during the spawning period. At the same time the immature specimens should be protected by banning the use of very small mesh sized nets so that juveniles are escaped. The fish resources also to be sustainably utilized otherwise commonly found fishes will also soon disappear from our fish menu meal.
- (vii) Introduction of the exotic fishes has been found in some cases adversely affecting the native fishes due to competition for food, breeding grounds and predation. In view of these types of potential hazards, introduction of exotic fishes should not be done without careful consideration of the ecological and biological impact over the resident fishes.
- (viii) Lastly it may be mentioned since out of the 4 endemic fish species 2 species are already threatened species in Tripura, therefore, all the endemic species should be considered at par the threatened species. Proper care should be taken for their sustainable utilization otherwise in course of time the remaining 2 species will sure to face the problem of their existence like those of the threatened fish species of Tripura.

### SUMMARY

Tripura, one of the states of the North-East India contains several species, which are common to both the Indo-Gangetic and South-East Asian river systems. The presence of these fishes in the sub-Himalayan region of Tripura is of special importance in the Fish Geography of the North Eastern region and that of the Indo-Malayan Archipelago. Generally the North Eastern Region of India is considered as of the Hot Spots of Biodiversity including that of the freshwater fishes of India. Therefore, an attempt was undertaken to estimate Fish Fauna of Tripura. The present author has identified the Fish fauna of this state. It shows that the fish fauna of Tripura contains 129 species belonging to 78 genera, 33 families and 11 orders. Out of these 129 species, 28 species are Vulnerable, 10 species are Endangered and 4 species are Rare species. This state also contains 4 endemic species. As the population in Tripura has been increasing, vast tracts of forests are cleared for agricultural, industrial and urbanization purposes. Several freshwater fish species of India have been described as the threatened species. To conserve and sustainably exploit the fish fauna particularly its threatened species of Tripura, measures should be adopted to protect and conserve this natural resources. Suggestions for conservation of these fishes are discussed in this paper.

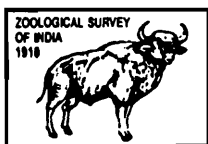
## ACKNOWLEDGEMENTS

I am thankful to Dr. J. R. B. Alfred, Director and to Dr. S. K. Chanda, Deputy Director, Zoological Survey of India, Kolkata for the facilities and encouragement for this study.

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## **THE FISHES OF THE KOLLERU LAKE, ANDHRA PRADESH, INDIA WITH COMMENTS ON THEIR CONSERVATION**

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### **INTRODUCTION**

Kolleru Lake is one of the National wetlands and the largest freshwater lakes of our country. Wetlands are very important productive ecosystems and their socioeconomic values are well established. Moreover, the riverine fishes use wetlands as their breeding grounds. In addition to these, this lake has been found to contain some threatened species of fishes, which needs to be conserved to protect them from extinct in near future. Considering these facts an attempt has been made to estimate the Fish resources of this lake. This work is based primarily on the fish collections from this lake by the author (Barman, 1993) in addition to the fishes recorded from this lake following the works of Chacko *et al.* (1952) and Dutt & Murthy (1971 & 1976). This Lake has been found to contain 51 freshwater fish species belonging to 35 genera, 21 families and 9 orders. A review on the fishes of this lake shows that it contains 4 endangered, 11 vulnerable and 1 rare species following the works of Molur and Walker (1998) and Menon (1999) as per the guidelines and criteria provided by the IUCN for determining the threatened species. Almost all the fishes of this lake are commercially important. Since this lake contains some important commercial fishes and 16 threatened species, it has been suggested for conservation specially to protect the threatened species and to maintain its biodiversity of the fishes as a whole.

### **TOPOGRAPHY**

The Lake Kolleru is a natural depression with an average depth of 1 metre and a maximum depth of 3 metres during the southwest monsoon, in the coastal belt between the deltas of the river Godavari to the east and Krishna to the west. It is located partly in Krishna and West Godavari districts of Andhra Pradesh. The Eluru canal (irrigation canal) connects these two rivers

to the north of this lake and the Bay of Bengal passes to its southwest side. This lake has an area of almost 250 sq. km. Four major streams, viz., Budameru, Thammileru, Ramileni and Gunderu and several irrigation channels open into this lake, carrying a considerable amount of silt in this lake. The Bay of Bengal is 32 km. away and is connected to this lake by one outlet, named Upputeru. This lake is a low-lying swamp type with almost 85% freshwater dominance. Although the lake is connected with the Bay of Bengal through Upputeru, the tidal waters do not enter into the lake proper, so the freshwater fishes can thrive there well.

### SYSTEMATIC ACCOUNT OF THE FISHES OF THE KOLLERU LAKE

The classification of Greenwood *et al.*, (1966) and Menon (1999) is followed here in listing the fishes of this lake as follows :

#### Order I ANGUILLIFORMES

##### Family 1 ANGUILLIDAE

1. *Anguilla bengalensis* (Gray and Hardwicke) (**Endangered species**)

#### Order II CLUPEIFORMES

##### Family 2 CLUPEIDAE

2. *Gudusia chapra* (Hamilton)

#### Order III OSTEOGLOSSIFORMES

##### Family 3 NOTOPTERIDAE

3. *Notopterus notopterus* (Pallas)

#### Order IV CYPRINIFORMES

##### Family 4 CYPRINIDAE

4. *Salmostoma clupeoides* (Bloch)
5. *Amblypharyngodon mola* (Hamilton)
6. *Chela laubuca* (Hamilton)
7. *Danio devario* (Hamilton)
8. *Esomus danricus* (Hamilton)
9. *E. thermoicos* (Valenciennes)
10. *Parluciosoma daniconius* (Hamilton) (= *Rasbora daniconius*)

11. *Thynnichthys sandkhol* (Sykes) (**Rare & Endemic species**)
12. *Osteobrama cotio cotio* (Hamilton)
13. *Rohtee ogilbii* Sykes (**Vulnerable & Endemic species**)
14. *Barbodes sarana sarana* (Hamilton) (= *Puntius sarana sarana*) (**Vulnerable species**)
15. *Hypselobarbus dobsoni* (Day) (= *Puntius dobsoni*) (**Endangered & Endemic species**)
16. *Puntius chola* (Hamilton) (**Vulnerable species**)
17. *P. sophore* (Hamilton)
18. *P. ticto* (Hamilton)
19. *Catla catla* (Hamilton)
20. *Cirrhinus mrigala* (Hamilton)
21. *C. reba* (Hamilton) (**Vulnerable species**)
22. *Labeo bata* (Hamilton)
23. *L. calbasu* (Hamilton)
24. *L. fimbriatus* (Bloch)
25. *L. rohita* (Hamilton)

#### Family 5 COBITIDAE

26. *Lepidocephalus guntea* (Hamilton)

#### Order V SILURIFORMES

#### Family 6 BAGRIDAE

27. *Mystus bleekeri* (Day) (**Vulnerable species**)
28. *M. cavasius* (Hamilton)
29. *M. gulio* (Hamilton)
30. *M. vittatus* (Bloch) (**Vulnerable species**)

#### Family 7 SILURIDAE

31. *Ompok bimaculatus* (Bloch) (**Endangered species**)

#### Family 8 SCHILBEIDAE

32. *Pseudeutropius atherinoides* (Bloch) (**Endangered species**)

#### Family 9 CLARIIDAE

33. *Clarias batrachus* (Linnaeus) (**Vulnerable species**)

#### Family 10 HETEROPNEUSTIDAE

34. *Heteropneustes fossilis* (Bloch) (**Vulnerable species**)

## Order VI ATHERINIFORMES

## Family 11 BELONIDAE

35. *Xenentodon cancila* (Hamilton)

## Family 12 CYPRINODONTIDAE

36. *Aplocheilichthys panchax* (Hamilton)

## Order VII CHANNIFORMES

## Family 13 CHANNIDAE

37. *Channa marulius* (Hamilton)  
38. *C. orientalis* Bloch & Schneider (**Vulnerable species**)  
39. *C. punctatus* (Bloch)  
40. *C. striatus* (Bloch)

## Order VIII SYNBRANCHIFORMES

## Family 14 SYNBRANCHIDAE

41. *Ophisternon bengalense* McClelland

## Order IX PERCIFORMES

## Family 15 CENTROPOMIDAE (= CHANDIDAE)

42. *Pseudambassis ranga* (Hamilton) (= *Chanda ranga*)

## Family 16 NANDIDAE

43. *Nandus nandus* (Hamilton)

## Family 17 CICHLIDAE

44. *Etroplus maculatus* (Bloch)  
45. *E. suratensis* (Bloch)

## Family 18 GOBIIDAE

46. *Glossogobius giurinus* (Hamilton)

## Family 19 ANABANTIDAE

47. *Anabas cobojus* (Hamilton) (**Vulnerable species**)  
48. *A. testudineus* (Bloch) (**Vulnerable species**)

#### Family 20 BELONTIDAE

49. *Polycanthus fasciatus* (Bloch & Schneider)

#### Family 21 MASTACEMBELIDAE

50. *Macrognaathus aral* (Bloch & Schneider)  
51. *M. pancalus* (Hamilton)

### DISCUSSIONS & CONSERVATION

The Lake Kolleru is one of the very important freshwater lakes and National wetlands of India. Many riverine important edible fishes utilize this wetland for their breeding grounds. The presence of juvenile specimens of almost all the fishes especially the carps in this lake indicates that these fishes use this water body as their spawning grounds. Since this lake is distantly connected with the Bay of Bengal through Upputeru often some marine fishes are also found in the fish fauna of this lake. Among the important commercial fishes of this lake *Anabas testudineus*, *Heteropneustes fossilis* and *Labeo rohita* are abundantly found throughout the year. This lake also has been found to contain 3 endemic species of our country. *Rohtee ogilbii* of this lake is a vulnerable and endemic fish species of our country. This species is found only in the two important south Indian waters of the river Godavari and Krishna. *Hypselobarbus dobsoni* is an endangered and endemic species in India. It has been recorded in the south Indian waters of the Rivers Krishna and Cauvery, and in the Anaimalai Hill drainages. *Thynnichthys sandkhol* is a rare and endemic fish species of India, found in the south Indian waters of the river Gadavari and Krishna only. Since these commercially important vulnerable, endangered and rare fish species are already in danger of extinction due to over exploitation, habitat destruction and other external factors, their protection and conservation measures should be taken immediately to save them from extinction.

To protect and conserve the fish resources along with its vulnerable, endangered and rare fish species of the Lake Kolleru the following measures may be undertaken :

- (1) Indiscriminate fishing by means of fixed engines should be stopped.
- (2) Restrictions on the use of certain nets during the specified times of the year from April to June (*i.e.*, closed season) as well as mesh size (usually the minimum mesh size of the nets permitted is 25 mm. in the Indian waters).
- (3) Restrictions on the capture and sale of legal sizes of fry and fingerlings of major carps to protect the juveniles of the fishes.
- (4) All types of landscapes alterations must be controlled and use of herbicides and insecticides also to be prohibited in and around this lake.

- (5) Mass awareness campaign should be organized to educate about the significance of the conservation of the fishes in their areas. Since the local fishermen and the people surrounding this lake are in constant contact with this wetland, they should be told that they are the real custodian of the flora and fauna of this Kolleru Lake. Destruction, shrinkage and misuses of this wetland will definitely create their socioeconomic problems due to the fact that the degradation of the wetlands with their rich faunal diversity throughout our country is already alarming.

### SUMMARY

The fishes of the Lake Kolleru have been reviewed following the works of Molur & Walker (1998) and Menon (1999). This shows that it contains some very important commercial fishes in addition to 11 vulnerable species, viz., *Rohtee ogilbii*, *Barbodes sarana sarana*, *Puntius chola*, *Cirrhinus reba*, *Mystus bleekeri*, *Mystus vittatus*, *Clarias batrachus*, *Heteropneustes fossilis*, *Channa orientalis*, *Anabas cobojus*, and *Anabas testudieus*, 4 endangered species, viz., *Anguilla bengalensis*, *Hypselobarbus dobsoni*, *Ompok bimaculatus* and *Pseudeutropius atherinoides* and 1 rare species, viz., *Thynnichthys sandkhol*. Considering the presence of these vulnerable, endangered and rare species, this Lake has been suggested for conservation measures.

### ACKNOWLEDGEMENTS

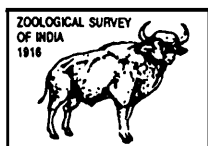
I thank Dr. J. R. B. Alfred, Director and Dr. S. K. Chanda, Deputy Director, Zoological Survey of India, Kolkata for necessary facilities. Thanks are also due to the Commissioner of Fisheries, Govt. of Andhra Pradesh, Hyderabad and the Assistant Director of Fisheries, Kolleru Lake for assistance and cooperation.

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## **TWO NEW SPECIES OF ASCID MITES (ACARINA : MESOSTIGMATA) FROM THE THAR DESERT OF RAJASTHAN, INDIA**

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### **INTRODUCTION**

Indian Thar Desert stretching from the west of Aravallis to the Indus basin, is an arid wasteland covered under wind-blown sands. It covers an area of 1,02,400 sq. kms., occupying 12% of the Indian mainland. Considering the huge land area, the invertebrate fauna of this region has been very little explored. Tandon (1996) gave a detailed account of taxonomic researches conducted on different insect groups in the Indian Thar Desert. Literature studies reveal that soil acarine fauna of the Thar Desert is represented by only ten species (Sanyal, 1996). Out of these, seven species belong to the order Cryptostigmata, two species belong to the order Mesostigmata and the remaining one belongs to the order Prostigmata. While working on soil acarine fauna of the Thar Desert, alongwith other acarines two new species of ascid mites belonging to two genera viz., *Lasioseius* Berlese and *Gamasellodes* Athias-Henriot were collected.

Nine species of plant-, soil- and nest-inhabiting *Lasioseius* mites are known from India (Chant, 1960; Menon and Ghai, 1968; Bhattacharyya, 1968; Gupta and Paul, 1985; Bhattacharyya *et al.*, 1997, 2000; Bhattacharyya and Bhattacharyya, 2001). Bhattacharyya (1978), Pramanik and Raychaudhury (1978) reported the occurrence of the *Gamasellodes bicolor* (Berlese, 1918) from West Bengal.

**KEY WORDS** : *Gamasellodes jodhpurensis* sp. nov., *Lasioseius prakashii* sp. nov., Thar Desert, Rajasthan, India.

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## MATERIAL AND METHODS

Mites were cleared in lactic acid before mounting on microscopic slides using Hoyer's medium. Measurement (in micrometer,  $\mu\text{m}$ ) were taken from slide-mounted specimens with stage-calibrated ocular micrometer. Setae were measured from the base of their insertion to their tips. The system of setal nomenclature for idiosoma and legs follows that of Lindquist and Evans (1965). Type-materials are deposited in the National Zoological Collection, Zoological Survey of India, Calcutta.

### *Gamasellodes jodhpurensis* sp. nov.

(Text-figs. 1-3)

**Female :** Anterior dorsal shield (126  $\mu\text{m}$  long along midline, 104  $\mu\text{m}$  wide at widest point) with fifteen pairs of simple setae; setae j1, j2 and z1 almost subequal in length (11  $\mu\text{m}$ ); posterior dorsal shield (120  $\mu\text{m}$  long, 101  $\mu\text{m}$  wide) with fifteen pairs of simple setae; setae J1–J3 subequal (11  $\mu\text{m}$ ), J4 and J5 subequal (9  $\mu\text{m}$ ); setae J5 and S5 40  $\mu\text{m}$  and 20  $\mu\text{m}$  long respectively; area between J4 and J5 finely granulated medially; six pairs of short, simple, smooth setae present on lineated lateral membrane; peritreme visible dorsally extending upto setae z1 apically (Fig. 1).

Sternal shield smooth, 62  $\mu\text{m}$  long, 61  $\mu\text{m}$  wide; setae st1 placed on extended anterior portion of sternal shield; bilobed portion containing setae st1 finely granulated; setae st3 longer (13  $\mu\text{m}$ ) than subequal st1 and st2 (11  $\mu\text{m}$ ); metasternal setae placed on ventral membrane; epigynial shield with a pair of setae; ventral membrane beyond epigynial shield folded to form membrane; ventral membrane around ventri-anal shield with three pairs of ventral setae and platelets as depicted in fig. 2; metapodal platelets narrow, arranged lateral to body margin. Ventri-anal shield (78  $\mu\text{m}$  long along midline, 100  $\mu\text{m}$  wide) coarsely granulated posteriorly, with four pairs of setae, excluding a pair of para- and a post-anal setae. Peritreme narrow, stigma placed on anterior level of coxa IV; post-stigmatal prolongation of peritrematal shield extending posteriorly, encircling coxa IV.

Tectum trispinnate (Fig. 3). Ventrally gnathosoma with five rows of deutosternal denticles; anterior second row widest, with five teeth.

Leg setation normal for the genus *i.e.*, femora I–II–III–IV, 12–10–6–6, and that of tibiae 13–11–8–9; legs I–II–III–IV, 257  $\mu\text{m}$ , 241  $\mu\text{m}$ , 223  $\mu\text{m}$  and 217  $\mu\text{m}$  long respectively.

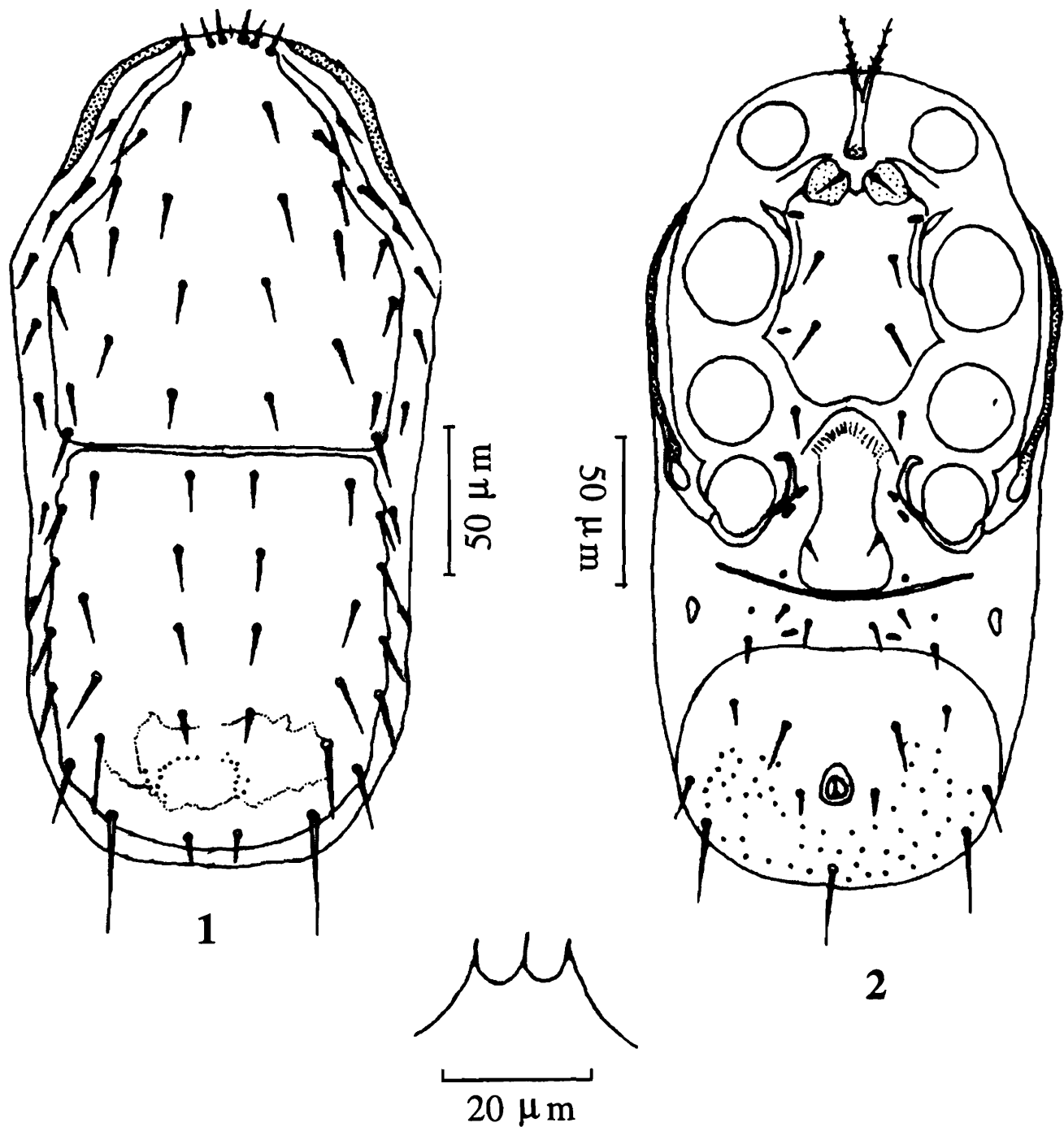
**Male :** Unknown.

**Material examined :** HOLOTYPE female, ex. soil; Kharia Mithapur, Jodhpur, Rajasthan; 20.i.2001; A. K. Bhattacharyya coll. PARATYPE : One female, data same as for holotype.

**Differential diagnosis :** The new species, *Gamasellodes jodhpurensis* shows its similarity with another Indian species *Gamasellodes islandicus* Bhattacharyya and Sanyal, 2002 in having similar shape of sternal and ventri-anal shield and tectum, nature and length of dorsal setae.

However, the new species differ from its allied species in the following aspects : setal disposition of j2, shorter length of j3, longer length of sternal setae st3, punctuated nature of ventri-anal shield and presence of exopodal shield.

*Etymology* : The specific designation *jodhpurensis* refers to the type-locality.



**Figs. 1-3.** : *Gamasellodes jodhpurensis* sp. nov., female : 1. Dorsum, 2. Venter, 3. Tectum.

*Lasioseius prakashii* sp. nov.

(Text-figs. 4–8)

**Female** : Dorsal shield (390  $\mu$ m long along midline, 180  $\mu$ m wide at their widest point) reticulated, with twenty-one pairs of simple to serrated setae; anterior region with twelve pairs of setae, nine pairs of setae on posterior region (Fig. 4); setae j1, r3, S5, Z5 and J5 33  $\mu$ m, 48  $\mu$ m, 60  $\mu$ m, 70  $\mu$ m and 12  $\mu$ m long respectively; setae S5 and J5 borne on tubercles; lateral membrane with three pairs of short, simple lateral setae; peritreme visible dorsally, extending beyond apical setae anteriorly.

Tritosternum with long, pilose lacinae. Sternal shield (90  $\mu$ m long along midline, 117  $\mu$ m wide between two anterolateral corners) slightly convex posteriorly, with three pairs of setae, st1 longer (23  $\mu$ m) than subequal st2 and st3 (15  $\mu$ m); paired platelets flanking the base of tritosternum present anterior to sternal shield; metasternal shield with metasternal seta; genital shield truncate posteriorly, reticulated laterally, with paired genital setae. Peritreme moderately wide, stigma at level of coxa IV; post-stigmatal prolongation of peritrematal shield encircling coxa IV posteriorly. Ventri-anal shield (148  $\mu$ m long along median line, 165  $\mu$ m wide at their widest point) large, completely reticulated, with a total of fifteen setae; ventral membrane posterior to ventri-anal shield with two pairs of setae (Fig. 5).

Tectum denticulate, roughly circular in shape (Fig. 6). Ventrally seven rows of deutosternal denticles present in hypognathal groove; anterior second and seventh row with eleven and five teeth respectively.

Chaetotactic formulae of genua and tibiae of legs I–II–III–IV as follows : 13–11–9–9 and 13–10–8–10 respectively; length of legs I–IV, 437  $\mu$ m, 318  $\mu$ m, 307  $\mu$ m and 443  $\mu$ m respectively.

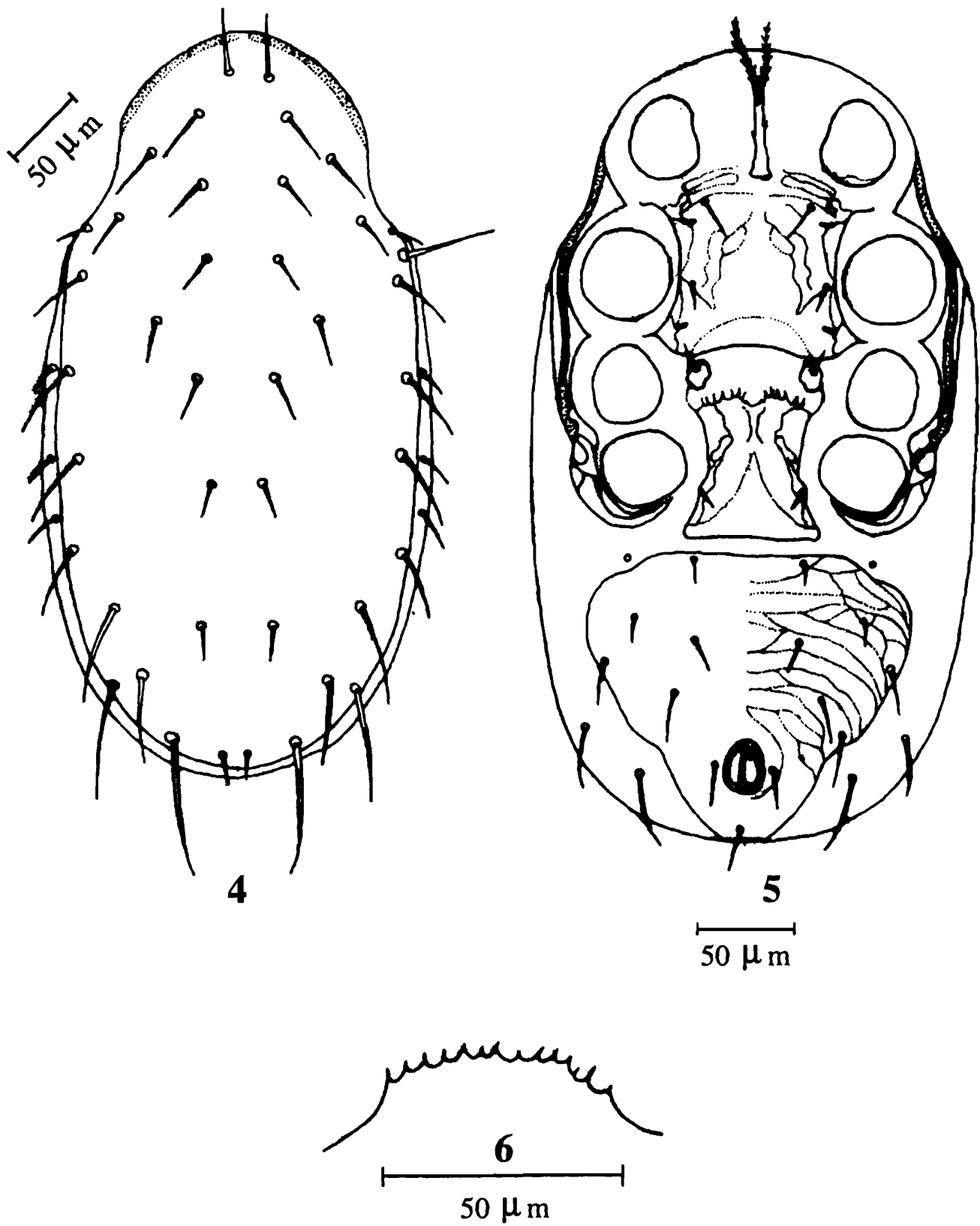
**Male** : Dorsal shield (278  $\mu$ m long, 128  $\mu$ m wide) with twenty pairs of setae, equally divided on anterior and posterior region; setae r3, j2, S5 and J5 32  $\mu$ m, 28  $\mu$ m, 51  $\mu$ m and 9  $\mu$ m long respectively (Fig. 7); reticulation of dorsal shield same as in female.

Tritosternum same as in female; sterniti-genital shield (117  $\mu$ m long along midline, 51  $\mu$ m wide along two anterolateral corners at level of setae st1) with three pairs of setae, st2 longest (11  $\mu$ m). Peritreme moderately wide, stigma situated at level of upper half of coxa IV. Ventri-anal shield (104  $\mu$ m long, 148  $\mu$ m wide) reticulated, with fifteen setae (Fig. 8).

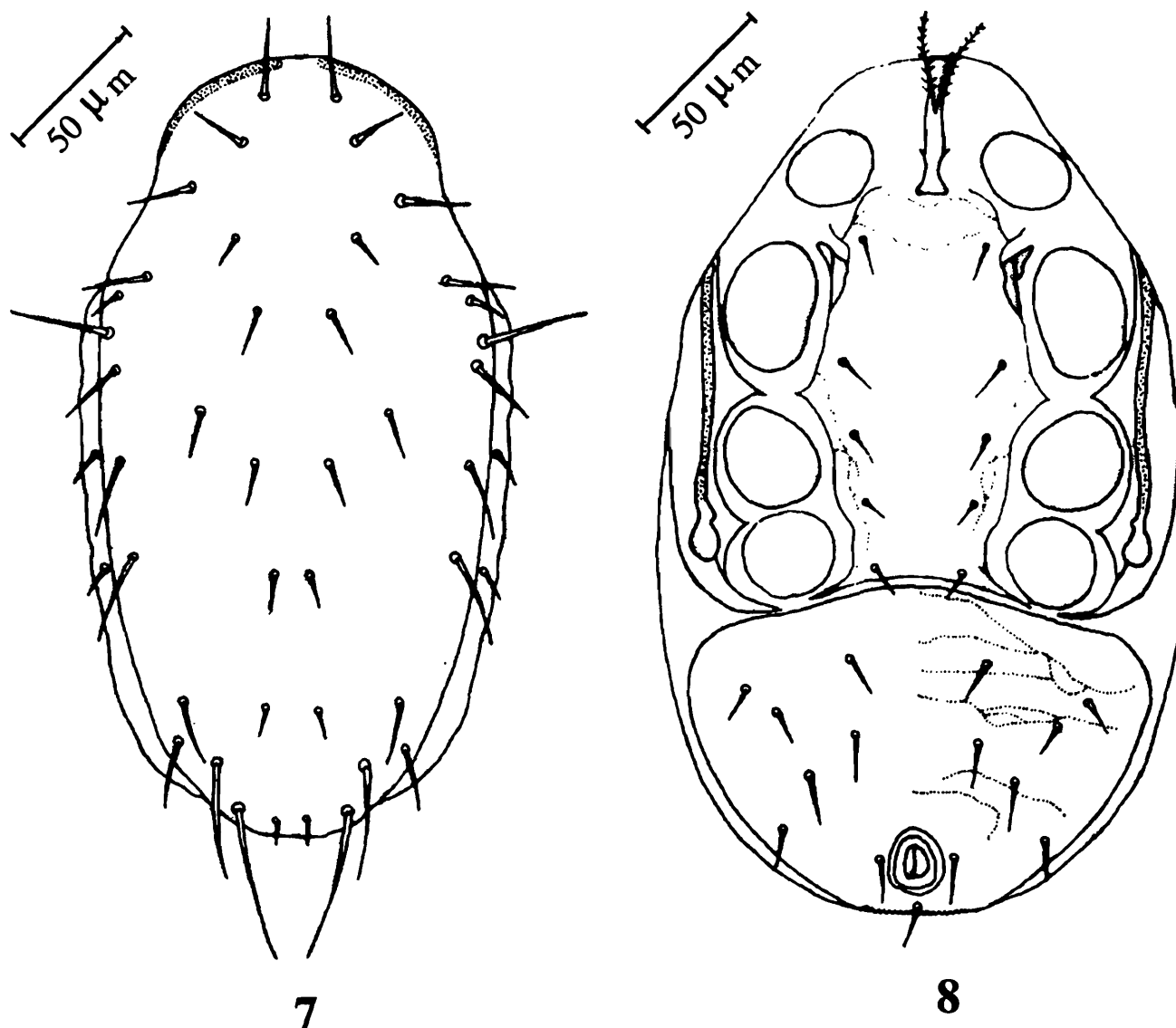
Tectum same as in female. Ventrally gnathosoma with seven rows of deutosternal denticles, with 9–15 teeth in each row, second row widest with fifteen teeth. Fixed cheliceral digit with nine teeth, spermatodactyl process long, movable cheliceral digit unidentate.

Sexual dimorphism absent in legs.

**Material examined** : HOLOTYPE female, ex. soil; Jaliwada, Jodhpur, Rajasthan; 15.i.2001; A. K. Bhattacharyya coll. PARATYPES : Two females, data same as for holotype. Two females,



Figs. 4-6. : *Lasioseius prakashii* sp. nov., female : 4. Dorsum, 5. Venter, 6. Tectum.



Figs. 7-8. : *Lasioseius prakashii* sp. nov., male : 7. Dorsum, 8. Venter.

ex. soil; Ghaseri, Jalore, Rajasthan; 6.xii.2001; A. K. Bhattacharyya coll. Three females, ex. soil; Kharia Mithapur, Jodhpur, Rajasthan; 20.i.2001; A. K. Bhattacharyya coll. Two females, ex. soil; Sri Vijaynagar, Sri Ganganagar, Rajasthan; 9.ii.2001; A. K. Bhattacharyya coll. One male, ex. soil; Sikwada, Jalore, Rajasthan; 6.xii.2000; A. K. Bhattacharyya coll.

**Differential diagnosis :** *Lasioseius prakashii* sp. nov. can be differentiated from its nearest congeneric species, *L. lindquisti* Nasr and Abou-Awad, 1987, in the following aspects : total number of setae on dorsal shield, shape of sternal shield, metasternal shield and tectum.

**Etymology :** The species is named after the name of late Dr. Ishwar Prakash, eminent Indian ecologist, considered an authority on desert ecology.

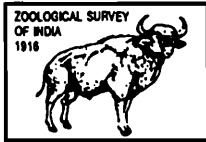
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## ***PLACOBDELLA HARASUNDARAI* (HIRUDINEA : GLOSSIPHONIDAE) A NEW SPECIES OF LEECH FROM WEST BENGAL, INDIA**

CHANDRA KANTA MANDAL

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Kolkata-700 016, India.*

### **INTRODUCTION**

A new species of leech *Placobdella harasundarai* is described from West Bengal, and is known by six species of this genus from India. It is distinguished in possessing the following characters. One pair round eyes, Green in colour (in living). Three lines dorsal papilla palpable, others are not so. Breeding season is August to September : Eggs seven to ten in number. One mid ventral line. Anterior sucker triangular in shape. Terminal mouth opening; Posterior sucker almost round in shape. Anterior sucker is one fourth of the posterior sucker.

*Placobdella harasundarai* sp. nov.

(Fig. 1 & 2)

*Holotype* : Z.S.I. Reg. No. An 3222/1, 1 ex., Coll. C. K. Mandal, 1.9.2002, Harasundarai pond, Vojerhat, South 24-Parganas, West Bengal, India.

*Paratypes* : Z.S.I. Reg. No. An 3223/1, Coll. C. K. Mandal, 1.9.2002, 1 ex., Harasundari pond, Vojerhat, South 24-Parganas, West Bengal, India.

*Diagnosis* : *Colour* : Green in colour in living, so beautiful that it is named as Green Queen leech of South 24-Parganas, Harasundari pond. The colour becomes faded in preserved state.

*Body* : Not transparent, so caeca are not visible. Body bears 60–65 segments.

*Sucker* : Anterior sucker triangular in shape, posterior sucker almost round in shape.

*Length* : The total length of *Placobdella harasundarai* 4.5–4.6 mm.

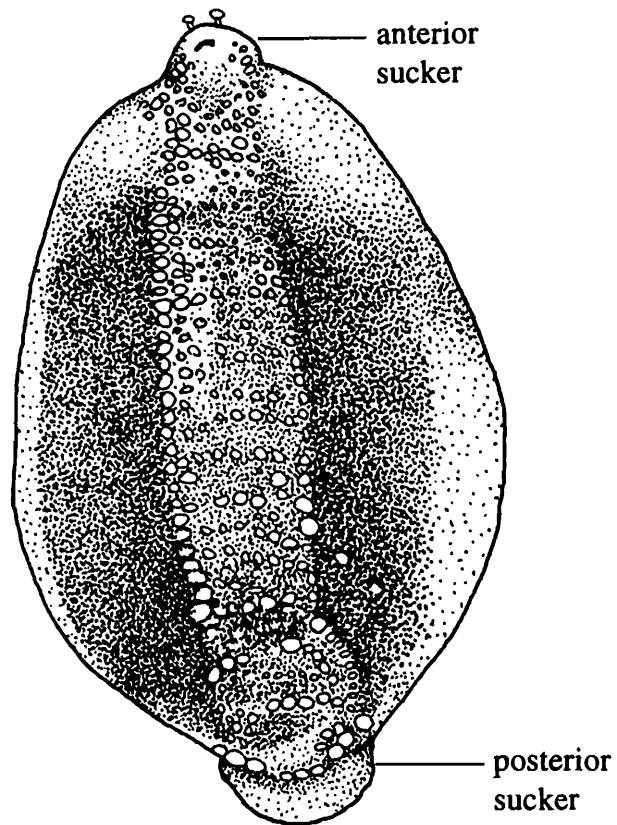


**Fig. 1.** : Dorsal view of the Leech *Placobdella harasundarai*.

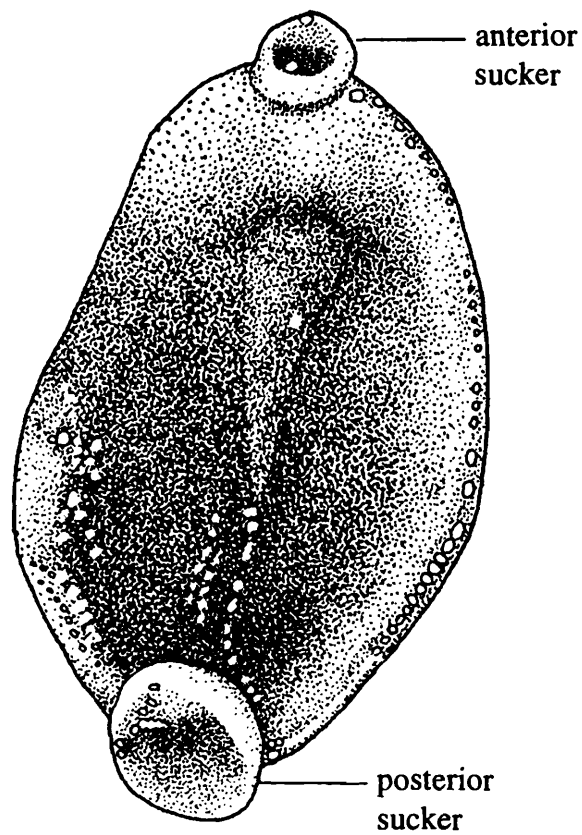


**Fig. 2.** : Ventral view of the Leech *Placobdella harasundarai*.

**Breadth** : 2.5 mm. and 3 mm. consecutively.

**Distribution** : India : West Bengal (Harasundari pond, Vojerhat, South 24-Parganas).

**Breeding Season** : August to September. During this time they form eggs and bear on the ventral side of the body. They bear 7–10 eggs around the gonopore in jelly like structure.

**Remarks** : The specific name is proposed according to the name of collection spot.

**Comparision** : Eyes one pair, round in shape in *Placobdella harasundarai*, coma shaped in *Placobdella emydae*, cup shaped in *Placobdella horai*, *Placobdella indica*, *Placobdella undulata* and three pairs of eyes in *Placobdella ceylanica*. Mouth opening triangular in *Placobdella harasundarai* but almost round in other six species. Posterior sucker is 1/4 of the broadest part of the body in *Placobdella harasundarai* and almost circular in shape. Circular posterior sucker of *Placobdella ceylanica* is 1/2 of the greatest width of the body, in *Placobdella emydae* posterior sucker is narrower than the widest part of the body, less than 1/2 of the body width in *Placobdella fulva*, almost 1/3 in *Placobdella horai* and *Placobdella undulata*. Breeding season in *Placobdella harasundarai* is August to September, May-July in *Placobdella emydae*, June-July in *Placobdella fulva* and *Placobdella horai*, May-July in *Placobdella undulata*. *Placobdella ceylanica* is parasitic on molluscs, frogs and turtles, *Placobdella emydae* on turtles, *Placobdella fulva* on fish and molluscs, *Placobdella horai* on prawn, fishes, *Placobdella undulata* on fishes, *Placobdella indica* on molluscs and *Placobdella harasundarai* on insect larvae and molluscs.

**Host and Habitat** : It is found in the pond, lakes under the submerged articles at the root of the water hyacinth or on the molluscs shells.

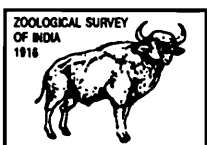
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## ENDEMIC LEECH FAUNA OF INDIA

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### INTRODUCTION

The leeches which are found only in India are called “ENDEMIC LEECHES OF INDIA” The number of endemic leech fauna of India is in remarkable position in the world because of its identical situation and natural diversity. 32 species have been found in India which are not seen anywhere in the world. Out of 32, 21 species being freshwater, 4 species marine and 7 species are terrestrial.

#### Family PISCICOLIDAE

##### Genus *Branchellion*

1. *Branchellion plicobranchus* Sanjeeva Raj, 1954.

*Type locality* : Assumption land, Bay of Bengal, Tamil Nadu.

*Type deposition* : Z. S. I.

*Distribution* : Tamil Nadu, Andhra Pradesh, Maharashtra and Kerala.

##### Genus *Ozobranchus*

2. *Ozobranchus polybranchus* Sanjeeva Raj, 1951.

*Type locality* : Porto Novo, Tamil Nadu.

*Type deposition* : Z. S. I.

*Distribution* : Tamil Nadu (Porto Novo).

Genus *Piscicola*

3. *Piscicola caeca* Kaburaki, 1921.

*Type locality* : Orissa (Chilka lake).

*Type deposition* : Not known.

*Distribution* : Orissa (Chilka lake).

Genus *Pterobdella*

4. *Pterobdella amara* Kaburaki, 1921.

*Type locality* : Orissa (Chilka lake).

*Type deposition* : Not known.

*Distribution* : Orissa (Chilka lake).

Genus *Batracobdella*

5. *Batracobdella hardingi* Baugh, 1960.

*Type locality* : Bihar (Monghyr).

*Type deposition* : Z. S. I.

*Distribution* : Bihar (Monghyr), Jammu and Kashmir.

6. *Batracobdella lobata* (Bhatia), 1934.

*Type locality* : Jammu and Kashmir (Srinagar).

*Type deposition* : Not known.

*Distribution* : Jammu and Kashmir.

7. *Batracobdella mahabiri* Baugh, 1960.

*Type locality* : Madhya Pradesh (Rewa).

*Type deposition* : Z. S. I.

*Distribution* : Madhya Pradesh (Rewa).

8. *Batracobdella reticulata* (Kaburaki), 1921.

*Type locality* : Punjab (Jalandhar).

*Type deposition* : Z. S. I.

*Distribution* : Punjab (Jalandhar), Himachal Pradesh, Maharashtra, Jammu and Kashmir.

Genus *Glossiphonia*

9. *Glossiphonia cruciata* Bhatia, 1930.

*Type locality* : Kashmir (Ahabal).

*Type deposition* : Not known.

*Distribution* : Jammu and Kashmir.

Genus *Helobdella*

10. *Helobdella nociva* Harding, 1924.

*Type locality* : Not known.

*Type deposition* : Not known.

*Distribution* : Himachal Pradesh, West Bengal, Orissa, Jammu and Kashmir.

Genus *Hemiclepsis*

11. *Hemiclepsis bhatiai* Baugh, 1960.

*Type locality* : Bihar (Kalipahar, Monghyr).

*Type deposition* : Z. S. I.

*Distribution* : Bihar, Jammu and Kashmir.

12. *Hemiclepsis marginata asiatica* Moore, 1924.

*Type locality* : Srinagar.

*Type deposition* : Z. S. I.

*Distribution* : Jammu and Kashmir, Bihar.

13. *Hemiclepsis viridis* Chelladurai, 1934.

*Type locality* : Kerala (Trivandrum).

*Type deposition* : Z. S. I.

*Distribution* : Kerala, Tamil Nadu (Ottacamund).

Genus *Paraclepsis*

14. *Paraclepsis praedatrix* Harding, 1924.

*Type locality* : Not known.

*Type deposition* : Not known.

*Distribution* : Himachal Pradesh, Haryana, Bihar, West Bengal, Assam, Rajasthan, Maharashtra, Jammu and Kashmir.

15. *Paraclepsis vulnifera* Harding, 1924.

*Type locality* : Tamil Nadu (Tanjore).

*Type deposition* : Not known.

*Distribution* : Himachal Pradesh, Maharashtra, Rajasthan, Tamil Nadu, Jammu and Kashmir, West Bengal.

Genus *Placobdella*

16. *Placobdella fulva* Harding, 1924.

*Type locality* : Not known.

*Type deposition* : Not known.

*Distribution* : Bihar, Jammu and Kashmir, West Bengal.

17. *Placobdella horai* Baugh, 1960.

*Type locality* : West Bengal (Purulia).

*Type deposition* : Z. S. I.

*Distribution* : West Bengal, Bihar (Manbhum).

18. *Placobdella indica* Baugh, 1960.

*Type locality* : Bihar (Sitkundi, Monghyr).

*Type deposition* : Z. S. I.

*Distribution* : Bihar, Jammu and Kashmir.

Genus *Theromyzon*

19. *Theromyzon mathaii* Bhatia, 1939.

*Type locality* : Jammu and Kashmir (Srinagar).

*Type deposition* : Not known.

*Distribution* : Jammu and Kashmir.

Family ERPOBDELLIDAE

Genus *Foraminobdella*

20. *Foraminobdella heptamerata* Kaburaki, 1921.

*Type locality* : Tamil Nadu (Nedurattan).

*Type deposition* : Z. S. I.

*Distribution* : Tamil Nadu (Nilgiris).

Genus *Herpobdelloidea*

21. *Herpobdelloidea lateroculata* Kaburaki, 1921.

*Type locality* : Madhya Pradesh (Saugar).

*Type deposition* : Z. S. I.

*Distribution* : Rajasthan, Madhya Pradesh, Maharashtra, Manipur, Jammu and Kashmir, West Bengal, Andhra Pradesh.

Genus *Nematobdella*

22. *Nematobdella indica* Kaburaki, 1921.

*Type locality* : Himachal Pradesh (Dharampur).

*Type deposition* : Z. S. I.

*Distribution* : Rajasthan, Himachal Pradesh, Haryana, Jammu and Kashmir, West Bengal and Andhra Pradesh.

## Family HIRUDIDAE

Genus *Dinobdella*

23. *Dinobdella notata* Moore, 1927.

*Type locality* : Not known.

*Type deposition* : Not known.

*Distribution* : Tamil Nadu.

Genus *Haemopsis*

24. *Haemopsis indicus* Bhatia, 1940.

*Type locality* : Kashmir (Pahalgam).

*Type deposition* : Not known.

*Distribution* : Jammu and Kashmir.

Genus *Poecilobdella*

25. *Poecilobdella viridis* Moore, 1927.

*Type locality* : Kerala (Travancore).

*Type deposition* : Z. S. I.

*Distribution* : Himachal Pradesh, Uttar Pradesh, Tamil Nadu, Kerala, Jammu and Kashmir.

## Family HAEMADIPSIDAE

Genus *Haemadipsa*

26. *Haemadipsa dussumieri* Blanchard, 1917.

*Type locality* : South India.

*Type deposition* : Paris Museum.

*Distribution* : South India (Andhra Pradesh).

27. *Haemadipsa montana* Moore, 1927.

*Type locality* : Tamil Nadu (Palni Hills).

*Type deposition* : Z. S. I.

*Distribution* : West Bengal, Sikkim, Arunachal Pradesh, Tamil Nadu.

28. *Haemadipsa moorei* Sanjeva Raj & Gladstone, 1981.

*Type locality* : Not known.

*Type deposition* : Not known.

*Distribution* : South India, Western ghat.

29. *Haemadipsa ornata* Moore, 1927.

*Type locality* : West Bengal (Darjeeling).

*Type deposition* : Z. S. I.

*Distribution* : West Bengal and Assam.

30. *Haemadipsa zeylanica agilis* Moore, 1927.

*Type locality* : Not known.

*Type deposition* : Not known.

*Distribution* : Himachal Pradesh, Uttar Pradesh, Arunachal Pradesh, Jammu and Kashmir, West Bengal.

31. *Haemadipsa zeylanica cochini* Moore, 1927.

*Type locality* : Kerala (Cochin).

*Type deposition* : Z. S. I.

*Distribution* : Tamil Nadu, Kerala, Maharashtra.

32. *Haemadipsa zeylanica montivindicis* Moore, 1927.

*Type locality* : West Bengal (Darjeeling).

*Type deposition* : Z. S. I.

*Distribution* : West Bengal, Assam, Sikkim and Arunachal Pradesh.

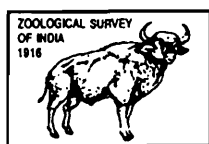
### ACKNOWLEDGEMENT

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*Rec. zool. Surv. India* : 103 (Part 1–2) : 111-114, 2004

## ***PARACLEPSIS GARDENSI* (HIRUDINEA : GLOSSIPHONIDAE) A NEW SPECIES OF LEECH FROM WEST BENGAL, INDIA**

CHANDRA KANTA MANDAL

*Zoological Survey of India, F. P. S. Building, Kolkata-700 016, India.*

### **ABSTRACT**

A new species of leech *Paraclepsis gardensi* is described from West Bengal, and is known by two species of this genus from India. It is distinguished in possessing the following characters : Eyes three pairs (2nd pair largest) stomach with seven pairs of caeca (Branched), mouth opening almost terminal, a bulb shaped structure on the dorsoventral part of the left anterior portion of the body, 18 greenish brown sub parallel longitudinal lines on the dorsal side 6 mid ventral. Length of a full grown preserved specimen is 10 mm. and width is 4.8 mm. Posterior sucker is 1 mm. in diameter. A living specimen resting in a dish is 28 mm. in length and 3.8 mm. in width.

***Paraclepsis gardensi* sp. nov.**

***Holotype*** : Z.S.I. Reg. No. An 2768/1, 1 ex., Coll. C. K. Mandal, 25.6.1994, King Lake, Botanical Garden, Shibpur, Howrah, West Bengal, India.

***Paratypes*** : Z.S.I. Reg. No. An 2816/1, Coll. C. K. Mandal, 6.6.19-95, 2 exs., Kalikapur field side pond, P.S. Barasat (N), 24-Parganas, West Bengal.

2 exs., Z.S.I. Reg. No. An 2785/1, 2785/2, Coll. C. K. Mandal, 21. 7. 1995, Mechagram, Midnapur District, West Bengal, India.

1 ex., Z.S.I. Reg. No. An 3221/1, Coll. C. K. Mandal, 1.9.2002, Vojerhat, South 24-Parganas, West Bengal.

***Diagnosis*** : *Colour* : Raddish brown in living condition and greyish in preserved state.

***Body*** : Ovate, continuous with the head region.

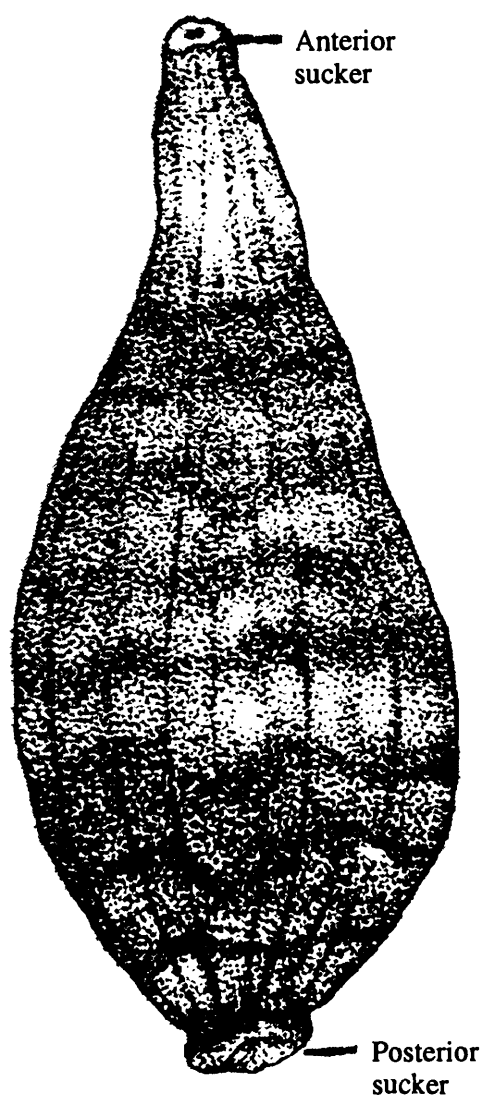
*Length* : The total length of *Paraclepsis gardensi* 10 mm. (in preserved state), 28 mm. in living.

*Distribution* : India : West Bengal (Howrah, Midnapur, North and South 24-Parganas).

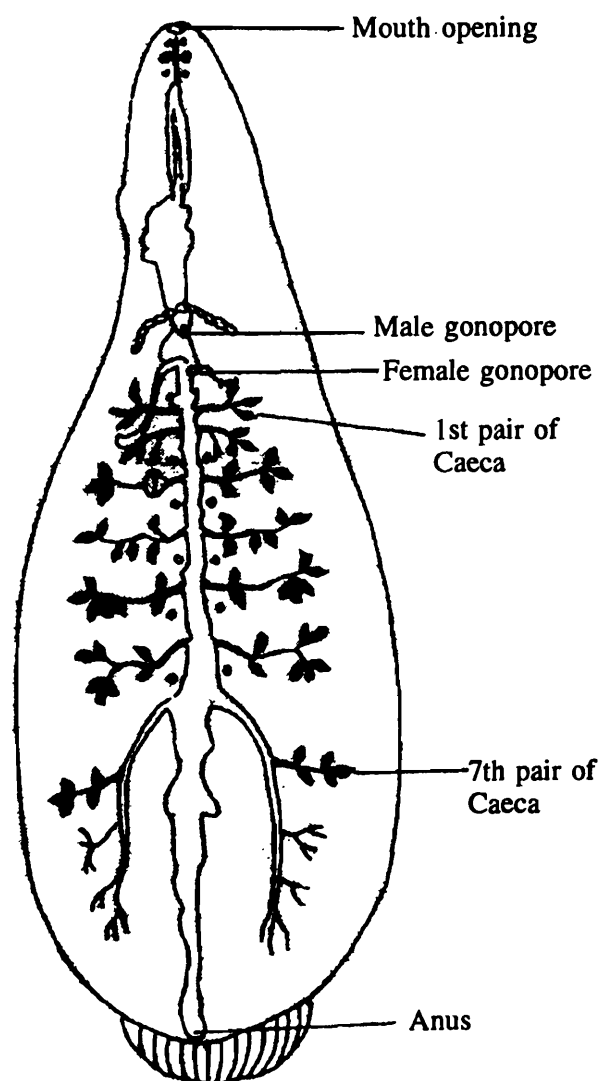
*Breeding Season* : April to August. During this time they form eggs and bear on the ventral side of the body. 5–7 eggs are found in the jelly like brood, within 20–25 days offsprings came out from the brood, taking rest for few hours leave the mothers body in search of food.

*Remarks* : The specific name is proposed according to the name of the place where from the first example was collected.

*Comparision* : *Paraclepsis gardensi* differs from other two species of the genus, so far recorded from Indian region. Dimention of eyes of the *Paraclepsis gardensi* varies from *Paraclepsis praedatrix* and *Paraclepsis vulnifera*. Third pair of eyes are largest in the two species where as in *Paraclepsis gardensi* 2nd pair largest. In *Paraclepsis gardensi* stomach is more branched than



*Paraclepsis gardensi* sp. nov.



Alimentary canal & caecal arrangement in the sp. nov.  
*Paraclepsis gardensi*

other two species of the genus. In *Paraclepsis gardensi* mouth opening is horse-shoe shaped and terminal in position. In other two species the mouth opening is almost round and sub terminal. Bulb shaped structure is absent in *Paraclepsis praedatrix* and *Paraclepsis vulnifers*. 18 dorsal sub parallel lines and 6 ventral greyish green lines (2 mid ventral) in *Paraclepsis gardensi* but such number of lines are not present in other two species of the genus. Greatest length of *Paraclepsis gardensi* in preserved state is 10 mm. whereas 15.5 mm. in *Paraclepsis praedatrix*, and 14 mm. in *Paraclepsis vulnifera*.

**Host and Habitat :** It is found in ponds, lakes and canals where tortoises, snakes and frogs abound in.

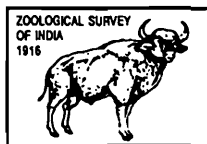
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*Rec. zool. Surv. India* : **103** (Part 1–2) : 115-121, 2004

## **THE LEGACY OF DR. NELSON ANNANDALE AND HIS CONTRIBUTION TO THE TAXONOMY OF PHLEBOTOMINE SANDFLY SPECIES (DIPTERA : PSYCHODIDAE : PHLEBOTOMINAE) TRANSMITTING LEISHMANIASIS<sup>1</sup>**

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### **INTRODUCTION**

Dr. T. N. Annandale was an extraordinary professional zoologist and gifted with administrative foresight. Under the stewardship of Annandale, the Zoological Survey of India was established on 1st July 1916 from the Zoological and Anthropological section of then known Indian Museum. He was primarily instrumental in the activities of Zoological Survey of India and laid the foundation for research on taxonomic zoology in India. This paper presents Annandale's contribution to the taxonomy of phlebotomine sandflies of which some are vectors of bishmaniasis.

### **BIOGRAPHY OF ANNANDALE**

*Academic pursuit* : Dr. Thomas Nelson Annandale, D.Sc., C.I.E., F.R.S., F.L.S., C.M.Z.S. (Fig. 1) was borne at Edinburgh on 15th June 1876. He was educated at Rugby and at Balliol College, graduating in 1898. In 1899 he joined the Sheat Expedition to Malay Archipelago. From 1902 to 1904 he held a research fellowship in Anthropology in the University of Edinburgh and was awarded the degree of D.Sc. in 1905.

*Research and professional excellence* : Annandale came to India in 1904 and joined the Indian Museum as Deputy Superintendent and later he was appointed as Superintendent in 1907.

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<sup>1</sup>Featured in 4<sup>th</sup> International Symposium on Phlebotomine Sandflies held in Salvador-Bahia, Brazil during August 3–7, 2002, as Entomol. Vect. 9 (Supl. 1) ISOPSIV, 2002 by the Universidade Gama Filho : 145 and abstracted in Zoological Record, Review of Applied Entomology, Quarterly Bibliography of Major Tropical Diseases & other international periodicals.

During this period he was responsible to bring out the Records of Indian Museum and Memoirs of the Indian Museum in 1907. He became the Director of Zoological Survey of India and continued to hold the post until his death in 1924.

Annandale was interested in wide groups of animal taxonomy, their field biology and ecology. He worked on sponges, polyzoa, fresh and brackish water molluscs, termite and termite mounds, true flies, lizards and snakes and published his findings in a series of volumes in the Fauna of British India, Ceylon and Burma, in the Records of Indian Museum and Memoirs of Indian Museum and in the Journals of Asiatic Society of Bengal, Bombay Natural History. For carriers of human disease, his works on the fresh water molluscs suspected vector of schistosomiasis and phlebotomine sand flies transmitting leishmaniasis are worth mentioning.



Fig. 1. Dr. Thomas Nelson Annandale

Annandale was an Honorary Secretary to the Trustee of the Indian Museum for several years, President of Asiatic Society of Bengal in 1923 and twice the Chairman of the Zoology Section of Indian Science Congress and its President in 1924. Dr. Annandale died in Calcutta on 10th April 1924 [sources, ZSI 1990].

## ANNANDALE'S CONTRIBUTION TO PUBLIC HEALTH ZOOLOGY

**Medical Malacology** : When the incidence of schistosomiasis occurred among the Indian troops returning from South Africa during the World War, Dr. Annandale was entrusted to take up the aetiology of the disease and its possible intermediate host. In his search for the intermediate snail host, Annandale travelled as far as Seistan Persia and to several places in India. He provided wealth information about the Indian fresh water molluscs collected from wide range of ecosystems including hill streams, ponds and lakes (Annandale, 1920b).

**Taxonomy of Phlebotomine sand fly vectors of leishmaniasis** : At the beginning of 20th century, a series of studies was made by the Europeans to explore the Dipterans, among other faunas, of India. Their interest for Indian Dipterans is that they represented not only bewildering diversity but also some of them, a serious pest of agriculture crops and of human diseases. They also extensively travelled across the Indian subcontinent to collect the Dipterans fauna, which were deposited both in their museums and in the Indian Museum.

During this period, Dr. T. N. Annandale joined the Indian Museum in 1904 and laid strong foundation to study the lower Diptera and public health entomology. A special 3 days fever [pappataciefieber, subsequently known popularly as leishmaniasis] being transmitted by the bite of Phlebotomine sand fly species was prevalent in Southern Europe and was believed to occur also in some parts of Northern India (Brunetti, 1912). This public health problem led and inspired Dr. Annandale for studying the natural history and taxonomy of Indian *Phlebotomus* sp. Annandale extensively travelled the entire India and its neighbouring regions to collect sand flies, provided flawless description and deposited them in the National collection of ZSI.

## CATALOGUE OF PHLEBOTOMINES DESCRIBED BY ANNANDALE

Annandale described 6 species of phlebotomines, which were subsequently treated under different genera and subgenera by the reviewers for taxonomic stability. Of the 6 taxa, 3 species are known as species complex and 2 species are now considered as major vectors of leishmaniasis. Their current catalogue, taxonomic status, geographical distribution and biology in reference to leishmaniasis are as follows :

Genus *Phlebotomus* Rondani & Berte

Subgenus *Euphlebotomus* Theodor

*Phlebotomus argentipes* Annandale & Brunetti

*Phlebotomua argentipes* Annandale & Brunetti in Annandale, 1908 : 101 [male, female]. Lectotype male [designated Quate (1962b : 157)], India : Calcutta, 28.xii.1907; monsoon forest (ZSI Calcutta).

*P. argentipes* var. *marginatus* Annandale; 1910b : 62 [female]. Holotype female, Sri Lanka : Peradeniya, v. 1909. [Types lost : Quate (1962b : 157).] [Synonymized by Sinton (1932a : 59).]

*P. annandalei* Sinton, 1923a : 744 [male]. Holotype male, India : Madras, Guindy, 1.ii.1922 (Dep?). [Synonymized by Sinton (1925a : 789).]

*P. argentipes* var. *glaucus* Mitra & Roy, 1953 : 372 [female]. Syntypes 10 female, India : Maharashtra, Pune (AFMC, Pune). [Synonymized by Lewis (1967a : 24).]

**Distribution** : Bangladesh, Burma, India, Indonesia, Laos, Nepal, Pakistan, Sri Lanka, Thailand, Vietnam, Malaysia.

**Biology** : Geographical and biological variation may indicate a species complex; in parts of India it is markedly anthropophilic and an important vector of Visceral Leishmaniasis (Kala-azar) caused by *L. donovani* (Killick-Kendrick, 1990; Lane, 1988; Lewis, 1978, 1982, 1987 cited in Seccombe *et. al.*, 1993; Ilango *et. al.*, 1994). Based on the morphology, especially genital diversity as a source of species isolation and biogeography, *Phlebotomus argentipes* sensu lato has been revised to include 3 sibling species (Ilango, unpublished).

#### Subgenus *Larroussius* Nitzulescu

##### *Phlebotomus major* Annandale

*Phlebotomus majo*, Annandale, 1910a : 46 [male]. Lectotype male [designated Quate (1962b : 157)], India : Naini Tal; dry tropical scrub and thorn forest (ZSI Calcutta). Female : Sinton (1925b : 107).

*P. major* var. *grisea* Annandale 1911 : 320 (as var. of *major*). Syntypes, India : Darjiling, Kurseong, 1425 m, vi.1910 & iv.1911. [Types lost : Quate (1962b : 157).]

[Synonymized by Sinton (1932 : 59) & Quate (1962b : 157).]

*P. crimicus* Shtefko & Minkevich, 1923 : 52 [male, female]. Syntypes 1 male, 1 female, U.S.S.R. (MH, Sinferopol). [Synonymized by Perfil'ev (1966 : 279); poor description, position doubtful; Lewis (1982) suggested this may be *P. sergenti*.]

**Distribution** : India, Nepal, Pakistan, Thailand.

**Biology** : *P. major* s.l. has been infected with *L. infantum* (Adler & Theodor, 1957); occurs along Himalayan foot hills in India, where summer rains are heavy (Sinton, 1932a; Lewis, 1982 cited in Seccombe *et. al.*, 1993).

**Notes** : The *P. major* species complex is reviewed by Artemiev & Neronov (1984), Leger & Pesson (1987) and Lewis (1982). The taxa include *P. krimensis*, *P. major*, *P. neglectus*, *P. syriacus*, *P. wenyoni*, and *P. wui*, most of which have been referred to as *P. major* in the past (Seccombe *et. al.*, 1993).

#### Genus *Sergentomyia* Franca & Parrot

##### Subgenus *Neophlebotomus* Franca & Parrot

##### *Sergentomyia malabarica* (Annandale)

*Phlebotomus malabarica* Annandale, 1910a : 48. [male, female]. Lectotype male [designated Quate (1962b : 158)], India : Maddathurai, 16.xi.1908 (ZSI Calcutta).

***Sergentomyia zeylanica* (Annandale)**

*Phlebotomus zeylanica* Annandale, 1910b : 60. [male, female]. Lectotype female [designated Quate (1962b : 158)], Sri Lanka : Peradeniya, 17.v.1910; tropical rainforest (ZSI Calcutta). Male : (as *P. chalami*) Young & Chalam (1927 : 849).

*P. chalami* Young & Chalam, 1927 : 849. [male, female]. Syntypes, India : Bombay, Colaba, 25.ix-5.x.1926 (BMNH 1 male, 1 female; (CRI.Kas.)).[Synonymized by Sinton (1928c : 319).]

**Distribution** : India, Sri Lanka.

**Notes** : Male of the type series of *zeylanica* reidentified as *P. argentipes*.

**Subgenus *Parrotomyia* Theodor*****Sergentomyia babu* (Annandale)**

*Phlebotomus babu* Annandale, 1910a : 49. [male,female]. Lectotype male [designated Quate (1962b : 158)], India : Calcutta, vi.1908; monsoon forest (ZSI Calcutta).

*P. niger* Annandale, 1911 : 320(as var. of *babu*). Syntypes, India : Bihar, Pusa. [believed lost (Quate, 1962b : 158).[Synonymized by Sinton (1932a : 60).]

*P. thapari* Mitra & Roy, 1952b : 188 [female]. Holotype female, India : Maharashtra, Pune ('Poona'), Hadapsar (Dep?). [Synonymized by Lewis (1978 : 257).]

**Distribution** : Afghanistan, Bangladesh, India Mauritius, Pakistan.

**Biology** : *S. babu* s.l. has been revised as the species complex with inclusion of *Sergentomyia babu* (Annandale) sensu stricto, *S. shorttii* Adler & Theodor, *S. baghdadis* Adler & Theodor, *S. insularis* (Theodor) and *S. yercaudensis* sp. nov. All 5 species are known exclusively from the Oriental Region. Their biology in relation to leishmaniasis, ecological distribution and adaptive radiation were discussed (Ilango, 2003).

***Sergentomyia himalayensis* Annandale**

*Phlebotomus himalayensis* Annandale, 1910a : 50. [male, female]. Lectotype female [desinated Quate (1962b : 158)], India : Darjiling District, Kurseong, 1500m, 3.vii.1908; mountain vegetation (ZSI Calcutta).

**Distribution** : India.

**SUMMARY**

Dr. Thomas Nelson Annandale, the founder Director of Zoological Survey of India, has been widely remembered for his exceptional interest in studying from invertebrates to anthropology. Among the contributions of Annandale, phlebotomine sand fly species transmitting leishmaniasis and fresh water snails as suspected vectors of schistosomiasis are the most important studies relevant to India. Annandale discovered and described 6 species of phlebotomines, of which *Sergentomyia babu*, *Phlebotomus argentipes* and *P. major* are super/or complex of sibling species and the latter

two are important vectors of visceral leishmaniasis. The disease is caused by the protozoan parasite, *Leishmania donovani* being transmitted by the bite of *P. argentipes* prevalent in Bihar, Uttar Pradesh, West Bengal, Tamil Nadu and in Bangladesh and, *L. infantum* by *P. major* from the foot hills of Himalayan Regions in India, Nepal and Pakistan. Among the sand fly species complex, *Sergentomyia babu* and *Phlebotomus major* have been revised while *P. argentipes* needs to be studied at gamma taxonomic level as its varieties stand valid species status and that will have an important bearing on the vector incrimination and control. This paper presents a brief biography of Annandale, his impeccable studies on the taxonomy of phlebotomine sand flies, their current catalogue and status of species known to transmit leishmaniasis.

### ACKNOWLEDGEMENT

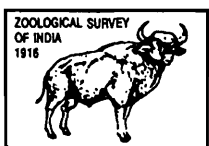
I thank the Director, Zoological Survey of India for encouragements.

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## DESCRIPTION OF THREE NEW SPECIES OF CRAB SPIDERS (ARANEAE : THOMISIDAE) FROM MADHYA PRADESH, INDIA

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### INTRODUCTION

Crab spiders of the genus *Runcinia* Simon, 1875 are not well known from India. Simon (1895) described the species *Runcinia bifrons* and Reimoser (1934) described *Runcinia escheri* from India. Tikader (1965) described *Runcinia roonwali*; Sen and Basu (1972) described *Runcinia chauhani* and Tikader (1980) *Runcinia ghorpadei*. Recently, Gajbe and Gajbe (2000b) described the species *Runcinia yogeshi* from India.

Unlike other crab spider genera, the genus *Thomisus* Walckenaer, 1805 is well represented from India. Stoliczka (1869) described the species *Thomisus elongatus* and *T. pugilis*; Simon (1906) described *Thomisus granulifrons*, *T. leucaspis* and *T. rigoratus*. Dyal (1935) described two species *Thomisus albens* and *T. tuberculatus*. Tikader (1960) described the species *Thomisus bulani*, *T. dhakuriensis* and *T. projectus*. The species *Thomisus sikkimensis* was described by Tikader (1962) and *Thomisus katrajghatus* by Tikader (1963). Basu (1963) described *Thomisus sorajaii*; Sen (1963) described *Thomisus shillongensis*, and Sen and Basu (1963) *Thomisus memae*. Basu (1965) described one species *Thomisus beautifularis*, while Tikader (1965) described three species *Thomisus lobosus*, *T. pooneus* and *T. shivajiensis*. Tikader (1966, 1970) described *Thomisus cherapunjeus* and *T. rishus*, respectively. Tikader (1980) described *Thomisus andamanensis* from the Andaman Islands, Reddy and Patel (1992) described two species *Thomisus godavariae* and *T. krishnae*. Kumari and Mittal (1997) described two species *Thomisus dyali* and *T. ludhianaensis*. Recently, Gajbe and Gajbe (2000a) described the species *Thomisus sundari* and Bhandari and Gajbe (2001) *Thomisus rajani* from Madhya Pradesh, India.

A new species of the genus *Runcinia* Simon and two new species of the genus *Thomisus* Walckenaer are described herein from Madhya Pradesh. The type specimens will in due course be deposited with the National Zoological Collection, Zoological Survey of India, Kolkata.

## SYSTEMATIC ACCOUNT

Family THOMISIDAE SUNDEVALL, 1833

Genus I. *Runcinia* Simon, 18751980. *Runcinia* Tikader, *Fauna of India, Spiders*, 1(1) : 58.

**Diagnosis :** Cephalic region with prominent ocular tubercles, clothed with hairs and spines. Legs long and stout, I and II remarkably longer than others. Abdomen long, spined, narrower behind. Lateral sides with conspicuous muscular corrugation.

**Type species :** *Runcinia grammica* (C. L. Koch, 1837)

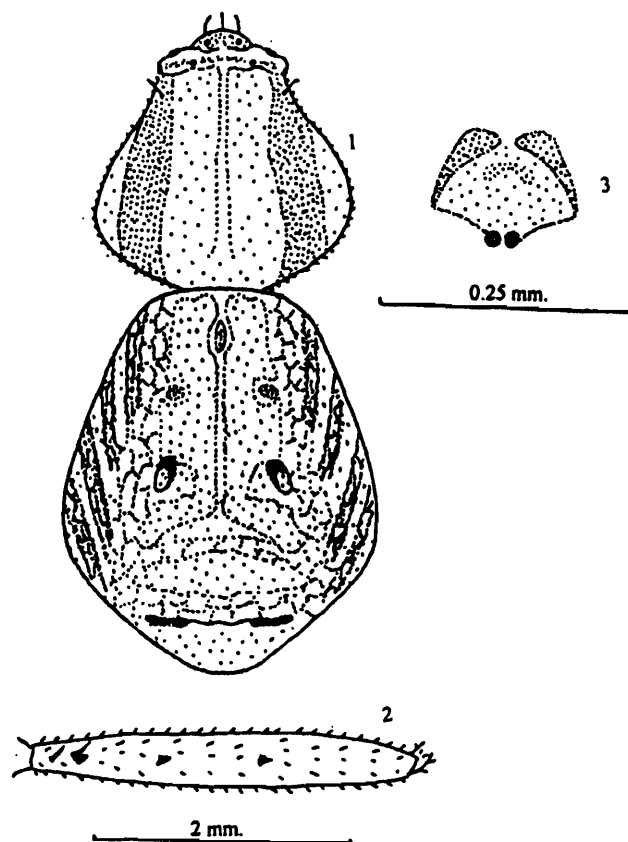
**Distribution :** Europe, Africa, Asia and Australia.

1. *Runcinia sitadongri* sp. nov.

(Figs. 1-3)

**General :** Cephalothorax, legs and abdomen brownish in colour. Total length 5.0 mm. Carapace 2.0 mm. long, 2.0 mm. wide; abdomen 3.0 mm. long, 2.5 mm. wide.

**Cephalothorax :** As long as wide, laterally with two longitudinal broad dark brown stripes, middle region with a longitudinal narrow chalk white stripe as in fig. 1. Eyes eight, black, arranged



Figs. 1-3. *Runcinia sitadongri* sp. nov. 1. Dorsal view of female, legs omitted. 2. Dorsal view of femur. 3. Epigyne.

in two rows; lateral eyes located on protuberance with greenish tinge, antero-lateral eyes largest. Cephalic region and clypeus with few spine-like hair, a spine-like hair present below each postero-lateral eye as in fig. 1. Maxillae dumbbell-shaped; labium slightly darker, as long as wide. Sternum heart-shaped, light brown, clothed with few hair. Legs I and II much longer than III and IV; femur I with two dorsal spines and three tiny dark brown spots as in fig. 2, femur II with one dorsal spine; tibiae and metatarsi I and II with a few long and prominent ventral spines.

**Abdomen** : Longer than wide, broadest just behind the middle, laterally with dark brown stripes; dorsum with three light brown spots in the anterior region, two oval blackish-brown spots in the middle region and two small black spots in the posterior region as in fig. 1. Ventral side lighter in colour, laterally with brownish stripes, the area between epigynal furrow and spinnerets with a light brown patch. Spinnerets clothed with hair, anterior- and posterior spinnerets equal in size. Epigyne present just above the epigynal furrow, appears as in fig. 3. Male unknown.

**Type specimen** : Holotype female, in spirit, other details as above.

**Type locality** : Sitadongri, Delakhari, Pachmarhi Biosphere Reserve, Chhindwara district, Madhya Pradesh, India; coll. Y. N. Gupta, 18.x.2002.

**Etymology** : The specific name is a noun taken in appropriation from the type locality.

This species resembles *Runcinia chauhani* Sen & Basu but can be distinguished from it as follows : (i) A longitudinal narrow chalk white stripe present in the middle region of cephalothorax but absent in *R. chauhani*. (ii) A spine-like hair present below each postero-lateral eye but absent in *R. chauhani*. (iii) Two small black spots present in the posterior region of abdomen but absent in *R. chauhani*. (iv) Femur I with two dorsal spines and three tiny dark brown spots but in *R. chauhani* with four dorsal spines only. (v) Structure of epigyne different in both species.

## Genus II. *Thomisus* Walckenaer, 1805

1980. *Thomisus* Tikadar, *Fauna of India, Spiders*, 1(1) : 30.

**Diagnosis** : Cephalothorax truncated in front, with the upper fore-corners strongly and conically protuberant and divergent, bearing the lateral eyes. Eyes small, black, antero-laterals largest. Abdomen narrow and truncated in front, enlarging to a considerable width behind, where at either corner of the dorsal side is a short blunt conical protuberance. Legs long, I and II much longer than III and IV.

**Type species** : *Thomisus onustus* Walckenaer, 1805.

**Distribution** : Europe, Africa, Asia, Australia and America.

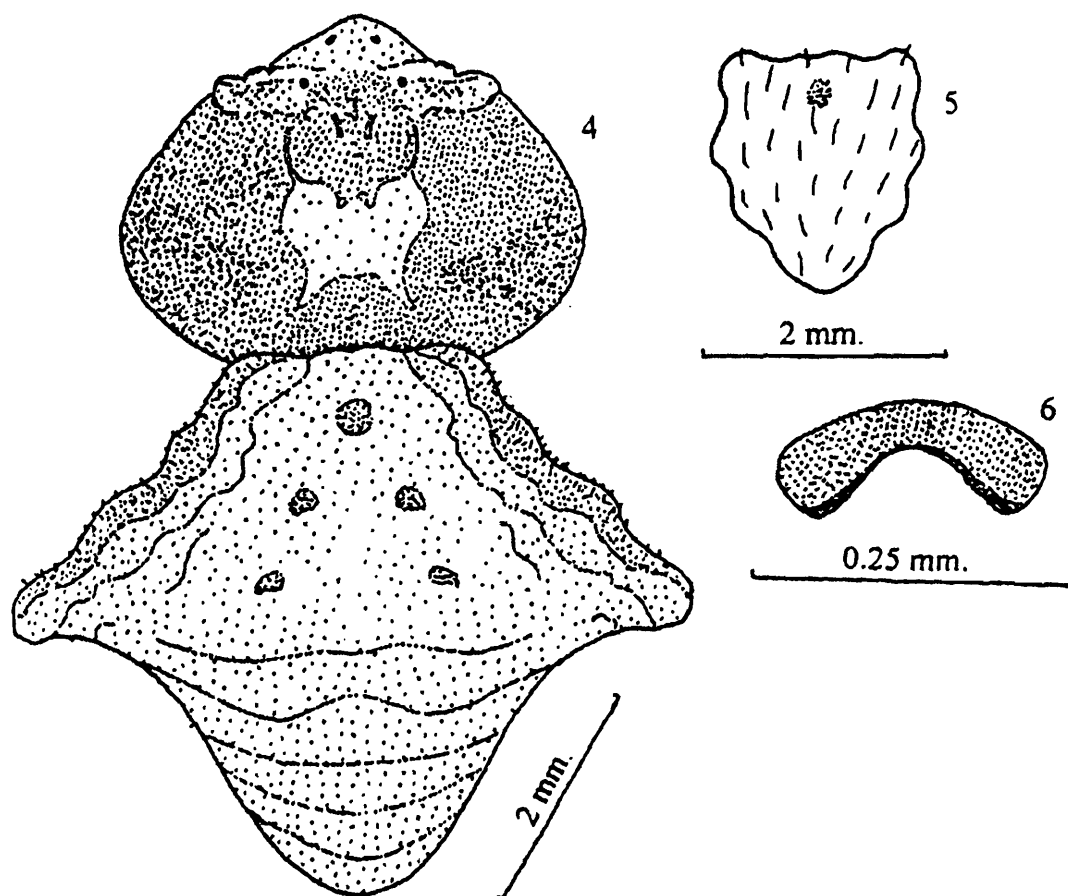
2. *Thomisus baghdeoi* sp. nov.

(Figs. 4-6)

**General :** Cephalothorax dark brown, legs and abdomen dark brown. Total length 7.5 mm. Cephalothorax 2.5 mm. long, 4.0 mm, wide; abdomen 5.0 mm. long, 6.0 mm. wide.

**Cephalothorax :** Wider than long, middle region with a heart-shaped light brown patch, postero-lateral region slightly darker as in fig. 4. Ocular protuberance light brown. Maxilla and labium light brown, clothed with hair, labium longer than wide. Sternum light brown, heart-shaped, clothed with hair, a small brownish spot present in the anterior region as in fig. 5. Chelicera light brown, clothed with hair. Legs clothed with hair, provided with some whitish patches, metatarsus I with five pairs of ventral spines.

**Abdomen :** Pentagonal, wider than long, strongly overlapping cephalothorax, ending in two raised tubercles, antero-lateral region blackish-brown, anterior end and antero-lateral border covered with light brown setae as in fig. 4. Dorsum depressed, with muscular corrugations laterally and posteriorly, provided with five dark brown spots as in fig. 4. Ventral region with transverse muscular corrugations. Spinnerets dark brown, anterior spinnerets thicker than others. Epigyne consisting of a sclerotised plate with an inverted U-shaped dark brown marking as in fig. 6. Male unknown.



Figs. 4-6. *Thomisus baghdeoi* sp. nov. 4. Dorsal view of female, legs omitted. 5. Sternum. 6. Epigyne.

*Type specimen* : Holotype female, in spirit, other details as above.

*Type locality* : Baghdeo, Pench Tiger Reserve, Seoni district, Madhya Pradesh, India; coll. M. L. Koshta, 27.vii.2001.

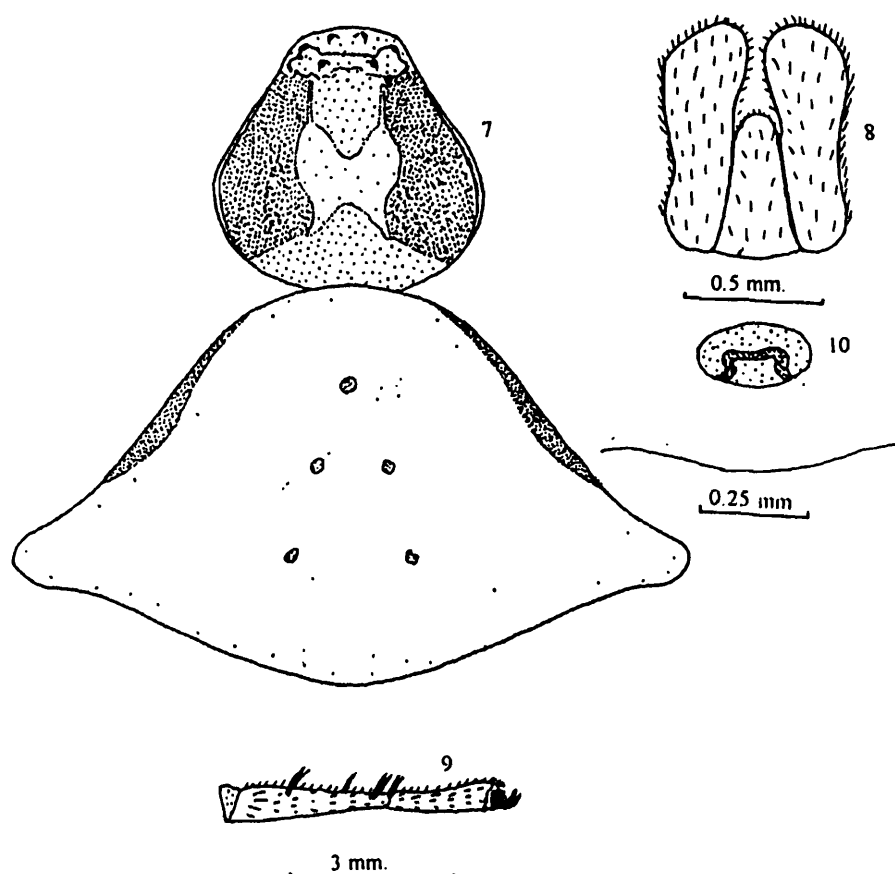
*Etymology* : The specific name refers to the type locality.

This species resembles *Thomisus projectus* Tikader but can be distinguished from it as follows : (i) Cephalothorax and abdomen dark brown but in *T. projectus* cephalothorax greenish and abdomen chalk white. (ii) Middle region of cephalothorax with a heart-shaped light brown patch, which is absent in *T. projectus*. (iii) Anterior region of sternum with a small brownish spot. (iv) Anterior end and antero-lateral border of abdomen covered with light brown setae. (v) Raised tubercles of abdomen without any spots but in *T. projectus* each tubercle with a black spot. (vi) Structure of epigyne different in both species.

### 3. *Thomisus kokiwadai* sp. nov.

(Figs. 7-10)

*General* : Cephalothorax dark brown, legs light brown and abdomen chalk white. Total length 12.0 mm. Carapace 4.5 mm. long, 4.5 mm. wide; abdomen 7.5 mm. long, 12.0 mm. wide.



**Figs. 7-10.** *Thomisus kokiwadai* sp. nov. 7. Dorsal view of female, legs omitted. 8. Labium and maxillae. 9. Ventral view of I metatarsus. 10. Epigyne.

*Cephalothorax* : As long as wide, lateral half with a broad dark brown patch and a chalk white patch in the middle region; area below the ocular region and the chalk white patch lighter in colour as in fig. 7. Eyes eight, black, in two recurved rows, lateral eyes on chalk white conical protuberance, antero-lateral eyes largest, ocular quad narrowing in front. Pedipalp clothed with hair and some spines, with one claw. Sternum heart-shaped, clothed with hair, light brown in colour. Maxilla and labium light brown, clothed with hair, labium one and half times longer than wide as in fig. 8. Legs I and II much longer than III and IV, all the legs clothed with hair and provided with some chalk white patches, metatarsi I and II with seven ventral spines each as in fig. 9.

*Abdomen* : As wide as the entire length of body, pentagonal, globular, widest and sloping in the posterior region, antero-lateral region with narrow dark brown patch, five small dark brown spots on the dorsum as in fig. 7. Ventral region chalk white, area between the epigynal furrow and spinnerets light brown with four pairs of small brownish spots. Spinnerets dark brown, posterior spinnerets longest. Epigyne oval, dark brown, surrounded with hairs, as in fig. 10. Male unknown.

*Type specimen* : Holotype female, in spirit, other details as above.

*Type locality* : Kokiwada, Pench Tiger Reserve, Madhya Pradesh, India; coll. K. Chandra, 25.xi.2001.

*Etymology* : The specific name refers to the type locality.

This species resembles *Thomisus lobosus* Tikader but can be distinguished from it as follows : (i) Lateral half of cephalothorax with a broad dark brown patch but in *T. lobosus* with longitudinal light brown to deep brown patches. (ii) Metatarsi I and II with seven ventral spines but in *T. lobosus* with four pairs of ventral spines. (iii) Anterolateral region of abdomen with narrow dark brown patch but in *T. lobosus* with some black spots. (iv) Structure of epigyne different in both species.

## SUMMARY

Three new species of crab spiders, viz., *Runcinia sitadongri* sp. nov., *Thomisus baghdeoi* sp. nov. and *Thomisus kokiwadai* sp. nov. have been described from Madhya Pradesh.

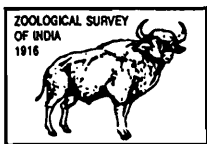
## ACKNOWLEDGEMENTS

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*Rec. zool. Surv. India* : 103 (Part 1–2) : 131-142, 2004

## **STUDIES ON SOME SPIDERS OF THE FAMILIES OECOBIIDAE, ERESIDAE, HERSILIIDAE, UROCTEIDAE AND ULOBORIDAE (ARANEAE : ARACHNIDA) FROM MADHYA PRADESH, INDIA**

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### **INTRODUCTION**

The spiders of the families Oecobiidae, Eresidae, Hersiliidae, Urocteidae and Uloboriade are little known from Madhya Pradesh. Pocock (1900) in his Fauna of British India described some species. Gravely (1921) described many species of some families. Sinha (1950) described many species of the family Hersiliidae. Tikader (1962,63,69,70,77) and Tikader & Biswas (1981) described some species of all the families.

#### **Family 1. OECOBIIDAE**

*Characters* : The members of this small family have three claws, both the carapace and sternum wider than long. The spiders live under stones, but are often found in houses, especially in corner angles of walls.

There is a striking similarity between oecobiidae and the ecribellate family Urocteidae of the old world. Some American workers prefer to consider both as sub-families within the same family, in this case, the name Oecobiidae having priority, should be used. Beside the presence or absence of calamistrum and cribellum only minor external differences can be found.

The most common genus is *Oecobius* with four species so far known from India.

#### **Genus 1. *Oecobius* Lucas**

1845. *Oecobius* Lucas, *Expt. Alg. Ar.*, : 101.

1981. *Characters* : This is the best known genus of the family. The cephalothorax is convex and moderately elevated. The legs are proportionately long, the metatarsus and tarsus together of

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each of the legs far exceeding the carapace in length. Median ocular quadrangle as long as, or longer than broad.

This spider makes small flat webs on window sills, and over cracks on the walls of buildings.

*Type-species* : *Oecobius domesticus* Lucas.

*Distribution* : America, Arabia, Japan and India.

### 1. *Oecobius putus* O.P. Cambridge

1876. *Oecobius putus* Cambridge, *Proc. zool. Soc.* : 544.

*Specimens Examined* : 5 ♀♀, office premises of Central Regional Station, Napier Town, Jabalpur, Madhya Pradesh, Coll. U. A. Gajbe, 6.IV.1985 (Reg. No. A/1793). 1 ♀, P.W.D. Rest House Piparia, Hoshangabad dist., Madhya Pradesh Coll. U. A. Gajbe, 7.1.1990 (Reg. No. A/1994). 5 ♀♀, Amanpur, Madan Mahal, Jabalpur, Madhya Pradesh, Coll. U. A. Gajbe, 28.VI.1982. (Reg. No. A/1795).

*General* : Cephalothorax and abdomen light deep to brown, legs pale green. Total length 2.60 mm. Carapace 0.90 mm long, 1.10 mm wide; abdomen 1.80 mm long, 1.10 mm wide.

*Cephalothorax* : Wider than long, depressed on the centre but cephalic region slightly high and eyes groups situated on the top, margin encircled by a deep brown line. Eyes unequal in size and dissimilar in form. The anterior medians and posterior lateral eyes dark in colour and others pearly white; posterior medians triangular in size, both rows procurved but anterior row more procurved than posterior. Legs long, clothed with five long hairs and all legs transversely banded with dark brown bands but in male no such bands.

*Abdomen* : Long, slightly pointed behind, clothed with long hairs, dorsum ornamented by dark and chalk-white irregular patches, middorsally with a spear-shaped black area extending from base to behind the middle. The hind spinnerets long and two joined; the second segment longer than the first and furnished with a comb of long spinning tubes on the inner side.

*Distribution* : INDIA : Madras, Tamil Nadu; Poona, Maharashtra; Kolkata, West Bengal; Jabalpur, Hoshangabad, Madhya Pradesh; Egypt, Tripoli, Yemen, Tanjanyika, Lahore.

*Remarks* : This species is being reported here for the first time from Madhya Pradesh.

### Family II ERESIDAE

*Characters* : Cephalothorax very wide in front (resembling at first sight that of Salticidae); cephalic region high; the clypeus low; the four median eyes forming a small quadrangle narrower in front than behind; the posterior lateral far removed from the rest of the eyes and situated high up on the posterior portion of the head. Abdomen very heavy, over hanging, cephalothorax; cribellum thick, transversely divided.

Genus 2. *Stegodyphus* Simon

1873. *Stegodyphus* Simon, *Ann. Soc. Ent. Fr.*, 3(5) : 336.

*Characters* : Cephalic region large, rounded, high, posterior lateral eyes remote from other eyes; anterior lateral eyes situated at the edge of clypeus; clypeus low, mandibles flat in front, fang groove scarcely toothed; legs strong and stout, spiny. Abdomen oval; anterior spinnerets thick.

The species of the genus occur on bushes or branches of trees, where they spin either large sheet-like webs, accompanied by a tubular retreat, or a large saccular nest, in which many individuals live, gregariously habits among spiders.

*Type-species* : *Stegodyphus lineatus* Latreille.

*Distribution* : Asia, Arabia, Africa.

2. *Stegodyphus sarasinorum* Karsch

1892. *Stegodyphus sarasinorum* Karsch, *Ent. Z. Berlin*, 36 : 275.

*Specimens examined* : 5 ♀♀, 1 ♂, Dhaurai village, Narayanpur, Tahsil, Baster dist., Coll. U. A. Gajbe, 24.XII.1983. (Reg. No. A/1782). 43 ♀♀, Forest Rest House, Katwadi, Coll. H. S. Sharma, 22.III.1990. (Reg. No. 1783). 144 ♀♀, Barghat, Seoni dist. Coll. U. A. Gajbe, 7.III.1987. (Reg. 1784). 83 ♀♀, Dokrikhera, Hoshangabad dist., Coll. U. A. Gajbe, 4.I.1990. (Reg. No. A/1785). 29 ♀♀, on the bank of Ramdohu river on way to Chhindwara– Chand road, Chhindwara dist., Coll. H. S. Sharma, 3.IV.1990. (Reg. No. A/1786). 1 ♂, P.W. D. Rest House, Amanganj, Panna dist. Coll. R. K. Singh, 21.II.1987. (Reg. No. A/1787). 125 ♀♀, patch village on way to Katawadi Shahpur road, Betul dist. Coll. H. S. Sharma, 21.III.1990. (Reg. No. A/1788), Kairagad, Rajnandgaon dist., Coll. U. A. Gajbe, 20.XII.1983. (Reg. No. A/1789). 57 ♀♀, Bhesdehi, Betul dist., Coll. H. S. Sharma, 31.III.1990. (Reg. No. A/1790). 1 ♀, Tanhai Village, Panna dist., Coll. R. K. Singh, 17.II.1987. (Reg. No. 1791). 10 ♀♀, 2 ♂, Near Jaon, Ratlam dist., Coll. R. K. Singh, 24.VIII.1990. (Reg. No. A/1803). 78 ♀♀, 2 ♂♂, Near Gandhi Sagar, Mandsaur dist., Coll. R. K. Singh, 17.VIII.1990. (Reg. No. A/1805). 62 ♀♀, 4 ♂♂, Near Tal, Ratlam dist., Coll. R. K. Singh, 25.VIII.1990. (Reg. No. A/1806). 78 ♀♀, 17 ♂♂, Near Bharthari cave, Ujjain dist., Coll. R. K. Singh, 29.VIII.1990. (Reg. No. A/1807). 22 ♀♀, 7 ♂, Mangalnath, Ujjain dist., Coll. R. K. Singh, 11.IX.1990. (Reg. No. A/1808). 29 ♀♀, 4 ♂♂, Bherogarh, Ujjain dist., Coll. R. K. Singh, 1.IX.1990. (Reg. No. A/1808). 45 ♀♀, 2 ♂, Near Rampura, Manasa, Mandsaur dist., Coll. R. K. Singh, 17.VIII.1990. (Reg. No. A/1810). 28 ♀♀, 2 ♂, Near Jaora, Ratlam dist., Coll. R. K. Singh, 26.VIII.1990. (Reg. No. A/1811). 6 ♀♀, 1 ♂, Near Kalladeh, Ujjain dist., Coll. R. K. Singh, 30.VIII.1990. (Reg. No. A/1312). 33 ♀♀, 5 ♂♂, Khachrod, Ujjain dist., Coll. R. K. Singh, 31.VIII.1990. (Reg. No. A/1813). 16 ♀♀, Near Chintamani Ganesh, Ujjain dist., Coll. R. K. Singh, 3.IX.1990. (Reg. No. A/1814). 52 ♀♀, 11 ♂♂, Near Manasa, Mandsaur dist., Coll. R. K. Singh, 15.VIII.1990. (Reg. No. A/1815). 39 ♀♀, 4 ♂, Near Bhanpura, Mandsaur dist., Coll. R. K. Singh,

16.VIII.1990. (Reg. No. A/1816). 20♀♀, Near Jaju Dam, Nimach, Mandsaur dist., Coll. R. K. Singh, 13.VIII.1990. (Reg. No. A/1817). 121♀♀, 22♂, Near Hussain Tekri Jaora, Ratlam dist., Coll. R. K. Singh, 20.VIII.1990. (Reg. No. A/1818). 51♀♀, 6♂♂, Near Mudali Village, Malhargarh, Mandsaur dist., Coll. R. K. Singh, 20.VIII.1990. (Reg. No. A/1819). 63♀♀, 3♂♂, Near Nagda, Ujjain dist., Coll. R. K. Singh, 18.VIII.1990. (Reg. No. A/1820). 1♀, Near Garod, Mandsaur dist., Coll. R. K. Singh, 18.VIII.1990. (Reg. No. A/1821). 1♀, Near Alot, Ratlam dist., Coll. R. K. Singh, 22.VIII.1990. (Reg. No. A/1824). 1♀, Ratangarh, Nimach, Mandsaur dist., Coll. H. P. Agrawal, 1.XI.1990.

This spider is gregarious in its habits. It spins a labyrinthine tube, which ends blindly at one end and the other end expands into a broad sheet, which however is smaller than that spun by the genus *Hippasa*. This species does not sting the prey to death, but feeds on the captive alive. All members of the colony sharing the same victim. Spiderlings hatch in the month of October and November and feed on their parents, hibernating in the web tubes in winter.

*Distribution* : INDIA : Travancore, Bangalore, Chingleput, Bilaspur, Poona, Uran, Calcutta, Barkuda Islands, Punjab and Madhya Pradesh.

### 3. *Stegodyphus socialis* Pocock

1900. *Stegodyphus socialis* Pocock, *Fauna Brit Indis*, *Arach.* : 209.

*Specimens examined* : 1♀, Forest Rest House, Hoshangabad, Madhya Pradesh, Coll. U. A. Gajbe, 13.I.1990. (Reg. No. A/1792).

*Distribution* : INDIA : Bangalore, Karnataka; Ahmednagar, Maharashtra; Hoshangabad, Madhya Pradesh.

*Remarks* : This species is being reported here for the first time from Madhya Pradesh.

### Family III HERSILIIDAE

*Characters* : The species of the family are very active spiders, living on tree trunks, old walls, or under stones and at most spinning a scanty web of irregular threads. Cephalothorax as wide as long, with cephalic region elevated, narrow and defined by a deep semicircular sulcus; eyes of anterior and posterior row strongly recurved, the anterior laterals standing high up half way between the anterior and posterior. Mandibles weak, at most weakly toothed below : maxillae inclined obliquely on the labium. Legs except III pair, very long and slender armed with three claws. Abdomen short, subpentagonal, posterior spinnerets very long usually longer than the abdomen.

*Distribution* : Africa, South Asia, Australia, South America.

Genus 3. *Hersilia* Audouin

1826. *Hersilia* Audouin, *Dercr. Egypte Arachn.*, : 114.

*Characters* : Ocular quadrangle parallel sided; head flat, angular laterally; clypeus usually very high, prominent, protarsi of Ist, IIInd and IV legs bisegmented.

*Type-species* : *Hersilia caudata* Audouin.

*Distribution* : Africa, Madagascar, Oriental region.

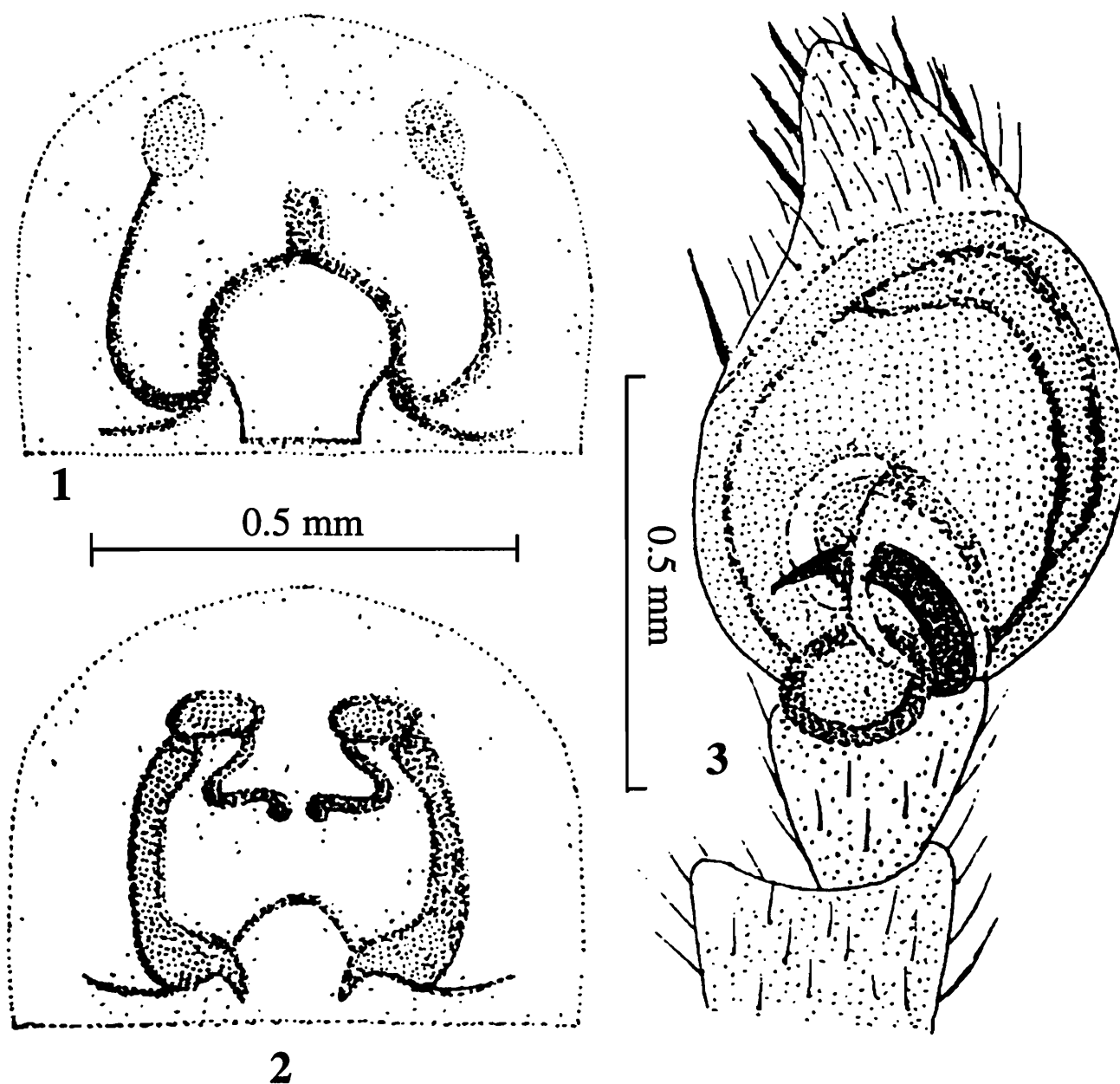
4. *Hersilia savignyi* Lucas

1836. *Hersilia savignyi* Lucas, *Mag. zool.*, 8 : 10.

*Specimens examined* : 2 ♀♀, 1 ♂, Around hot water tank on Jabalpur Mandla Road, dist. Mandla, Madhya Pradesh, Coll. U. A. Gajbe, 4.V.1982. (Reg. No. A/1665). 1 ♀, Narayanganj, dist. Mandla, Madhya Pradesh, Coll. U. A. Gajbe, 23.I.1985. (Reg. No. A/1666). 1 ♀, Borla, dist. Rajnandgaon, M.P., Coll. U. A. Gajbe, 1.I.1984. (Reg. 1667). 3 ♂♂, Dhaurai Village, Near Narayanpur, dist. Bastar, M.P., Coll. U. A. Gajbe, 24.XIII.1983. (Reg. No. A/1668). 1 ♀, Chotedonger, dist. Bastar, M.P., Coll. U. A. Gajbe, 28.XII.1983. (Reg. No. 2258). 2 ♀♀, Tondabeda Village Near Orccha, dist. Bastar, M.P., Coll. U. A. Gajbe, 29.XII.1983. (Reg. No. A/2253). 4 ♀♀, 1 ♂, Garhbengal village near Narayanpur, dist. Bastar, M.P., Coll. U. A. Gajbe, 30.XII.1983. (Reg. No. A/2255). 7 ♀♀, 1 ♂, Hatkachora village near Jagdalpur, dist. Bastar, M.P., Coll. U. A. Gajbe, 2.I.1984. (Reg. No. A/2254). 1 ♀, P.W.D. Rest House Compound, Jagdalpur, dist. Bastar, M.P., Coll. U. A. Gajbe, 2.I.1984. (Reg. No. A/1673). 1 ♀, Near Tal, Ratlam dist., M.P., Coll. R. K. Sharma, 25.VIII.1990. (Reg. No. A/1847). 1 ♂, Near Mainpura village, Mandsaur district, M.P., Coll. R. K. Singh, 11.VIII.1990. (Reg. No. A/1848). 7 ♀♀, 4 ♂, Banjar village, Baihar Tahsil, Balaghat district, M.P., Coll. R. K. Ghose, 25.I.1991. (Reg. No. A/1849). 11 ♀♀, 3 ♂, Around Forest Rest House Mukki, Balaghat district, M.P., Coll. R. K. Ghose, 24.I.1991. (Reg. No. A/1851). 1 ♀, Kanha Rest House, Kanha, Mandia district, M.P., Coll. R. K. Ghose, 24.I.1991. (Reg. No. 1852).

*General* : Cephaloghorax and legs brown, abdomen brownish-black. Total length 6.00 mm. Carapace 2.50 mm. long, 2.00 mm. wide; abdomen 3.50 mm. long, 3.00 mm. wide.

*Cephaloghorax* : Longer than wide, slightly narrowing in front, clothed with pubescence. Cephalic area very high, black. Both eye row recurved. Anterior median eyes are black, larger than the other eyes, lateral small and oval, equally spaced. Posterior row of eyes slightly recurved, equal in size and equidistant from each other. Median ocular quadrangle longer than wide, widest in front than behind. Clypeal height much greater than the diameter of the anterior median eyes. Chelicerae strong, vertical, narrowing in front, inner margin without tooth, outer margin with one tooth. Labium broad than long, triangular, maxillae oblique, longer than wide and provided with black setae. Sternum heart-shaped, pointed behind, clothed with long black setae. Legs long, clothed with hairs and some spines, protarsi I, II and IV bisegmented.



Figs. 1-3. : *Hersilia savignyi* Lucas. 1. Epigyne; 2. Internal genitalia; 3. Male palp, ventral view.

**Abdomen** : Longer than wide, subpentagonal, narrowing behind with black rim, transverse stripes, three pairs of sagilla, ventral side very lighter than the dorsal, midventrally provided with brown coloured dots extends upto the spinnerets. Epigyne bilobate, the lobes separated by deep emargination. Spinnerets widely separated, posterior spinnerets very long and longer than the abdomen. Males smaller in size, same in colour as female. The male palp as in fig. 3. Females larger in size, same in colour as male. Epigyne bilobate, the lobes separated by deep emargination as in fig. 1. Internal genitalia as in fig. 2.

This species is active hunting spiders, living on tree trunks and wall of old houses. The body colour varies according to the colour of the substratum and spinning a scanty web of irregular threads.

**Distribution** : INDIA : Nilgiri Hills, Madras, Tamil Nadu; Bangalore, Karnataka; Poona, Maharashtra; Allahabad, Dehradun, Uttar Pradesh; Kolkata, Serampur, Howrah, West Bengal; Assam; Ranchi, Chota Nagpur, Chakradharpur, Dinapur Siripur, Pusa, Bihar; Puri, Orissa; Mandla, Bastar, Rajnandgaon, Balaghat, Madhya Pradesh.

**Remarks** : This is a common species found every where in India.

#### Family IV UROCTEIDAE

**Characters** : These spiders live under stones where they spin a small saccular tent-like web of about five subradially arranged bands of silk attached to the underside of it. Carapace transversely reuniform widely rounded in front and laterally, posteriorly emarginate, ocular group compact. Legs short and strong, spiny, subequal in length, tarsi armed with three claws. Abdomen large and depressed. Posterior spinnerets much longer than the anterior and anterior spinnerets short, subcylindrical, separated by a colulus; and patella very large and furnished laterally with fringe of long hairs.

**Distribution** : Mediterranean Region, China, Japan, South Africa, India.

#### Genus 4. *Uroctea* Dufour

1820. *Uroctea* Dufour, *Ann. Sci. Phys.*, 5 : 198.

**Characters** : These spiders live under stones, where they spin a small saccular tent-like web attached to the under side of the stone by about five subradially arranged bands of silk.

**Type-species** : *Uroctea durandi* Latreille.

**Distribution** : Mediterranean region; China, Japan, South Africa, India.

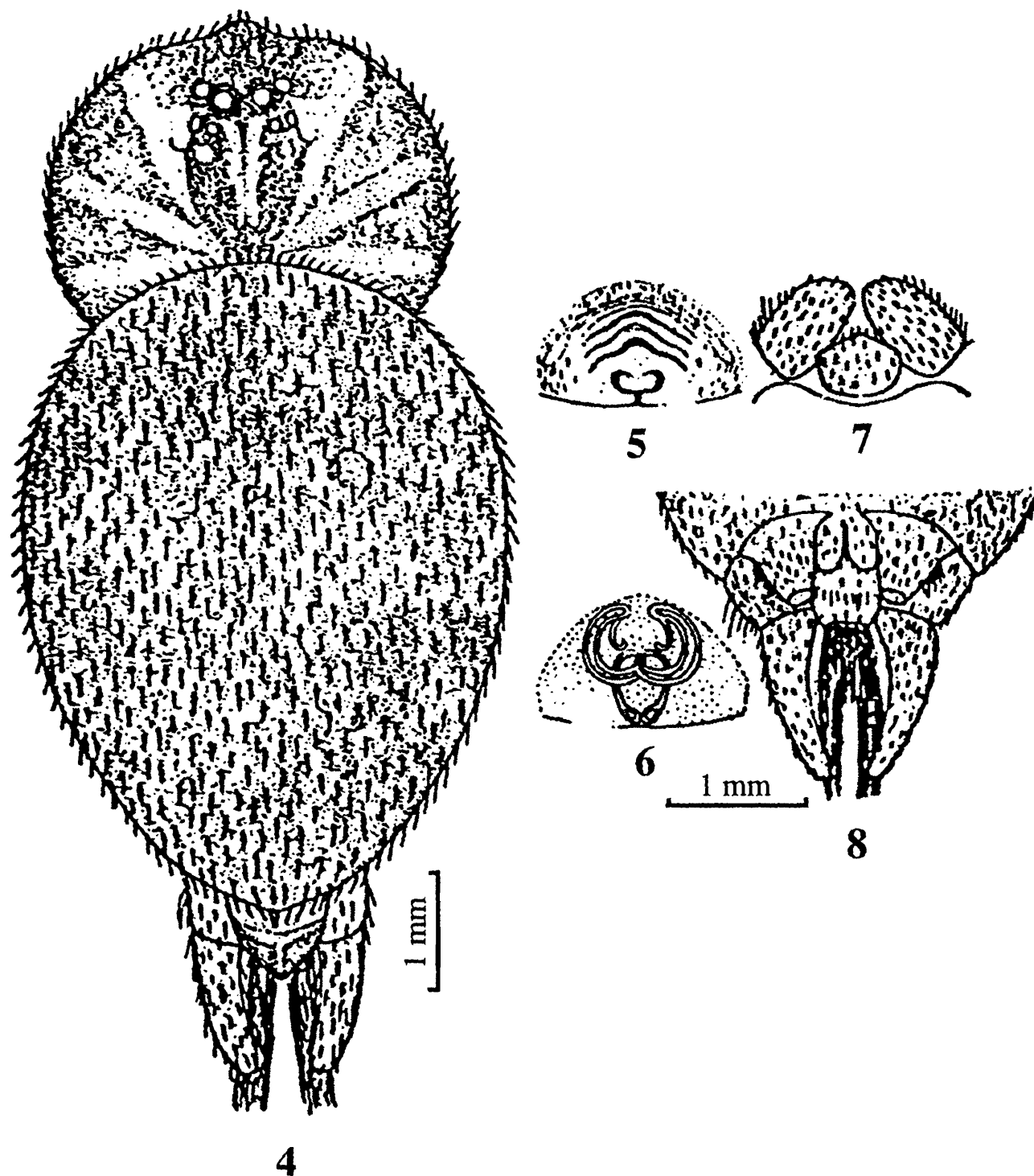
#### 5. *Uroctea indica* Pocock

1900. *Uroctea indica* Pocock, *Fauna Brit. India, Arach.*, : 243.

**Specimens examined** : 1 ♀, Shelter caves, Hoshangabad dist., Madhya Pradesh, Coll. U. A. Gajbe, 10.I.1990. (Reg. No. A/1796).

**General** : Cephalothorax and legs reddish-brown, abdomen brownish-black. Total length 8.5 mm. Carapace 2.80 mm. long, 3.70 mm. wide; abdomen 6.30 mm. long, 4.30 mm. wide.

**Cephalothorax** : Transversely reuniform, strongly rebordered clothed with hairs. Radiating black strips diverges from foveal region to lateral sides of cephalothorax. Eyes compact, pearly white, arranged in two distinct rows. Anterior row of eyes slightly procurved; medians longer than the laterals and closer to laterals than to each other. Posterior row of eyes slightly procurved, medians slightly smaller than the laterals widely separated from each other, closer to the adjacent laterals. Median ocular quadrangle wider than long and wider behind than in front. Chelicerae weak vertical, dorsally clothed with hair, inner and outer margin without tooth. Labium wider than long, pentagonal



Figs. 4-8. : *Uroctea indica* Pocock. 4. Dorsal view of female, legs omitted; 5. Epigyne; 6. Internal genitalia; 7. Labium and maxillae; 8. Spinnerets.

in shape, maxillae convergent, clothed with hair and some spine like hair shape as in fig. 7. Sternum heart-shaped, pointed behind, clothed with long hairs. Legs long, stout, clothed with hairs and spines. Femur of all legs dorsally provided with black and pale patches.

**Abdomen** : Longer than wide, oval with spine like hair dorsally provided with three pairs of sagitta and some round white spots as in fig. 4. Ventral side slightly lighter than the dorsal, clothed with hairs and provided with four longitudinal white bands starting from epigastric furrow to the anal tubercle. Epigyne consisting of transversely elliptical plate and marked with nearly semi-circular grooves, as in fig. 5. Internal genitalia with oval spermathecae and three spermathecal ducts as in fig. 6. Spinnerets six, clothed with hair, posterior spinnerets longer than others, bisegmented, anterior spinnerets short and cylindrical as in fig. 8. The anal tubercle large thick, bisegmented and clothed with long hair. The apical segment provided with a lateral fringe of long flexible hair.

**Distribution** : INDIA : Poona, Maharashtra; Nagpur, Rajasthan; Hoshangabad, Madhya Pradesh.

**Remarks** : This species is reported here for the first time from Madhya Pradesh.

#### Family V ULOBORIDAE

**Characteres** : Eyes dark in colour, the lateral eyes on each side farther apart from the median eyes; and the posterior median eyes moderate in size. Chelicerae moderately robust, nearly parallel-sided. Anterior legs longest. Femora with dorsal thichobothria; tarsi with three foot claws. Metatarsus IV bearing the calamistrum, somewhat curved at least along the dorsal edge. Anal tubercle well developed and close to posterior spinners. These spiders spin geometrical orb webs or sectors of webs, similar to those of Araneidae. They are very unique and mostly common in the field, garden old houses and forests. They are a good predators of pest insects in the rice fields.

#### Genus 5. *Uloborus* Latreille

1806. *Uloborus* Latreille, *Gen. Crust. Ins. etc.*, 1 : 109.

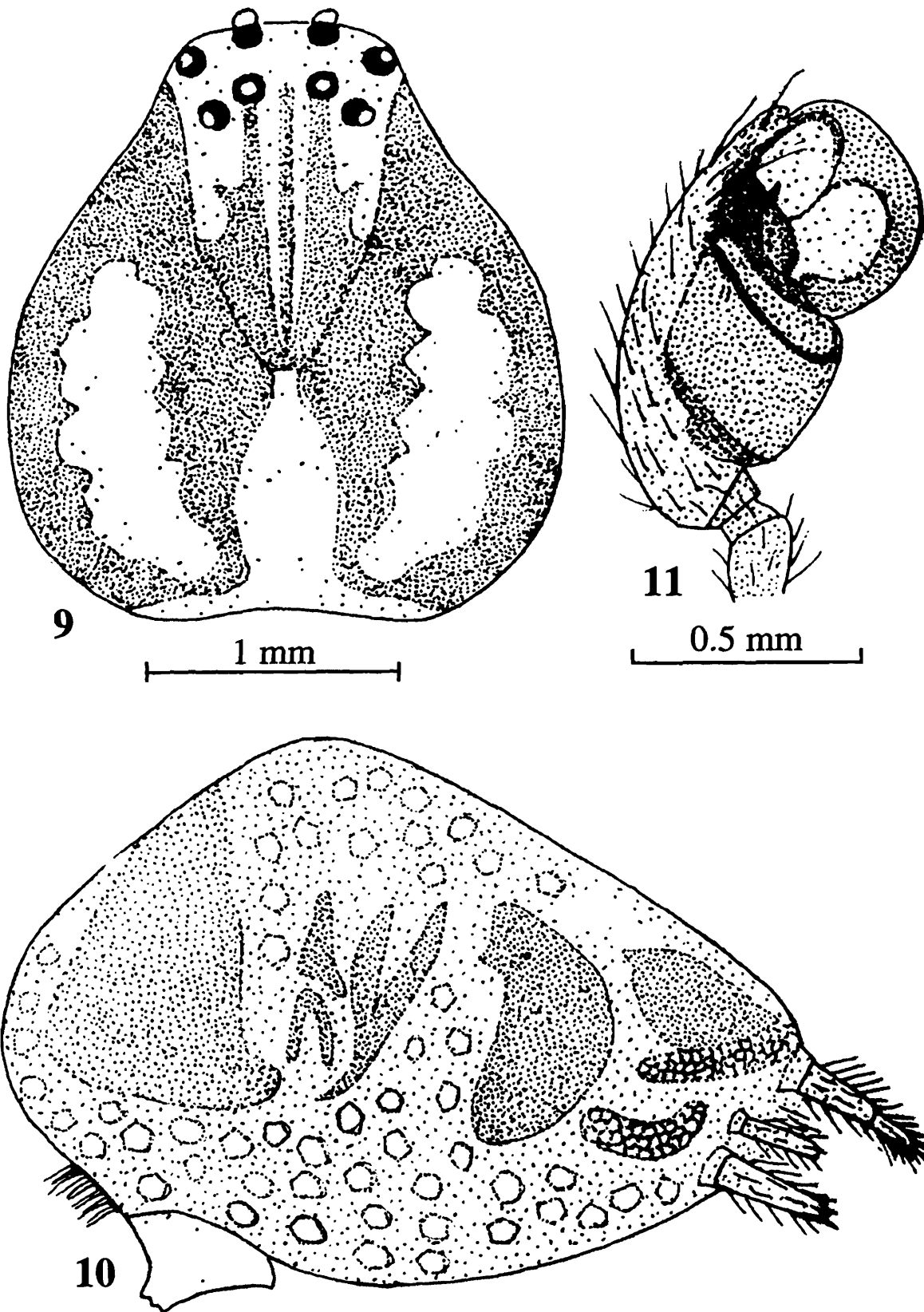
**Characters** : Anal tubercle prominent in the female, diminished in the male, legs I pair much longer and stronger than the rest. Male tibia of I with six to seven dorsal spines, almost in the form of teeth.

**Type-species** : *Uloborus walckenaerius* Latreille.

#### 6. *Uloborus danolius* Tikader

1969. *Uloborus danolius* Tikader, *Proc. Indian Acad. Sci.*, 70(3) : 129.

**Specimens examined** : 1 ♀, 1 ♂, Vijay Nagar, Jabalpur dist., Madhya Pradesh, Coll. Pawan Gajbe, 30.IV.1995. (Reg. No. 2252).



Figs. 9-11. : *Uloborus danolius* Tikader. 9. Dorsal view of cephalothorax, legs omitted; 10. Lateral view of abdomen; 11. Male palp, ventral view.

**General** : Cephalothorax and legs light yellowish-green. Abdomen yellowish green. Total length 4.80 mm. Carapace 2.40 mm. long, 2.10 mm. wide; abdomen 3.60 mm. long, 2.30 mm. wide.

**Cephalothorax** : Slightly longer than wide, narrow in front, two conspicuous longitudinal deep brown broad patches on the cephalothorax as in fig. 9. Eyes black in two rows, anterior row slightly longer than the posterior row. Anterior row of eyes slightly recurved, anterior medians larger than the laterals and closer to each other than to adjacent laterals. Posterior row of eyes almost equal in size, posterior medians slightly closer to adjacent laterals than to each other. Median ocular quadrangle longer than wide and wider behind than in front. Clypeus narrow, length of clypeus is little smaller than the diameter of anterior median eyes. Sternum heart-shaped pointed behind and rebordered at coxae of all legs and deep brown in colour. Legs long and strong, clothed with hairs and conspicuously banded with transverse black patches. Legs I and IV longer than II and III. Male palp as in fig. 11.

**Abdomen** : Longer than wide, high and broad in front clothed with pubescence and decorated with brownish patches and fine net like structure as in fig. 10. Anterior dorsal side of abdomen provided with a hump, Mid ventral side provided with longitudinal deep brown band extending from epigastric fold to above the calamistrum.

**Distribution** : INDIA : Maharashtra; Danoli, Dist. Ratnagiri (Type-locality), Poona, Nagpur, West Bengal; Kolkata, Car-Nicobar.

## SUMMARY

This paper deals with 6 species under 5 genera of the families, Oecobiidae, Eresidae, Hersiliidae, Urocteidae and Uloboridae.

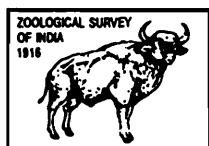
## ACKNOWLEDGEMENTS

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*Rec. zool. Surv. India* : 103 (Part 1–2) : 143-155, 2004

## **ON A COLLECTION OF FISH FROM BANGALORE AND KOLAR DISTRICTS, KARNATAKA**

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### **INTRODUCTION**

In pursuance of the approved annual programme of work, two surveys have been conducted in Bangalore and Kolar districts during December 2001 and March 2002. A total of 2578 specimens under 15 families, 22 genera and allocated to 29 species have been collected and studied. Species have been identified following the guidelines of Day (1875–78), Talwar and Jhingran (1991), Jayaram (1999) and Menon (1999). There is paucity of reliable scientific information on the ichthyofaunal diversity of these districts and hence this work.

The systematic list includes relevant reference, material examined giving details of specimens collected, their length range, locality, date of collection and registration numbers, followed by details of distribution. Sample collections have been done by M. B. Raghunathan from 10.12.2001 to 29.12.2001 and S. Krishnan from 11.03.2002 to 29.03.2002.

### **LIST OF FISHES**

Order **OSTEOGLOSSIFORMES**

Family **NOTOPTERIDAE**

1. *Notopterus notopterus* (Pallas)

Order **CYPRINIFORMES**

Family **CYPRINIDAE**

Subfamily **DANIONINAE**

2. *Amblypharyngodon microlepis* (Bleeker)
3. *Danio aequipinnatus* (McCl.)

4. *Esomus danricus* (Hamilton)
5. *Esomus thermoicos* (Val.)
6. *Rasbora caverii* (Jerdon)
7. *Rasbora daniconius* (Hamilton)
8. *Rasbora labiosa* Mukerji

Family CYPRINIDAE

Subfamily CYPRININAE

9. *Cyprinus carpio communis* (Linnaeus)
10. *Cyprinus carpio specularis* (Linnaeus)
11. *Puntius bimaculatus* (Bleeker)
12. *Puntius conchonus* (Hamilton)
13. *Puntius sophore* (Hamilton)

Family COBITIDAE

14. *Lepidocephalus thermalis* (Val.)

Order SILURIFORMES

Family BAGRIDAE

15. *Aorichthys aor* (Hamilton)
16. *Mystus cavasius* (Hamilton)
17. *Mystus montanus* (Jerdon)

Family SILURIDAE

18. *Ompok bimaculatus* (Bleeker)

Family CLARIIDAE

19. *Clarias batrachus* (Linnaeus)

Family HETEROPNEUSTIDAE

20. *Heteropneustes fossilis* (Bloch)

Order CYPRINODONTIFORMES

Family POECILIDAE

21. *Gambusia affinis* (Baird & Girard)
22. *Poecilia (Lebistes) reticulata* (Peters)

Family APLOCHEILIDAE

23. *Aplocheilus panchax* (Hamilton)

Order PERCIFORMES

Suborder GOBIOIDEI

Family GOBIIDAE

24. *Glossogobius giuris* (Hamilton)

Suborder LABROIDEI

Family CICHLIDAE

25. *Etilia suratensis* (Bloch)

26. *Oreochromis mossambica* (Peters)

Suborder CHANNOIDEI

Family CHANNIDAE

27. *Channa punctatus* (Bloch)

Suborder MASTACEMBELOIDEI

Family MASTACEMBELIDAE

28. *Mastacembelus armatus* (Lacepede)

Order MUGILIFORMES

Family MUGILIDAE

29. *Rhinomugil corsula* (Hamilton)

**SYSTEMATIC ACCOUNT**

Order OSTEOGLOSSIFORMES

Family NOTOPTERIDAE

1. *Notopterus notopterus* (Pallas)

1769. *Gymnotus notopterus* Pallas, *Spicil. Zool.*, 7 : 40, Pl. 6, fig. 2 (Type locality : ? Indian Ocean).

1991. *Notopterus notopterus*, Talwar & Jhingran, *Inland fishes of India and Adjacent Countries*, Vol. I : 64.

*Material* : 1 ex., 118 mm SL, Suburban Bangalore, 12.3.2002, F.6985.

*Distribution* : India : Brahmaputra, Cauvery, Ganges, Godavari, Krishna, Mahanadi and other river systems in South India. Java. Malaysia. Myanmar. Sumatra. Thailand.

## Order CYPRINIFORMES

## Family CYPRINIDAE

## Subfamily DANIONINAE

**2. *Amblypharyngodon microlepis* (Bleeker)**

1853. *Leuciscus microlepis* Bleeker, *Verh. Batav. Genootsch. Kunst. Wet.*, **25** : (Type locality : Ganges river and Brahmaputra River).

1991. *Amblypharyngodon microlepis*, Talwar & Jhingran, *Inland fishes of India and Adjacent Countries*, Vol. I : 337.

**Material** : 9 exs., 48–58 mm SL, Uyyampalli, 17.3.2002, F.6890; 11 exs., 36–59 mm SL, BEML Township, 22.3.2002, F.6904; 3 exs., 28–33 mm SL, Holasa Halli, 19.3.2002, F.6930; 28 exs., 38–74 mm SL, Uyyampalli, 17.3.2002, F.6941.

**Distribution** : India : Eastern and Southern India. Bangladesh. Both Talwar and Jhingran (1991) and Menon (1999) do not include the west face of Western Ghats and limit the distribution of the species to the eastern part of India and Bangladesh.

**3. *Danio aequipinnatus* (McCl.)**

1839. *Perilampus aequipinnatus* McClelland, *Asiat. Res.*, **19**(2) : 393, pl. 60, fig. 1 (Type locality : Assam).

1991. *Danio aequipinnatus*, Talwar & Jhingran, *Inland fishes of India and Adjacent Countries*, Vol. I : 364.

**Material** : 1 ex., 49 mm SL, Bangalore, 28.12.2001, F.6864.

**Distribution** : India : Peninsular India. Bangladesh. Myanmar. Nepal. Sri Lanka. Thailand.

**4. *Esomus danricus* (Hamilton)**

1822. *Cyprinus danrica* Hamilton, *Fishes of Ganges* : 325, 390, pl. 16, fig. 88 (Type locality : Ponds and ditches of Bengal)

1991. *Esomus danricus*, Talwar & Jhingran, *Inland fishes of India and Adjacent Countries*, Vol. I : 377.

**Material** : 12 exs., 40–60 mm SL, Mullagat Highway, 22.3.2002, F.6915; 14 exs., 37–44 mm SL, Kambina Halli, 24.3.2002, F.6921; 1 ex. 38 mm SL, Kombalagodu, 14.3.2002, F.6972; 5 exs., 32–37 mm SL, Kolar-Mulbagal Highway, 22.3.2002, F.6975.

**Remarks** : This species, probably introduced through aquarium trade has recently been found in several water bodies.

**Distribution** : Throughout North India and in some parts of South India. Bangladesh. Myanmar. Nepal. Pakistan. Sri Lanka.

### 5. *Esomus thermoicos* (Val.)

1842. *Nuria thermoicos* Valenciennes, *Hist. nat. Poiss.*, **16** : 238, pl. 472 (Type locality : Hot springs at Kanniya, Sri Lanka)

1991. *Esomus thermoicos*, Talwar & Jhingran, *Inland fishes of India and Adjacent Countries*, Vol. I : 378.

**Material** : 7 exs., 28–33 mm SL, Amerahalli Kere, 690 m, 12.12.2001, F.6872; 2 exs., 30–39 mm SL, Yelahanka, 800 m., 17.12.2001, F.6876; 43 exs., 47–68 mm SL, BEML Township outer, 22.3.2002, F.6903; 4 exs., 49–70 mm SL, BEML Township, 22.3.2002, F.6917; 3 exs., 41–42 mm SL, Jangamkote, 24.3.2002, F.6949.

**Distribution** : India : Southern India. Sri Lanka.

### 6. *Rasbora caverii* (Jerdon)

1849. *Leuciscus caverii* Jerdon, *Madras J. Sci., & Lit.*, **15** : 320 (Type locality : Cauvery River, Karnataka).

1991. *Rasbora caverii*, Talwar & Jhingran, *Inland fishes of India and Adjacent Countries*, Vol. I : 388.

**Material** : 28 exs., 25–51 mm SL, Amerahalli kere, 690 m, 12.12.2001, F.6873; 13 exs., 28–29 mm SL, Yelahanka, 17.12.2001, F.6878; 41 exs., 28–52 mm SL, Uyyampalli, 17.3.2002, F.6891; 21 exs., 65–109 mm SL, BEML Township outer, 22.3.2002, F.6919; 350 exs., 17–35 mm SL, Holasa Halli, 19.3.2002, F.6929; 41 exs., 25–51 mm SL, Magadi Tank, 18.3.2002, F.6936; 236 exs., 17–80 mm SL, Narasapura, 15.3.2002, F.6967; 58 exs., 17–31 mm SL, Arabikothanur, 15.3.2002, F.6971; 10 exs., 21–26.5 mm SL, Kumbalagodu, 14.3.2002, F.6973.

**Distribution** : Southern India, notably Karnataka, especially the Cauvery basin, also Eastern Ghats. Sri Lanka.

### 7. *Rasbora daniconius* (Hamilton)

1822. *Cyprinus daniconius* Hamilton, *Fishes of Ganges* : 327, 391, pl. 15, Fig-89 (Type locality : Rivers of Southern Bengal).

1999. *Rasbora daniconius*, Jayaram, *The freshwater fishes of the Indian regions* : 82.

**Material** : 31 exs., 25–40 mm SL, Bangalore Dist., 28.12.2001, F.6865; 26 exs., 25–54 mm SL, Magadi Tank, 18.3.2002, F.6935.

**Distribution** : Throughout India. Bangladesh. Malay Archipelago. Myanmar. Nepal. Pakistan. Sri Lanka. Zanzibar.

### 8. *Rasbora labiosa* Mukerji

1935. *Rasbora labiosa* Mukerji, *Rec. Indian Mus.*, **37**(3) : 376, Fig. 1,2 (Type locality : Deolali, Nasik Dist., Maharashtra)

1999. *Rasbora labiosa*, Jayaram, *The freshwater fishes of the Indian regions* : 83.

**Material :** 36 exs., 17–91 mm SL, BEML Township outer, 22.3.2002, F.6907; 1 ex., 50 mm SL, Magadi Tank, 18.3.2002, F.6937; 108 exs., 34–54 mm SL, Uyyampalli, 17.3.2002, F.6942.

**Remarks :** This is the first report of the species from Cauvery system in Karnataka. Though the specimens are characterised by hypertrophied labial fold; some differences have been observed from the typical species, details of which are being discussed elsewhere.

**Distribution :** India : Maharastra, Karnataka.

## Family CYPRINIDAE

### Subfamily CYPRININAE

#### 9. *Cyprinus carpio communis* (Linnaeus)

1758. *Cyprinus carpio* Linnaeus, *Systema Naturae*, ed. 10, 1 : 320 (Type locality : Europe)

1991. *Cyprinus carpio communis*, Talwar & Jhingran, *Inland fishes of India and Adjacent Countries*, Vol. I : 185.

**Material :** 1 ex., 49 mm SL, Khajikalla Halli, Kolar Dist., 15.3.2002, F.6897; 5 exs., 70–196 mm SL, Mungana Halli, 23.3.2002, F.6899; 1 ex., 194 mm SL, BEML Township outer, 22.3.2002, F.6906; 2 exs., 145–166 mm SL, Mungana Halli, 23.3.2002, F.6912; 3 exs., 84–90 mm SL, Mungana Halli, 23.3.2002, F.6927; 6 exs., 46–91 mm SL, Naickarpalya Kere, 18.3.2002, F.6933; 2 exs., 70–80 mm SL, Chintamani, 23.3.2002, F.6957; 1 ex., 37 mm SL, Narasapura, 15.3.2002, F.6969.

**Distribution :** Central Asia. Introduced into India.

#### 10. *Cyprinus carpio specularis* (Linnaeus)

1758. *Cyprinus carpio* Linnaeus, *Systema Naturae*, ed. 10, 1 : 320 (Type locality : Europe)

1991. *Cyprinus carpio specularis*, Talwar & Jhingran, *Inland fishes of India and Adjacent Countries*, Vol. I : 185.

**Material :** 1 ex., 124 mm SL, Mungana Halli, 23.3.2002, F.6900.

**Distribution :** Central Asia. Introduced into India.

#### 11. *Puntius bimaculatus* (Bleeker)

1864. *Gnathopogon bimaculatus* Bleeker, *Verb. Nat. Holl. Maatsch*, Haarlem, (2)20 : 17, pl. 4, fig. 1 (Type locality : Ceylon)

1991. *Puntius bimaculatus*, Talwar & Jhingran, *Inland fishes of India and Adjacent Countries*, Vol. I : 259.

**Material :** 10 exs., 16–35 mm SL, Bangalore Dist., 28.12.2001, F.6866; 8 exs., 42–56 mm SL, Mulbagal High way, 22.3.2002, F.6916; 12 exs., 50–56 mm SL, BEML Township, 22.3.2002,

F.6918; 1 ex. 38 mm SL, Magadi Tank, 18.3.2002, F.6838; 1 ex. 35 mm SL, Narasapura, 15.3.2002, F.6968.

*Distribution* : Southern India. Sri Lanka.

#### 12. *Puntius conchoni* (Hamilton)

1822. *Cyprinus conchoni* Hamilton, *Fishes of Ganges* : 317, 389 (Type locality : Ponds of northeast Bengal, Kosi river and Ami River)

1991. *Puntius conchoni*, Talwar & Jhingran, *Inland fishes of India and Adjacent Countries*, Vol. I : 266.

*Material* : 17 exs., 38–43 mm SL, Kanva Reservoir, 16.3.2002, F.6963.

*Distribution* : India : Throughout. Bangladesh. Nepal. Pakistan.

#### 13. *Puntius sophore* (Hamilton)

1822. *Cyprinus sophore* Hamilton, *Fishes of Ganges* : 310, 389 (nec. pl. 19, fig. 86) (Type locality : Ponds and rivers in Gangetic Reservoir)

1991. *Puntius sophore*, Talwar & Jhingran, *Inland fishes of India and Adjacent Countries*, Vol. I : 288.

*Material* : 1 ex., 44 mm SL, Uyyampalli, 17.3.2002, F.6892; 6 exs., 72–81 mm SL, Munganahalli, 23.3.2002, F.6898; 2 exs., 28–56 mm SL, BEML Township outer, 22.3.2002, F.6905; 16 exs., 22–49 mm SL, Kambina Halli, 24.3.2002, F.6922; 1 ex., 64 mm SL, Mungana Halli, 23.3.2002, F.6926; 17 exs., 43–57 mm SL, Uyyampalli, 17.3.2002, F.6943; 2 exs., 26–33 mm SL, Jangamkotte, 24.3.2002, F.6950; 3 exs., 46–65 mm SL, Chintamani, 23.3.2002, F.6958; 2 exs., 42 & 43 mm SL, Kanva Reservoir, 16.3.2002, F.6961.

*Distribution* : India : Throughout. Bangladesh. Myanmar. Nepal. Pakistan. Sri Lanka.

### Family COBITIDAE

#### 14. *Lepidocephalus thermalis* (Valenciennes)

1846. *Cobitis thermalis* Valenciennes, *Hist. nat. Poiss.*, 18 : 78 (Type locality : Sri Lanka)

1991. *Lepidocephalus thermalis*, Talwar & Jhingran, *Inland fishes of India and Adjacent Countries*, Vol. I : 527.

*Material* : 13 exs., 10–31 mm SL, Amerahalli Kere, 690 m, 12.12.2001, F.6874; 2 exs., 24 & 32 mm SL, Yelahanka, 17.12.2001, F.6879; 13 exs., 38–55 mm SL, BEML Township outer, 22.3.2002, F.6909; 10 exs., 33–41 mm SL, Bagepalli, 28.3.2002, F.6903; 4 exs., 35–41 mm SL, Kambina Halli, 24.3.2002, F.6923; 8 exs., 36–47 mm SL, Holasa Halli, 19.3.2002, F. 6931; 2 exs., 38 & 39 mm SL, Jangamkote, 24.3.2002, F.6951; 2 exs., 32.5–45 mm SL, Kolar-Mulbagal Highway, 22.3.2002, F.6976.

*Distribution* : India : South India. Sri Lanka.

## Order SILURIFORMES

## Family BAGRIDAE

15. *Aorichthys aor* (Hamilton)

1822. *Pimelodus aor* Hamilton, *Fishes of Ganges* : 205, 375, pl. 20, fig. 68 (Type locality : Rivers of Bengal and upper parts of Gangetic estuary).

1991. *Aorichthys aor*, Talwar & Jhingran, *Inland fishes of India and Adjacent Countries*, Vol. II : 547.

*Material* : 3 exs., 152–165 mm SL, Suburban Bangalore, 12.3.2002, F.6978.

*Distribution* : India : Throughout. Bangladesh. Myanmar. Pakistan.

16. *Mystus cavasius* (Hamilton)

1822. *Pimelodus cavasius* Hamilton, *Fishes of Ganges* : 203, 379, pl. 11, fig. 67 (Type locality : Gangetic Provinces).

1991. *Mystus cavasius*, Talwar & Jhingran, *Inland fishes of India and Adjacent Countries*, Vol. II : 559.

*Material* : 2 exs., 119 & 120 mm SL, Suburban Bangalore, 12.3.2002, F.6980.

*Distribution* : India. Bangladesh. Pakistan. Thailand.

17. *Mystus montanus* (Jerdon)

1849. *Bagrus montanus* Jerdon, *Madras Jour. Lit. & Sci.*, 15(2) : 337 (Type locality : Manantoddy, Wynaad, Kerala State).

1991. *Mystus montanus*, Talwar & Jhingran, *Inland fishes of India and Adjacent Countries*, Vol. II : 567.

*Material* : 55 exs., 48–75 mm SL, Bagepalli, 28.3.2002, F.6914; 4 exs., 74–94 mm SL, BEML Township outer, 22.3.2002, F.6920; 5 exs., 45–58 mm SL, Kambina Halli, 24.3.2002, F.6924; 17 exs., 41–61 mm SL, Jangamkote, 24.3.2002, F.6954.

*Distribution* : India : Kerala, Tamil Nadu, Karnataka, Maharashtra, Madhya Pradesh and Assam.

## Family SILURIDAE

18. *Ompok bimaculatus* (Bloch)

1797. *Silurus bimaculatus* Bloch, *Ichthyol. Hist. nat. des. Poiss.*, 11 : 17, pl. 364 (Type locality : Malabar).

1991. *Ompok bimaculatus*, Talwar & Jhingran, *Inland fishes of India and Adjacent Countries*, Vol. II : 582.

*Material* : 6 exs., 135–175 mm SL, Suburban Bangalore, 12.3.2002, F.6981.

*Distribution* : Throughout India. Bangladesh. Malaya. Nepal. Pakistan. Sri Lanka. Thailand. Vietnam. Yunnan.

## Family CLARIIDAE

19. *Clarias batrachus* (Linnaeus)

1758. *Silurus batrachus* Linnaeus, *Systema Naturae*, 1, ed. 10 : 305 (Type locality : Asia and Africa).

1991. *Clarias batrachus*, Talwar & Jhingran, *Inland fishes of India and Adjacent Countries*, Vol. II : 684.

**Material** : 1 ex., 325 mm SL, BEML Township outer, 22.3.2002, F.6902; 1 ex., 235 mm SL, Ellamalappa kere, Avalahalli, 15.3.2002, F.6948.

**Distribution** : India. Bali. Bangladesh. Borneo. Java. Malacca. Malaya. Myanmar. Nepal. Pakistan. Philippines. Singapore. Sri Lanka. Sumatra. Thailand.

## Family HETEROPNEUSTIDAE

20. *Heteropneustes fossilis* (Bloch)

1794. *Silurus fossilis* Bloch, *Naturgesch. ausl. Fische*, 8 : 46, pl. 370, fig. 2 (Type locality : Tranquebar, Tamil Nadu).

1991. *Heteropneustes fossilis*, Talwar & Jhingran, *Inland fishes of India and Adjacent Countries*, Vol. II : 689.

**Material** : 2 exs., 80 & 89 mm SL, Jangamkote, 24.3.2002, F.6952; 8 exs., 62–100 mm SL, Jangamkote, 24.3.2002, F.6953.

**Distribution** : India. Bangladesh. Laos. Myanmar. Nepal. Pakistan. Sri Lanka. Thailand.

## Order CYPRINODONTIFORMES

## Family POECILIDAE

21. *Gambusia affinis* (Baird & Girard)

1853. *Heterandria affinis* Baird and Girard, *Proc. Acad. Nat. Sci. Philad*, 6 : 390 (Type locality : San Antonio River Drainage, Texas).

1991. *Gambusia affinis*, Talwar & Jhingran, *Inland fishes of India and Adjacent Countries*, Vol. II : 756.

**Material** : 76 exs., 11–40 mm SL, 13.12.2001, Kolarkere, Basavantha Halli, F.6868; 4 exs., 30–36 mm SL, BEML Township, 22.3.2002, F.6908; 15 exs., 8.5–32 mm SL, Kambina Halli, 24.3.2002, F.6925; 22 exs., 18–31 mm SL, Holasa Halli, 19.3.2002, F.6932; 6 exs., 18.5–31.5 mm SL, Jangamkote, 24.3.2002, F.6956; 4 exs., 19.5–32 mm SL, Naraspura, 15.3.2002, F.6970; 45 exs., 13.5–30 mm SL, Kumbalagodu, Bangalore Rural, 14.3.2002, F.6974.

**Distribution** : Throughout India. Myanmar. Pakistan and Sri Lanka.

## 22. *Poecilia (Lebistes) reticulata* (Peters)

1859. *Poecilia reticulata* Peters, K. Preussische. Akad. Wiss. Berlin : 412 (Type locality : Venezuela).

1991. *Poecilia (Lebistes) reticulata*, Talwar & Jhingran, *Inland fishes of India and Adjacent Countries*, Vol. II : 756.

**Material** : 73 exs., 10–24 mm SL, Bangalore Dist., 28.12.2001, F.6867; 188 exs., 8–28 mm SL, near Kondapalli, 750 m, 16.12.2001, F.6870; 290 exs., 9–22 mm SL, Illapallikere, 700 m, 20.12.2001, F.6871; 34 exs., 13–27 mm SL, Amerahallikere, 690 m, 12.12.2001, F.6875; 103 exs., 9–30 mm SL, Yelahanka, 800 m, 17.12.2001, F.6881; 21 exs., 13–22 mm SL, Hosuhuddiahalli pond, 700 m, 20.12.2001, F.6882; 74 exs., 13–33 mm SL, Mallasandrakere, 700 m, 21.12.2001, F.6883; 256 exs., 7.5–29 mm SL, Chintamani, 23.3.2002, F.6960; 18 exs., 18–30 mm SL, Kolar-Mulbagal High way, 22.3.2002, F.6977.

**Distribution** : Tropical America. Introduced into India.

## Family APLOCHEILIDAE

## 23. *Aplocheilus panchax* (Hamilton)

1822. *Esox panchax* Hamilton, *Fishes of Ganges* : 211, 380, pl. 3, fig. 69 (Type locality : Bengal).

1991. *Aplocheilus panchax*, Talwar & Jhingran, *Inland fishes of India and Adjacent Countries*, Vol. II : 752.

**Material** : 46 exs., 19–41 mm SL, Kanva Reservoir, 16.3.2002, F.6966.

**Remarks** : This is the first report after Hora (1937) of the species in the wild from Karnataka, Southern India.

**Distribution** : India (now introduced elsewhere) originally Andaman Is., Orissa & West Bengal (Jayaram, 1991). Bangladesh. Malay Archipelago. Myanmar. Pakistan. Thailand.

## Order PERCIFORMES

## Suborder GOBIOIDEI

## Family GOBIIDAE

## 24. *Glossogobius giuris* (Hamilton)

1822. *Gobius giuris* Hamilton, *Fishes of Ganges* : 51, pl. 33, fig. 15 (Type locality : Gangetic provinces).

1991. *Glossogobius giuris*, Talwar & Jhingran, *Inland fishes of Indian and Adjacent Countries*, Vol. II : 936.

**Material** : 3 exs., 50–81 mm SL, Hanumanthnagar (Kanakpura), 17.3.2002, F.6895; 1 ex., 44 mm SL, Uyyampalli, 17.3.2002, F.6944; 1 ex., 79 mm SL, Kanva Reservoir, 16.3.2002, F.6964.

**Distribution** : Throughout India. Bangladesh. Myanmar. Nepal. Pakistan. Sri Lanka. It has a wide range from the East coast of Africa to Japan, Australia and South Pacific.

## Suborder LABROIDEI

## Family CICHLIDAE

25. *Etroplus suratensis* (Bloch)

1785. *Chaetodon suratensis* Bloch, *Syst. Ichth.* : 217 (Type locality : ? Surat).

1991. *Etroplus suratensis*, Talwar & Jhingran, *Inland fishes of India and Adjacent Countries*, Vol. II : 885.

*Material* : 1 ex., 102 mm SL, Suburban Bangalore, 12.3.2002, F.6979.

*Distribution* : India : South India. Sri Lanka.

26. *Oreochromis mossambica* (Peters)

1852. *Chromis (Tilapia) mossambicus* Peters, *Montab, Acad. Wiss.*, Berlin : 681 (Type locality : Mozambique).

1991. *Oreochromis mossambica*, Talwar & Jhingran, *Inland fishes of India and Adjacent Countries*, Vol. II : 887.

*Material* : 265 exs., 6–36 mm SL, Kolarkere, Basvanathahalli, 600 m, 13.12.2001, F.6869; 9 exs., 18–27 mm SL, Yelahanka, 800 m, 17.12.2001, F.6880; 5 exs., 50–111 mm SL, Ulsoor tank, 12.3.2002, F.6889; 22 exs., 41–96 mm SL, Uyyampalli, 17.3.2002, F.6893; 44 exs., 30–65 mm SL, Khajikalla Halli, 15.3.2002, F.6896; 8 exs., 45–130 mm SL, Munganahalli, 23.3.2002, F.6901; 52 exs., 20–98 mm SL, BEML Township, 22.3.2002, F.6910; 2 exs., 145 mm SL, Hunganoor, 19.3.2002, F.6911; 6 exs., 46–140 mm SL, Mungana Halli, 23.3.2002, F.6928; 240 exs., 19–113 mm SL, Naickarpalya Kere, 18.3.2002, F.6933; 18 exs., 16–73 mm SL, Magadi Tank, 18.3.2002, F.6940; 22 exs., 35–68 mm SL, Bannerghata, 12.3.2002, F.6946; 4 exs., 124–140 mm SL, Ellamalappa Kere, 12.3.2002, F.6947; 73 exs., 7.5–69 mm SL, Chintamani, 23.3.2002, F.6959.

*Distribution* : East Africa. Introduced in India in 1952.

## Suborder CHANNOIDEI

## Family CHANNIDAE

27. *Channa punctatus* (Bloch)

1793. *Ophiocephalus punctatus* Bloch, *Naturges, Ausland. Fische.*, (7) : 139, pl. 358 (Type locality : Rivers and Lakes of Coromandal Coast).

1991. *Channa punctatus*, Talwar & Jhingran, *Inland fishes of Indian and Adjacent Countries*, Vol. II : 1020.

*Material* : 7 exs., 56–110 mm SL, Hanumanthnagar (Kanakpura), 17.3.2002, F.6894; 2 exs., 35 & 56 mm SL, Magadi Tank, 18.3.2002, F.6939; 1 ex., 39 mm SL, Uyyampalli, 17.3.2002, F.6945; 1 ex., 46 mm SL, Jangamkote, 24.3.2002, F.6955; 1 ex., 65 mm SL, Kanva Reservoir, 16.3.2002, F.6965; 1 ex., 178 mm SL, Suburban Bangalore, 12.3.2002, F.6983.

*Distribution* : Throughout India. Afghanistan. Bangladesh. China. Malaya. Myanmar. Nepal. Pakistan. Polynesia. Sri Lanka.

## Suborder MASTACEMBELOIDEI

## Family MASTACEMBELIDAE

28. *Mastacembelus armatus* (Lacépède)

1800. *Macrogustus armatus* Lacépède, *Hist. nat. Poiss.*, 2 : 286 (Type locality : Not known).

1991. *Mastacembelus armatus*, Talwar & Jhingran, *Inland fishes of India and Adjacent Countries*, Vol. II : 1031.

*Material* : 1 ex., 315 mm SL, Suburban Bangalore, 12.3.2002, F.6982.

*Distribution* : Throughout India. Bangladesh. South China. Hainan island. Java. Malaya. Myanmar. Nepal. Pakistan. Sri Lanka. Sumatra. Thailand. Tonkin. Vietnam.

## Order MUGILIFORMES

## Family MUGILIDAE

29. *Rhinomugil corsula* (Hamilton)

1822. *Mugil corsula* Hamilton, *Fishes of Ganges* : 221, 381, pl. 9, fig. 97 (Type locality : Ganges River).

1991. *Rhinomugil corsula*, Talwar & Jhingran, *Inland fishes of India and Adjacent Countries*, Vol. II : 897.

*Material* : 3 exs., 150–160 mm SL, Suburban Bangalore, 12.3.2002, F.6984.

*Distribution* : India. Bangladesh. Nepal. Burma.

## DISCUSSION

A comprehensive account of the ichthyofauna of Cauvery River system by Jayaram *et al.*, (1982) reports the presence of 93 species in Karnataka. Recently Chandrashekhariah *et al.*, (2000) have given elaborate version of distributional pattern and status of the ichthyofauna in the different drainages in Karnataka viz., Cauvery, Krishna, Godavari and west flowing rivers in the state. They reported 97 species from Cauvery River including 42 species not reported by Jayaram (*op. cit.*). The ichthyofaunal composition of the Cauvery system draining Karnataka, based on the above cited papers totals to 135.

In the present study from Bangalore and Kolar districts alone 29 species have been collected which includes two new records viz., *Esomus thermoicos* and *Rasbora labiosa* the former new addition to Karnataka fauna and the latter to the Cauvery system. *E. thermoicos* earlier thought to be restricted to Sri Lanka is now found in Southern India. *Rasbora labiosa* restricted to its type locality in Deolali Nasik district, Maharashtra has been reported recently in the Godavary system in Karnataka also (Chandrashekhariah *et al.*, *op. cit.*). Also *Amblypharyngodon microlepis* and *Aplocheilichthys panchax* were collected in the wild after their first report by Hora in 1937.

### SUMMARY

Studies on a collection of fish from Bangalore and Kolar districts, Karnataka have resulted in reliable identification of 29 species, of which *Esomus thermoicos* (Val.) is an addition to Karnataka fauna and *Rasbora labiosa* Mukerji to the Cauvery system. *Amblypharyngodon microlepis* (Bleeker) and *Aplocheilichthys panchax* (Hamilton) are reported from the wild after a span of 65 years.

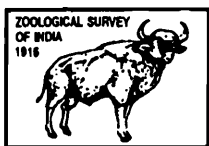
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## **A NOTE ON THE MITES OCCURRING ON MEDICINAL PLANTS IN NORTHEAST INDIA**

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### **INTRODUCTION**

Northeast India, due to its interesting geographical location, climatic condition and vegetation shows enormous diversity in the composition of its fauna and flora. It is considered as a unique biological spot which abounds in various interesting species of plants and animals. This region is rich in natural resources of medicinal plants belonging to different families.

In spite of the richness and abundance of fauna in this part of Indian subcontinent the acarine fauna of this region infesting the plants of medicinal importance remained unattended by the acarologists for the reasons best known to them.

A perusal of literature reveals that no such consolidated information on the medicinal plants infested by mites in northeast India is available except the work of Lal and Mukherjee (1977) though the region is sound faunistically. This has prompted the author to undertake the present work chiefly based on published works with a view to get a first hand information. As such, a complete list of mites occurring on medicinal plants in northeast India is provided hereinunder. Consultation of available literature reveals that 45 species of mites infest medicinal plants belonging to 21 species under 14 plant families. In this contribution, the texts are arranged in two sections. In Section–I mite species are arranged according to their families as has been followed by Gupta (1985) and in Section–II, medicinal plants are arranged alphabetically with respective plant family. In Section–I under each family the mite species and their respective host plants are also alphabetically arranged.

The plants considered here as medicinal plants are according to I. C. M. R. publications (1976, 1987) and Chopra *et al.* (1956).

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## SECTION-I

| Sl No. | Name of Mite                                                             | Family       | Host Plant                                           | Distribution                                                                                                                                                                                                                                                                                                                                                               |
|--------|--------------------------------------------------------------------------|--------------|------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 1.     | <i>Amblyseius (Amblyseius) Channabasavannai</i><br>Gupta & Daniel        | Phytoseiidae | <i>Azadirachta indica</i><br><i>Mangifera indica</i> | India : Meghalaya, Kerala, Tamil Nadu, West Bengal.                                                                                                                                                                                                                                                                                                                        |
| 2.     | <i>Amblyseius (Amblyseius) herbicolus</i> (Chant)                        | Phytoseiidae | <i>Musa paradisiaca</i>                              | India : Meghalaya, Arunachal Pradesh, Tripura, West Bengal, Elsewhere : Philippines, Taiwan, Thailand, Japan, U.S.A., Madagascar, South America.                                                                                                                                                                                                                           |
| 3.     | <i>Amblyseius (Amblyseius) largoensis</i> (Muma)                         | Phytoseiidae | <i>Musa paradisiaca</i>                              | India : Meghalaya, Andaman & Nicobar Isls., Arunachal Pradesh, Assam, Andhra Pradesh, Bihar, Gujarat, Himachal Pradesh, Kerala, Orissa, Manipur, Karnataka, Nagaland, Pondichery, Punjab, Tamil Nadu, Tripura, Uttar Pradesh, West Bengal, Elsewhere : Philippines, Taiwan, Thailand, Hong Kong, Israel, Iran, Japan, New Zealand, Kenya, U.S.A., Brazil, Mexico, Jamaica. |
| 4.     | <i>Amblyseius (Amblyseius) mcmurtryi</i> Muma                            | Phytoseiidae | <i>Psidium guajava</i>                               | India : Meghalaya, Assam, Elsewhere : Northern and Western Iran.                                                                                                                                                                                                                                                                                                           |
| 5.     | <i>Amblyseius (Paraphytoseius) multidentatus</i><br>(Swirski & Shechter) | Phytoseiidae | <i>Mangifera indica</i>                              | India : Meghalaya, Andaman & Nicobar Isls., Andhra Pradesh, Assam, Maharashtra, Karnataka, Tamil Nadu, Bihar, Tripura, Uttar Pradesh, West Bengal.                                                                                                                                                                                                                         |
| 6.     | <i>Amblyseius (Euseius) alstoniae</i> Gupta                              | Phytoseiidae | <i>Cassia occidentalis</i>                           | India : Tripura, Jammu & Kashmir, Meghalaya, Bihar, Madhya Pradesh, Punjab, Orissa, Tamil Nadu, Rajasthan.                                                                                                                                                                                                                                                                 |

| Sl No. | Name of Mite                                          | Family       | Host Plant                                                                   | Distribution                                                                                                                                                                                                                                        |
|--------|-------------------------------------------------------|--------------|------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 7.     | <i>Amblyseius (Euseius) coccineae</i> Gupta           | Phytoseiidae | <i>Psidium guajava</i>                                                       | India : Tripura, Andhra Pradesh, Gujarat, Bihar, Tamil Nadu, Jammu & Kashmir, Meghalaya, Madhya Pradesh, Orissa, Pondichery, Uttar Pradesh.                                                                                                         |
| 8.     | <i>Amblyseius (Euseius) ovalis</i> (Evans)            | Phytoseiidae | <i>Luffa acutangula</i><br><i>Ficus religiosa</i><br><i>Musa paradisiaca</i> | India : Tripura, Gujarat, Andaman & Nicobar Isls., Bihar, Manipur, Tamil Nadu, Meghalaya, Pondichery. Elsewhere : Philippines, Taiwan, Malaysia, Japan, Hong Kong, Indonesia, New Zealand, Mauritius, Hawaii, Mexico.                               |
| 9.     | <i>Amblyseius (Euseius) pruni</i> Gupta               | Phytoseiidae | <i>Carica papaya</i>                                                         | India : Tripura, Assam, Meghalaya, West Bengal, Himachal Pradesh, Jammu & Kashmir.                                                                                                                                                                  |
| 10.    | <i>Amblyseius (Neoseiulus) longispinosus</i> (Evans)  | Phytoseiidae | <i>Luffa acutangula</i>                                                      | India : Tripura, West Bengal, Andaman & Nicobar Isls., Karnataka, Bihar, Punjab, Orissa, Pondichery, Tamil Nadu, Uttar Pradesh, Elsewhere : Philippines, Taiwan, Indonesia, Malaysia, Japan, Hong Kong, New Zealand, Jamaica, Hawaii, South Africa. |
| 11.    | <i>Amblyseius (Typhlodromips) meghalayensis</i> Gupta | Phytoseiidae | <i>Psidium guajava</i>                                                       | India : Meghalaya. Elsewhere : Pakistan, Thailand, Philippines, Madagascar, Malaya, Nigeria, Hong Kong.                                                                                                                                             |
| 12.    | <i>Amblyseius (Typhlodromips) suknaensis</i> Gupta    | Phytoseiidae | <i>Mangifera indica</i>                                                      | India : Meghalaya, Andaman & Nicobar Isls., Assam, Kerala, West Bengal.                                                                                                                                                                             |
| 13.    | <i>Amblyseius (Typhlodromips) syzygii</i> Gupta       | Phytoseiidae | <i>Psidium guajava</i>                                                       | India : Tripura, West Bengal, Uttar Pradesh, Orissa, Meghalaya, Bihar, Elsewhere : Thailand.                                                                                                                                                        |

| Sl No. | Name of Mite                                       | Family        | Host Plant                                       | Distribution                                                                                                                                                                                                                                                    |
|--------|----------------------------------------------------|---------------|--------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 14.    | <i>Acarus farris</i> Oudemans                      | Acari         | <i>Cocos nucifera</i><br><i>Musa paradisiaca</i> | India : Tripura, Meghalaya, Elsewhere : England, Netherland, Wales, Scotland, U.S.A., Germany, Kenya, Czechoslovakia.                                                                                                                                           |
| 15.    | <i>Aponychus baghensis</i> Prasad                  | Tetranychidae | <i>Musa paradisiaca</i>                          | India : Meghalaya, Bihar.                                                                                                                                                                                                                                       |
| 16.    | <i>Agistemus garrulus</i> Chaudhri, Akbar & Rasool | Stigmaeidae   | <i>Morus alba</i>                                | India : Meghalaya, Elsewhere : Pakistan.                                                                                                                                                                                                                        |
| 17.    | <i>Agistemus gamblei</i> Gupta                     | Stigmaeidae   | <i>Machilus gamblei</i>                          | India : Arunachal Pradesh.                                                                                                                                                                                                                                      |
| 18.    | <i>Agistemus fleschneri</i> Summers                | Stigmaeidae   | <i>Mangifera indica</i>                          | India : Arunachal Pradesh, Suji, Assam, Manipur, Tripura, Agartala.                                                                                                                                                                                             |
| 19.    | <i>Agistemus macrommatus</i> Gonzalez-Rodriguez    | Stigmaeidae   | <i>Carica papaya</i>                             | India : Arunachal Pradesh,                                                                                                                                                                                                                                      |
| 20.    | <i>Agistemus edulis</i> Gupta                      | Stigmaeidae   | <i>Macheles edulis</i>                           | India : Arunachal Pradesh,                                                                                                                                                                                                                                      |
| 21.    | <i>Brevipalpus phoenicis</i> (Geij)                | Tenuipalpidae | <i>Psidium guajava</i>                           | India : Meghalaya, Assam, Bihar, Delhi, Himachal Pradesh, Karnataka. Maharashtra, Orissa, Punjab, Tamil Nadu, West Bengal. Elsewhere : Kenya, Tanganayika, Okinawa Isl., Australia, Holland, Spain, Portugal, Syria, Italy, U.S.A, Trinidad, Argentina, Brazil. |
| 22.    | <i>Bdellodes grandiflora</i> Gupta                 | Bdellidae     | <i>Thunbergia grandiflora</i>                    | India : Arunachal Pradesh                                                                                                                                                                                                                                       |
| 23.    | <i>Bdella angustifolius</i> Gupta                  | Bdellidae     | <i>Canthium angustifolium</i>                    | India : Manipur                                                                                                                                                                                                                                                 |
| 24.    | <i>Bdella khasyana</i> Gupta                       | Bdellidae     | <i>Litsaea khasyana</i>                          | India : Arunachal Pradesh                                                                                                                                                                                                                                       |
| 25.    | <i>Cunaxa anacardae</i> Gupta                      | Cunaxidae     | <i>Mangifera indica</i>                          | India : Tripura, West Bengal                                                                                                                                                                                                                                    |
| 26.    | <i>Cunaxa lambusae</i> Gupta & Ghosh               | Cunaxidae     | Wood apple ( <i>Feronia elephantum</i> )         | India : Tripura, West Bengal Andaman & Nicobar Isls.                                                                                                                                                                                                            |

| Sl No. | Name of Mite                                      | Family        | Host Plant                                | Distribution                                                                                                                                                                                            |
|--------|---------------------------------------------------|---------------|-------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 27.    | <i>Cunaxa crista</i> Gupta                        | Cunaxidae     | <i>Caesalpinia crista</i>                 | India : Arunachal Pradesh.                                                                                                                                                                              |
| 28.    | <i>Cunaxa curassavica</i> Gupta                   | Cunaxidae     | <i>Asclepias curassavica</i>              | India : Arunachal Pradesh.                                                                                                                                                                              |
| 29.    | <i>Cheyletus malaccensis</i><br>Oudemans          | Cheyletidae   | <i>Michaelia champaca</i>                 | India : Meghalaya, Kerala, Karnataka, West Bengal.                                                                                                                                                      |
| 30.    | <i>Eupodes</i> sp.                                | Eupodidae     | <i>Mangifera indica</i>                   | India : Meghalaya, Songsok, Tripura.                                                                                                                                                                    |
| 31.    | <i>Hemicheyletia indica</i> Gupta                 | Cheyletidae   | <i>Pavetta indica</i>                     | India : Arunachal Pradesh                                                                                                                                                                               |
| 32.    | <i>Iphiseius andamanicus</i><br>Gupta             | Phytoseiidae  | <i>Musa paradisiaca</i>                   | India : Tripura, Andaman & Nicobar Isls., Karnataka.                                                                                                                                                    |
| 33.    | <i>Ledermulleria parryorum</i> Gupta              | Stigmaeidae   | <i>Mussandra parryorum</i>                | India : Arunachal Pradesh.                                                                                                                                                                              |
| 34.    | <i>Oligonychus gossypii</i><br>(Zacher)           | Tetranychidae | <i>Mangifera indica</i>                   | India : Tripura. Elsewhere : Africa (Togo, Senegal, Sierra, Leone, Nigeria, Cameroon, Zaire, Angola).                                                                                                   |
| 35.    | <i>Oligonychus indicus</i> (Hirst)                | Tetranychidae | <i>Musa paradisiaca</i>                   | India : Meghalaya, Delhi, Andhra Pradesh, Punjab, Haryana, Karnataka, Orissa, Tamil Nadu. Elsewhere : Pakistan.                                                                                         |
| 36.    | <i>Oligonychus mangiferus</i><br>(Rahman & Sapra) | Tetranychidae | <i>Morus alba</i>                         | India : Meghalaya, Delhi, Gujarat, Haryana, Karnataka. Elsewhere : South Africa, New Zealand, U.S.A.                                                                                                    |
| 37.    | <i>Oligonychus biharensis</i><br>(Hirst)          | Tetranychidae | <i>Ficus religiosa</i>                    | India : Tripura, Bihar, Andaman & Nicobar Isls., Gujarat.                                                                                                                                               |
| 38.    | <i>Panonychus citri</i> (McGregor)                | Tetranychidae | <i>Carica papaya</i><br><i>Morus alba</i> | India : Meghalaya, Tripura, Andaman & Nicobar Isls., Assam, Jammu & Kashmir, West Bengal. Elsewhere : Thailand, New Zealand, China, Middle East, Japan, South Africa, U.S.A., Argentina, Cuba, Bermuda. |
| 39.    | <i>Panonychus ulmi</i> (Koch)                     | Tetranychidae | <i>Musa paradisiaca</i>                   | India : Meghalaya, Himachal Pradesh, Uttar Pradesh, Jammu & Kashmir. Elsewhere : Europe.                                                                                                                |

| Sl No. | Name of Mite                                              | Family       | Host Plant                         | Distribution                                                                                                                                             |
|--------|-----------------------------------------------------------|--------------|------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------|
| 40.    | <i>Phytoseius (Pennaseius) kapuri</i> (Gupta)             | Phytoseiidae | <i>Psidium guajava</i>             | India : Tripura, West Bengal, Bihar, Andaman & Nicobar Isls., Orissa, Punjab, Rajasthan, Tamil Nadu, Gujarat, Jammu & Kashmir, Meghalaya, Uttar Pradesh. |
| 41.    | <i>Phytoseius (Phytoseius) roseus</i> (Gupta)             | Phytoseiidae | <i>Psidium guajava</i>             | India : Tripura, Punjab, Gujarat, Tamil Nadu, Jammu & Kashmir, West Bengal, Uttar Pradesh. Elsewhere : Pakistan.                                         |
| 42.    | <i>Typhlodromus (Amblydromella) darjeelingensis</i> Gupta | Phytoseiidae | <i>Michaelia champaca</i>          | India : Meghalaya, Tamil Nadu, Karnataka, Uttar Pradesh, Punjab, West Bengal, Tripura.                                                                   |
| 43.    | <i>Typhlodromus (Amblydromella) gopali</i> Gupta          | Phytoseiidae | Banana ( <i>Musa paradisiaca</i> ) | India : Tripura, West Bengal, Rajasthan, Punjab, Himachal Pradesh.                                                                                       |
| 44.    | <i>Tydeus</i> sp.                                         | Tydeidae     | <i>Mallotus philippensis</i>       | India : Meghalaya.                                                                                                                                       |
| 45.    | <i>Walzia indiana</i> Smith-Meyer & Uckermann             | Stigmaeidae  | <i>Morus alba</i>                  | India : Meghalaya, West Bengal                                                                                                                           |

## SECTION-II

| Sl No. | Name of Plant                 | Family         | Name of Mite                                                                               |
|--------|-------------------------------|----------------|--------------------------------------------------------------------------------------------|
| 1.     | <i>Asclepias curassavica</i>  | Asclepiadaceae | <i>Cunaxa curassavica</i>                                                                  |
| 2.     | <i>Azadirachta indica</i>     | Meliaceae      | <i>Amblyseius (Amblyseius) channabasavannai</i>                                            |
| 3.     | <i>Canthium angustifolium</i> | Rubiaceae      | <i>Bdella angustifolius</i>                                                                |
| 4.     | <i>Carica papaya</i>          | Caricaceae     | <i>Amblyseius (Euseius) pruni</i> , <i>Agistemus macrommatus</i> , <i>Panonychus citri</i> |
| 5.     | <i>Cassia occidentalis</i>    | Fabaceae       | <i>Amblyseius (Euseius) alstoniae</i>                                                      |
| 6.     | <i>Cocos nucifera</i>         | Palmae         | <i>Acarus farris</i>                                                                       |
| 7.     | <i>Feronia elephantum</i>     | Rutaceae       | <i>Cunaxa bambusae</i>                                                                     |
| 8.     | <i>Ficus religiosa</i>        | Moraceae       | <i>Oligonychus biharensis</i>                                                              |
| 9.     | <i>Litsaea khasyana</i>       | Lauraceae      | <i>Amblyseius (Neoseiulus) longispinosus</i> , <i>Bdella khasyana</i>                      |

| Sl No. | Name of Plant                 | Family        | Name of Mite                                                                                                                                                                                                                                                                                                                                              |
|--------|-------------------------------|---------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 10.    | <i>Luffa acutangula</i>       | Brassicaceae  | <i>Amblyseius (Euseius) ovalis</i>                                                                                                                                                                                                                                                                                                                        |
| 11.    | <i>Macheles edulis</i>        | Lauraceae     | <i>Agistemus edulis</i>                                                                                                                                                                                                                                                                                                                                   |
| 12.    | <i>Machilus gamblei</i>       | Lauraceae     | <i>Agistemus gamblei</i>                                                                                                                                                                                                                                                                                                                                  |
| 13.    | <i>Mallotus philippensis</i>  | Euphorbiaceae | <i>Tydeus</i> sp.                                                                                                                                                                                                                                                                                                                                         |
| 14.    | <i>Mangifera indica</i>       | Anacardiaceae | <i>Amblyseius (Typhlodromips) suknaensis</i> ,<br><i>Amblyseius (Paraphytoseius) multidentatus</i> ,<br><i>Amblyseius (Amblyseius) channabasavannai</i> ,<br><i>Agistemus fleschneri</i> , <i>Oligonychus gossypii</i> ,<br><i>Cunaxa anacardae</i> , <i>Amblyseius (Typhlodromips) syzygii</i>                                                           |
| 15.    | <i>Michaelia champaca</i>     | Magnoliaceae  | <i>Typhlodromus (Amblydromella) darjeelingensis</i> , <i>Cheyletus malaccensis</i>                                                                                                                                                                                                                                                                        |
| 16.    | <i>Morus alba</i>             | Moraceae      | <i>Agistemus garrulus</i> , <i>Panonychus citri</i> ,<br><i>Oligonychus mangiferus</i> , <i>Walzia indiana</i>                                                                                                                                                                                                                                            |
| 17.    | <i>Musa paradisiaca</i>       | Musaceae      | <i>Amblyseius (Amblyseius) herbicolus</i> ,<br><i>Amblyseius (Amblyseius) largoensis</i> ,<br><i>Aponychus baghensis</i> , <i>Panonychus citri</i> ,<br><i>Panonychus ulmi</i> , <i>Oligonychus indicus</i> ,<br><i>Amblyseius (Euseius) ovalis</i> , <i>Typhlodromus (Amblydromella) gopali</i> , <i>Acarus farris</i> ,<br><i>Iphiseius andamanicus</i> |
| 18.    | <i>Mussandra parryorum</i>    | Rubiaceae     | <i>Ledermulleria parryorum</i>                                                                                                                                                                                                                                                                                                                            |
| 19.    | <i>Pavetta indica</i>         | Rubiaceae     | <i>Hemicheyletia indica</i>                                                                                                                                                                                                                                                                                                                               |
| 20.    | <i>Psidium guajava</i>        | Myrtaceae     | <i>Amblyseius (Typhlodromips) meghalayensis</i> ,<br><i>Amblyseius (Amblyseius) mcmurtryi</i> ,<br><i>Brevipalpus phoenicis</i> , <i>Amblyseius (Euseius) coccineae</i> , <i>Phytoseius (Pennaseius) kapuri</i> ,<br><i>Phytoseius (Phytoseius) roseus</i>                                                                                                |
| 21.    | <i>Thunbergia grandiflora</i> | Acanthaceae   | <i>Bdellodes grandiflora</i>                                                                                                                                                                                                                                                                                                                              |

### SUMMARY

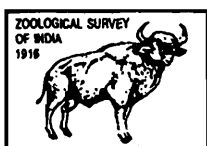
A total of 45 species of mites occurring on 21 species of medicinal plants under 14 families from Northeast India are listed in the paper. It includes distribution of each mite species both in India and elsewhere. Lists of mite-host plant and host plant-mite are also incorporated in the paper under Section-I and II respectively.

### ACKNOWLEDGEMENTS

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## **SUITABILITY OF WATER QUALITY FOR IRRIGATION. A CASE STUDY OF KONDAKARLA LAKE, ANDHRA PRADESH**

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### **INTRODUCTION**

Water quality refers to the degree of suitability for a specific purpose and it largely depends on the physico-chemical composition of its water. The suitability of water for irrigation purposes should therefore be assessed on the basis of its ability to create favourable conditions for crop growth. Irrigation water contains measurable quantities of dissolved salts originating from different sources. Eaton (1950), Szaboles and Daras (1968), Rhoades (1972), Sreerama Murthy *et al.*, (1995) are some of the attempts made on the water quality for irrigation in general.

Kondakarla Lake is situated at 50 km. south-west of Visakhapatnam in Andhra Pradesh and stretched between latitudes 17°35'30" and 17°36'02" N and longitudes 82°59'27" and 83°01'0" E. Though located at about 20 kms. away from the Bay of Bengal, the lake water is the main source of irrigation to the surrounding agricultural fields, where sugar cane is the major crop (75%) followed by paddy (15%) and vegetables (5%). This paper assumes significance due to its maiden attempt in analysing suitability of the water for irrigation.

### **MATERIAL AND METHODS**

Water samples have been collected on 22.04.2000 from three sites of the lake where the crop density is much in its surroundings, viz., Kondakarla village, Vadrepalle and Haripalem. These samples have been analysed for 13 parameters required for the study. The factors like Sodium Absorption Ratio (SAR), Residual Sodium Carbonate (RSC) and Percent Sodium (PS) have been calculated with the following formula :

$$SAR = Na / \sqrt{\left( \frac{Ca + Mg}{2} \right)}$$

$$RSC = (Co_3 + HCo_3) - (Ca + Mg)$$

$$PS = \frac{100 Na}{Na + Ca + Mg + K}$$

## RESULTS AND DISCUSSION

Results of the 13 parameters analysed together with its tolerance limits are given in Table I. Suitability of irrigation water depends primarily upon the silt and salt constituents. The total concentration of soluble salts, the proportion of sodium to other cations, bicarbonate concentration and calcium with magnesium concentration are the important factors for assessing the suitability of water quality for irrigation.

**pH :** The water is found alkaline with pH value 8.5 at all the three spots of the water body. The tolerance limits of this factor is 6.0 to 8.5. Accordingly, this water is suitable for agricultural purposes.

**Electric conductivity :** This parameter ranged from 990 (Vadrepalle) to 1450 micro mhos/cm (Kondakarla Village). Waters below the level of 2,250 are found to be suitable for good crop growth with proper management and drainage conditions, but saline conditions may develop if leaching and drainage are inadequate. Irrigational water with electric conductivity between 750–2250 is classified as C3 water and accordingly Kondakarla lake water falls under this class.

**Bicarbonates :** Abnormal quantity of bicarbonates affects the uptake and metabolism of nutrients by plants and it varies in different species. Calcium and magnesium precipitate as carbonates in waters having more concentration of bicarbonates and also increase the exchangeable sodium percentage. Bicarbonates in the ecosystem was found from 3.6 to 5.2 m.eq/L.

**Chloride :** Abundance of chlorides may be toxic to fruit crops and injurious to leaves. Maximum tolerable limit of this factor is 17 m.eq/L. and this value in the ecosystem is found between 4–7. The rate of accumulation of this parameter in soil does not have any relation with its concentration in irrigating waters. Silty clay loams accumulate more chlorides in a given time than sandy loams and sands.

**Sodicity :** Concentration of sodium relative to other cations is called sodicity. Sodium, magnesium, chloride and sulphate are abundantly found in saline waters. Magnesium is one of the important criteria in determining the irrigational waters and high magnesium absorption affects the soil unfavourably. (Szaboless and Daras, 1968).

**Table I. : Physico-chemical parameters of Kondakarla Lake.**

| <b>Sl. No.</b> | <b>Parameters</b>                     | <b>Kondakarla Village</b>     | <b>Haripalem Village</b>      | <b>Vadrepalle Village</b>     | <b>Tolerance limits (max.)</b> |
|----------------|---------------------------------------|-------------------------------|-------------------------------|-------------------------------|--------------------------------|
| 1.             | pH                                    | 8.55                          | 8.5                           | 8.6                           | 6.0–8.5                        |
| 2.             | Electric conductivity (Micro mhos/cm) | 1450                          | 1320                          | 990                           | 2250                           |
| 3.             | Carbonates (m.eq./L.)                 | 0.8                           | 0.6                           | 1.0                           | –                              |
| 4.             | Bicarbonates "                        | 5.2                           | 4.2                           | 3.6                           | –                              |
| 5.             | (Calcium + Magnesium) "               | 6.0                           | 6.2                           | 3.8                           | –                              |
| 6.             | Sodium "                              | 8.48                          | 7.04                          | 6.08                          | –                              |
| 7.             | Potassium "                           | 0.05                          | 0.05                          | 0.1                           | –                              |
| 8.             | Chloride "                            | 7.0                           | 5.2                           | 4.0                           | 17                             |
| 9.             | Sulphate "                            | 1.4                           | 2.8                           | 1.0                           | 21                             |
| 10.            | Nitrate "                             | 0.13                          | 0.11                          | 0.23                          | –                              |
| 11.            | Residual Sodium Carbonate "           | NIL                           | NIL                           | 0.6                           | 1.25                           |
| 12.            | Sodium Absorption Ratio –             | 4.9                           | 4.0                           | 4.41                          | 26                             |
| 13.            | Percent Sodium –                      | 58.36                         | 52.97                         | 60.92                         | 60                             |
| 14.            | Water Quality –                       | C <sub>3</sub> S <sub>1</sub> | C <sub>3</sub> S <sub>1</sub> | C <sub>3</sub> S <sub>1</sub> | –                              |

m.eq = milli equivalents

The sodium hazard of irrigation waters is measured by the concentration of sodium to calcium and magnesium which is called Sodium Absorption Ratio (SAR). The SAR values in the present study floated from 4.0 to 4.9 and its tolerance limit is 26. The sodium hazard of irrigation waters as expressed by SAR does not take account the effect and anionic composition. The higher SAR values deteriorates the soil texture in irrigation waters. As per the Indian Standards (2296–1982) irrigation water with SAR less than 10 is classified as  $S_1$  and accordingly Kondakarla lake water belongs to this class.

Residual Sodium Carbonate (RSC) during the survey was found 0.6 m.eq/lit. at Vadrepalle and absent in the other two places. According to Eaton (1950), waters with RSC greater than 2.5 m.eq/lit. may be regarded as deleterious while those with less than 1.25 m.eq/lit. are considered safe.

From the water samples the percent sodium ranged from 53 to 61 (rounded off to nearest fraction) and its maximum tolerance limit is 60.

**Sulphates :** Sensitivity of plants to high sulphate concentration is related to the tendency of high sulphate concentrations to limit the calcium uptake by plants.

The decrease in the uptake of the factor is associated with relative increases in the absorption of sodium and potassium. Sulphate quantity in the lake water during the survey ranged between 1.0 to 2.8 while its tolerance limit is 21.

## CONCLUSION

The suitability of irrigation water has to be assessed on the basis of specific conditions like different agroclimatic conditions, different crops (sensitive, semitolerant, tolerant), its varieties and cultural practices. Due to differences in these conditions in different areas, one can treat the above guidelines for evaluating irrigation water quality.

As such the Kondakarla lake irrigation water has been classified as  $C_3S_1$  on the basis of the electric conductivity (750–2250 micro mhos/cm) and SAR (less than 10). All the parameters of Kondakarla lake water are within the limits required for agricultural purpose and thus indicated its suitability for irrigation purposes.

## SUMMARY

In order to assess the suitability of water quality for irrigation purposes at Kondakarla Lake which is forming one of the major wetlands in Visakhapatnam District of Andhra Pradesh, the author has collected its water samples and analysed the relevant parameters. The positive results obtained have been discussed in the light of its suitability.

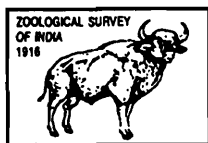
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## NEW RECORDS OF BATS FROM CENTRAL WESTERN INDIA

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### INTRODUCTION

During ecological study and faunastic survey of bats from Pune city (Maharashtra) performed for two years 1998–2000, three bat species are recorded for the first time from Central Western India. All three bat species belong to genus *Pipistrellus* i.e. *P. pipistrellus* (Schreber, 1774), *P. kuhli* (Kuhl, 1819) and *P. savii* (Bonaparte, 1837).

The occurrence of small evening bats is common in the study area. These bats prefer to live in small groups of 5 to 25 bats, but their consolidated population is large. The bats belonging to genus *Pipistrellus* show species diversity in the city area, about 8 species are recorded in Pune city.

*Pipistrellus pipistrellus*, *P. kuhli* and *P. savii*, all these species are confirmed by morphological, cranial and dental measurements. Their occurrence in the peninsular India has extended their distribution in the Indian subcontinent.

### OBSERVATIONS

#### TAXONOMY AND ECOLOGICAL DETAILS

##### (1) COMMON PIPISTRELLE

Class MAMMALIA

Order CHIROPTERA

Suborder MICROCHIROPTERA

Family VESPERTILIONIDAE

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\*Department of Environment Science, Pune University, Pune.

Genus *Pipistrellus*Species *Pipistrellus* (Schreber, 1774)

1774. *Vespertilio pipistrellus*, Schreber, 167, pl. 54. Type locality : France.

**Diagnosis of the species :** Small sized pipistrelle, with forearm length 29–32 mm and head and body length 43–46 mm. The tail is relatively long (32–35 mm). The brain case is moderately high and rounded and interdental palate is longer than wide. Inner upper incisor  $I^2$  is bicuspidate, outer upper incisor ( $I^3$ ) is similar in crown area to  $I^2$ , but half or slightly more in height.  $Pm^2$  is similar in crown area to  $I^2$  and not much intruded from tooth-row. Upper canine is clearly separated from posterior premolar  $Pm^4$ , and  $Pm^2$  is visible laterally.

$$\text{Dental formula : } i \frac{-2 \ 3}{1 \ 2 \ 3}, c \frac{1}{1}, pm \frac{-2-4}{-2-4}, m \frac{1 \ 2 \ 3}{1 \ 2 \ 3} = 34$$

**External, cranial and dental measurements (mm) of *Pipistrellus pipistrellus***

|     |         |                                |           |
|-----|---------|--------------------------------|-----------|
| HB  | 43–46   | GTL                            | 11.8–12.2 |
| HF  | 6–7     | CCL                            | 10.6–11.3 |
| T   | 32–35   | ZB                             | 6–6.3     |
| FA  | 29–32   | BB                             | 5.8–6.2   |
| E   | 10–12   | PC                             | 3.4–3.8   |
| 5MT | 27–30   | CM <sup>3</sup>                | 4.2–4.5   |
| 4MT | 28–31   | CM <sub>3</sub>                | 4.3–4.6   |
| 3MT | 28–31   | M <sup>3</sup> –M <sup>3</sup> | 5.4–5.6   |
| TIB | 10–11   | M                              | 8.4–8.7   |
| WSP | 190–203 | RW                             | 5–5.2     |

\*n = 3 (2 female, 1 male)

HB : Head & body length, HF : Foot length, T : Tail length, FA : Forearm length, E : Ear length, 5MET : Length of 5<sup>th</sup> metacarpus, 4MET : Length of 4<sup>th</sup> metacarpus, 3MET : Length of 3<sup>rd</sup> metacarpus, TIB : Length of tibia, WSP : Wingspan, GTL : Greatest length of skull, CCL : Condylor-canine length, ZB : Zygomatic breadth, BB : Length of braincase, PC : postorbital constriction, CM<sup>3</sup> : Maxillary tooththrow, CM<sub>3</sub> : Mandibular tooththrow, M<sup>3</sup>–M<sup>3</sup> : Posterior palatal width, M : Mandible length, RW : Width of rostrum.

Pelage is soft, dense and silky. Dorsally the pelage colour is blackish brown and slightly paler on the ventral side. Some of the hair tips on the ventral side are grey to buffy brown. Snout, ears and membranes are uniformly dark brown. The ears are held almost horizontally on the head, the

tragus is tall and slightly curved inwardly. The tibiae are short and the soles are small. The dorsal profile of the skull rises gradually from the nasal aperture to lambda. The cranium is bulbous and the rostrum is long and narrow.

*Collecting locality* : The evening bats of the present species are found hiding behind the wooden notice board at the second floor of Bharati Vidyapeeth, near Katraj lake, on southern border of the city.

*Systematic remark* : Specimens from India and Pakistan are provisionally referred to the Indian subspecies *P. p. aladdin* (Corbet & Hill, 1992). Those from north of the main massif of the Hindu-Kush Mountains Afghanistan are referred to *P. p. bacrianus* (Gaisler, 1970).

*Distribution* : The present species of bat is reported from North Pakistan (Gilgit), Kashmir; and to W. Europe, N. Africa and Turkestan.

*Ecological note* : A group of about 20 bats of adult and subadults were found roosting under the same shelter in early February. This part of city is comparatively cool and humid in monsoon i.e. from June to September but for the remaining season the surrounding is dry, when the bats were located. After trapping and releasing, the disturbed colony left the roosting site and did not turn up to this site till the date. Nothing is known about the reproduction cycle.

## (2) KUHLMAN'S PIPISTRELLE

Class MAMMALIA

Order CHIROPTERA

Suborder MICROCHIROPTERA

Family VESPERTILIONIDAE

Genus *Pipistrellus*

Species *kuhlmanni* (Kuhl, 1819)

1819. *Vespertilio kuhlmanni* Kuhl, 1819. Type locality : Trieste, Italy.

*Diagnosis of species* : The medium sized pipistrelle with forearm length ranging between 34.8–36. The tail length (33–35 mm) is sub equal to the head and body length (46.8–49.4 mm). It differs from other closely related species in dental peculiarities.  $I^2$  is unicuspid,  $I^3$  and  $pm^2$  are small, about one half or less in the crown area of  $I^2$ . The tip of  $I^3$  extends slightly beyond the cingulum of  $I^2$ . The wing membranes are translucent and the most characteristic feature is the presence of distinct white border on the patagium running between the foot and the fifth digit.

**External, cranial and dental measurements (mm) of *Pipistrellus kuhl***

|     |           |                                |         |
|-----|-----------|--------------------------------|---------|
| HB  | 46.8–49.4 | GTL                            | 13–13.6 |
| HF  | 6–7       | CCL                            | 12–13   |
| T   | 33–35     | ZB                             | 8.5–8.8 |
| FA  | 34.8–36   | BB                             | 6.8–7   |
| E   | 11.1–13   | PC                             | 3.4–3.8 |
| 5MT | 31–33.8   | CM <sup>3</sup>                | 4.8–5   |
| 4MT | 31.8–34.5 | CM <sub>3</sub>                | 5.2–5.6 |
| 3MT | 32–35     | M <sup>3</sup> –M <sup>3</sup> | 5.7–6   |
| TIB | 13–14     | M                              | 10–10.6 |
| WSP | 233–242   | RW                             | 4.9–5   |

\*n = 3 (2 female, 1 male)

HB : Head & body length, HF : Foot length, T : Tail length, FA : Forearm length, E : Ear length, 5MET : Length of 5<sup>th</sup> metacarpus, 4MET : Length of 4<sup>th</sup> metacarpus, 3MET : Length of 3<sup>rd</sup> metacarpus, TIB : Length of tibia, WSP : Wingspan, GTL : Greatest length of skull, CCL : Condylorcanine length, ZB : Zygomatic breadth, BB : Length of braincase, PC : postorbital constriction, CM<sup>3</sup> : Maxillary toothrow, CM<sub>3</sub> : Mandibular toothrow, M<sup>3</sup>–M<sup>3</sup> : Posterior palatal width, M : Mandible length, RW : Width of rostrum.

The dorsal pelage is dark brown and slightly paler ventrally. The hair roots on the ventral body surface have darker base. The snout, ears and wing membranes are uniformly brown. The tragus is inwardly curved, but the tip is narrow and the outer border lacks triangular projection, the presence of which is the peculiarity of *P. savii*. The skull is long, its dorsal profile is almost straight and the lambdoid crest in front of the small triangular area is well developed. Pm<sup>2</sup> is displaced inwardly as a result the upper canine and pm<sup>4</sup> seem to be in contact. Pm<sup>2</sup> is smaller, about half of Pm<sup>4</sup> in height and crown area.

**Collection locality :** While surveying bat colonies in urban area of Pune city (Maharashtra, India), two colonies of *Pipistrellus kuhl* were located. In the first case, from the small population of about 6–7 bats, two bats were trapped in early June from the old stony building of St. Hilda's Girls' School premises in Guruwar Peth. The adult males and females live in the crevices of an old stony building at the ground floor verandah covered with old-fashioned clay tiles. The bats of *P. ceylonicus* and *P. savii* were also trapped from the vicinity. Another colony of about four to five bats of *P. kuhl* was located in early February roosting behind the wooden board again at the ground floor of an old stony building of Fergusson College.

**Systematic remark :** There is no endemic subspecies in the Indian subcontinent.

**Distribution of species :** This bat species is reported from southern Europe to India and also from Morocco to Egypt and South Africa (Corbet and Hill, 1992). From India it is reported from Kolkata (West Bengal), Cachar District from Assam and Cherapunji from Meghalaya (Kurup, 1968). The present report is the extension of the species in the central western region of India.

**Ecological note :** Both these colonies are located in the urban area, where the surrounding is quite green due to indigenous plants and hence cool and humid even in summer.

Like other species of *Pipistrellus*, the bats of the present species come out from their diurnal roost about 10 to 15 minutes after sunset. The bats leave their roost one by one at the interval of about 2 to 3 minutes. The flight is jerky but regular.

Nothing is known about the reproduction. The bats seem to shift the day roosts in response to even slight disturbance in their habitat or due to human interference.

### (3) SAVI'S PIPISTRELLE

Class MAMMALIA

Order CHIROPTERA

Suborder MICROCHIROPTERA

Family VESPERTILIONIDAE

Genus *Pipistrellus*

Species *savii* (Bonaparte, 1837)

1837. *Vespertilio savi* Bonaparte : fasc. 20 Type Loc. : Pisa, Italy.

**Diagnosis of species :** Inner upper incisor  $I^2$  is bicuspid.  $I^3$  is half or more in height to  $I^2$ , but similar in crown area.  $Pm^2$  is little reduced in crown area, about two thirds of that of  $I^2$ . Postorbital region, supraorbital region and rostrum are moderately widened. Supraorbital tubercles are small. Braincase is low, flat and elongate. Basial pits are lacking. Pelage is soft, dense, long and silky.

**Dental formula :**  $i \frac{-2 \ 3}{1 \ 2 \ 3}, c \frac{1}{1}, pm \frac{-2-4}{-2-4}, m \frac{1 \ 2 \ 3}{1 \ 2 \ 3} = 34$

#### External, cranial and dental measurements (mm) of *Pipistrellus savii*

|    |           |     |           |
|----|-----------|-----|-----------|
| HB | 46–51     | GTL | 14.4–14.5 |
| HF | 6–7       | CCL | 12.4–13.5 |
| T  | 29.5–30   | ZB  | 8.3–8.5   |
| FA | 35.8–36.7 | BB  | 7–7.2     |

|     |           |                                |          |
|-----|-----------|--------------------------------|----------|
| E   | 11.6–12.2 | PC                             | 3.5–3.7  |
| 5MT | 31–31.6   | CM <sup>3</sup>                | 5.1–5.2  |
| 4MT | 33.6–34.3 | CM <sub>3</sub>                | 5–5.2    |
| 3MT | 30.2–33.4 | M <sup>3</sup> –M <sup>3</sup> | 6–6.1    |
| TIB | 13.2–14.5 | M                              | 9.5–10.5 |
| WSP | 235–249   | RW                             | 5.5–5.7  |

\*n = 2 male

HB : Head & body length, HF : Foot length, T : Tail length, FA : Forearm length, E : Ear length, 5MET : Length of 5<sup>th</sup> metacarpus, 4MET : Length of 4<sup>th</sup> metacarpus, 3<sup>rd</sup> MET : Length of 3<sup>rd</sup> metacarpus, TIB : Length of tibia, WSP : Wingspan, GTL : Greatest length of skull, CCL : Condylorcanine length, ZB : Zygomatic breadth, BB : Length of braincase, PC : postorbital constriction, CM<sup>3</sup> : Maxillary tooththrow, CM<sub>3</sub> : Mandibular tooththrow, M<sup>3</sup>–M<sup>3</sup> : Posterior palatal width, M : Mandible length, RW : Width of rostrum.

The medium sized bat with uniformly dark brown long, silky, soft and dense pelage. Ventrally the hair bases are darker, while the tips are pale in colour. The snout, ears and wing membranes are uniformly dark brown. The muzzle is naked and flat. The membranes are translucent. The ear lobes are long and broad at the base. The tip of the ear lobe is rounded. The tragus is long, inwardly curved and with blunt tip. On its outer margin on the lower half, there is a triangular projection. The tail is significantly shorter than the head and body length.

*Collecting locality* : The bats of the present species *Pipistrellus savii* were trapped, when hiding behind the nameplate fitted on the stony wall of old building in the premises of Fergusson College. Two isolated males were trapped, one in mid March 1999 and the other in mid February next year.

*Systematic remark* : Specimens from India and Myanmar are provisionally referred to *P. s. austenianus* (Ellerman & Morrison-Scott, 1951 and Hill, 1962) as reported by Corbet & Hill, (1992).

*Distribution of the species* : *Pipistrellus savii* is reported from Korea, Japan, Arabia, Iran, Afghanistan, India, Myanmar and North Africa. In India Cherapunji (Meghalaya) is the type locality of *P. s. austenianus*. It is a widespread but little studied species. In Indian subcontinent the endemic subspecies *P. s. austenianus* has a restricted range. But its occurrence in the peninsular India has extended its distribution in this subcontinent.

*Ecological notes* : Nothing is known about the food and feeding habit or reproduction cycle of the present species.

### SUMMARY

Occurrence of three species of pipistrelles, *Pipistrellus pipistrellus* (Schreber, 1774), *P. kuhlii* (Kuhl, 1819) and *P. savii* (Bonaparte, 1837) in urban area of Pune (Maharashtra, India) has extended the distribution of these species in the Indian subcontinent. The results are based on the morphological, cranial and dental measurements.

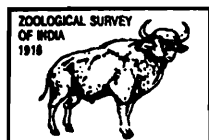
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### ***Short Communication***

## **ANIMALS FROM INDIA IN THE CARIBBEAN**

No substantial research has been done on the animals and birds that came from India to the West Indies/Caribbean. Historians have instead chosen to focus their studies on Indians (West Indians) in relation to religion, caste, leadership, law and land. Animals were brought on the same ship with labourers who were imported to work on the sugar cane plantations after the abolition of slavery. Large lop-eared goats, for instance, were the survivors of the ship *Lapwing* which was wrecked near Barbados on its way to Guyana (cited in Shannon 1945). As agricultural workers during Indentureship (1838–1917), Indians worked alongside cattle in the fields, and they also kept private animals as property and pets. Indians have an ancient tradition of animal husbandry which continued in the West Indies. Indeed, it must be remembered that the cow (cattle) has always been sacred to Hindus who form a major ethnic group in Trinidad and Guyana. *Until the 1950s every Indian family raised cows to produce dung, milk and manure for subsistence and sale.* The animals were raised on common holdings and fed crop residues, wild grass and cane tops. They, therefore, did not compete with their owners for food and space.

This neglect in research is unfortunate. Researchers Julie Cole, Will Faust and Matt Fleming claim in their work on “The Evolution of Wild Cattle” (1991) that the first known bovid (family of cattle, sheep and goats) in the world was the Aurochs, which is of Indian origin. The breed first evolved in Asia, and then in Europe and Africa at approximately the same time during the Pleistocene Period (1.8 million to 11,000 years ago). The closest resemblance of the Aurochs today can be found in the wild Zebu cattle of India, and the Sanga cattle from Africa. Archaeological findings and genetic evidence have proven that farmers in India were the first to capture and tame the humped Zebu cattle which is native to that country (Bradley 2003).

Though domesticated cattle was first brought to the Americas by Columbus on his second voyage, the Zebu cattle (*Bos indicus*) was brought to the West Indies by the British in the 1860's.<sup>1</sup>

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<sup>1</sup> *Bos indicus* is thought to have originated in India more than 4,000 years ago (RRAT 2002).

Over 30 breeds (including a miniature) came and were named after their province of origin such as the Nellore, Hissar, Mysore and the Gujarat. These have huge curved horns, a massive hump just behind the neck, and thrive in hot humid conditions. Zebus have built-in protection against biting insects in the form of muscles that allow better twitching of the skin. They do not eat when water is unavailable and live off of the fat in their hump. These were later crossed with other breeds in Jamaica and Martinique Chantal *et al.* (1998) in the 1950's to produce more beef (Hoyt 2003; JAS 1961). Several *B. indica* breeds have been developed into the Brahman breed<sup>2</sup> in the United States, where it was first imported 1849.<sup>3</sup>

In 1905 and 1908 during indentureship, 30 Jafarabadi Indian water Buffaloes ("bhaisa") were brought to Trinidad in the Tacarigua sugar estate to replace the cattle herds (Zebu and Brahman breeds) which were infected with tuberculosis (L. Rastogi *et al.* 1993; Lidga 1996). Several importations of other breeds like the Murrah, Surti, Nili and Bhadawari, on the advice of Dr. L. Shannon, occurred until 1949.<sup>4</sup> Crossbreeding by Steve Bennett in the 1960s has produced a Trinidadian type ("Buffalypso") that has been shipped to 19 different countries around the world, especially to Central and South America, Cuba and Barbados. Since 1974, the Food and Agriculture Organization (FAO) has signposted buffalo (*Bubalus carabanesis* and *Bubalus bubalis*) as the most neglected animal for production of milk,<sup>5</sup> meat (Indian Diary 2002), Cheese, leather (Bennett 2003), and one may add draft power. Buffaloes in Trinidad have been found to be relatively free from cattle diseases and insects, and almost twice as efficient as cows in producing milk. Researcher Leela Restogi and others (1993) argue that their meat is also reported to be superior in quality to beef, and buffaloes have the unique quality to convert poor quality rations into remarkable muscle growth. In 1978, there were 6,000 buffaloes in Trinidad living in environments hostile to other animals (R. Rastogi *et al.* 1978). With the increasing use of tractor power and the imminent death of the sugar cane industry (Caroni 1975 Ltd.), these animals are destined to disappear as drought animals.

The small mongoose was imported from India (sometimes through London) to Jamaica and Trinidad around 1872. It (*Herpestes auropunctatus*) was brought to control rats that infested the sugar cane plantations which caused tremendous losses in revenue (Hinton and Dunn 1967; NHSJ 1949). From these islands they were sent to Cuba, Puerto Rico, Grenada and Barbados. They also kill snakes by inducing them to strike, stepping aside quickly, and then pouncing on their head

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<sup>2</sup> Brahman cattle is thought to have originated in India more than 4,000 years ago (RRAT 2002).

<sup>3</sup> Henry Koontz was the great grandson of Captain John N. Keeran, who with his friend A. H. "Shanghai" Pierce, imported some of the first Zebu cattle to Texas and the United States in 1878 (Liar's Lake 1999).

<sup>4</sup> India has the highest buffalo population in the world (IVA 2003).

<sup>5</sup> India has emerged as the largest milk producer in the world today (IVA 2003). About 20 years ago, nearly 60% of milk production came from buffaloes (R. Rastogi *et al.* 1978).

above with a bite that cracks their skull. They are extremely intelligent animals and reliable pets (Sanderson 1953).

Goats are probably the oldest ruminant animal (next to dogs) to be domesticated 8000 years ago. Domestication occurred along the rivers of the ancient civilizations of Nile (Africa), Tigris and Euphrates (Asia), and Indus (India). In 1872, Indian goats were bought from vessels in England, and about the same time they were brought to the West Indies to be milked for the children of immigrant labourers on the ships (Shannon 1945). The original goats imported from Africa, Arabia and India were long-legged and hardy, and were crossed by British breeders.<sup>6</sup> Goats adapt easily to mountainous and semi-arid environments, and are used for meat, milk and hide production. Goat milk is valued for people suffering with ulcers and matasmus.

Rhesus monkeys (*Macaca mulatta*) were released in islands near Puerto Rico in the 1960s (SZGD 2000, ZOO 2002), and later in Florida (BBC 2003). They have a squat thickset built and are highly intelligent. In India, they are considered sacred and are left unmolested.

Very few birds from India were brought to the Caribbean, and none could have flown over the vast oceans. The most widely distributed is the Peafowl (*Pavo cristatus*). The Peacock is identified by its magnificent huge tail that can be raised into a broad fan. Both male and female emit a loud scream. They are raised as garden and farmyard ornamental birds (Höner 2003; Raffaele *et al.* 1998). Their feathers play an important part in Hindu iconography.

Another bird that is native to India and found in the Caribbean is the Hill Myna (*Gracula religiosa*). It is also called “The Talking Myna” because it has the surprising ability to mimic human speech, bird calls, and other sounds. There are other birds like the Red Avadavat (*Amandava amandava*) (“Strawberry Finch”), Warbling Silverbill (*Lonchura malabarica*) (“Indian Silverbill”), Nutmeg Mannikin (*Lonchura punctulata*) (“Spice Finch”), and the Chestnut Mannikin (*Lonchura malacca*) (“Black-headed Nun”). These birds were introduced to Puerto Rico (in the 1960s) Cuba, Jamaica, Hispaniola, Martinique and Guadeloupe (NFSS 1999; Faffaele *et al.* 1998; Sims 2002). It is likely that they escaped or were released from cages.

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<sup>6</sup> Shannon (1945) argues that the term **Anglo-Nubian** is a misnomer; Anglo-Indian is a more appropriate and accurate designation.

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### ***Short Communication***

## **FIRST RECORD OF *MADASUMMA SOROR* CHOPARD, 1969 (GRYLLIDAE : ORTHOPTERA : INSECTA) FROM KAKKAYAM RESERVE FOREST, KOZHICODE DISTRICT, KERALA, INDIA**

### **INTRODUCTION**

While conducting a faunistic survey of Kakkayam reserve forest located in Kozhikode district, Kerala state, an interesting Orthopteran species was collected and identified as *Madasumma soror* Chopard, 1969 which turned out to be hitherto unreported from the state. Thus, this communication is intended to report the extended distribution of this taxon in the Kerala state.

Kakkayam reserve forest is located between 11°35' N latitude and 75°54' E longitude and about 60 Km. north east of Calicut city, Kerala. Thick evergreen forests and plantations of coffee and cardamom surround the area, at an altitude varying from 600 to 1500 m. above mean sea level. The proximity of Kakkayam reservoir and the forests provide the area with good shelter for many insects and other animals. The specimen of *Madasumma soror* was collected from this locality at night. The literature (Chopard, 1969; Vasanth, 1991) reveals that the species is reported so far in India from Maharashtra only. Chopard (1969) described this as a new species in his work. Details of the specimen presently studied are as follows.

**Material examined :** *Madasumma soror* Chopard, 1 adult male. Locality : Kakkayam reserve forest, Kozhikode district, Kerala state, India. Date : 22-ii-2003. Collector : M. Jafer Palot. Specimen deposited in Western Ghats Field research Station, Zoological Survey of India, Calicut. Reg. No. 12754.

**Diagnostic characters :** Head with 3 wide dark brown bands above. Pronotum feebly narrow in front, posterior margin sinuated. Abdomen light brown above, yellow below. Anterior tibiae with an oval tympanum. 5 spines on each margin of the posterior tibiae. Elytra with 2 white, callous spots – one on the external angle of the mirror, the other near its posterior margin and

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The National Zoological Collections comprising nearly 15,000 types are housed in the Zoological Survey of India, Calcutta and are properly maintained. All these specimens have Registration numbers and are readily available for study as and when required. Data pertaining to locality, date of collection, name of collector, sex, up to date valid species name, name of the host (for parasite) etc., of each *type of collection* have already been computerised. The computerised data are stored in the computer centre of Zoological Survey of India. Scientists/Naturalists interested for any information on type species present in Zoological Survey of India may contact the *Director, Zoological Survey of India, 'M' Block, New Alipore, Kolkata-700 053.*

Dr. J. R. B. ALFRED  
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In order to enrich the “*National Zoological Collection*” (NZC) and to up date information on the occurrence and distribution of animal species in India Scientists/Naturalists and researchers working on animal taxonomy/systematics are requested to deposit their identified specimens to the Zoological Survey of India at the following address :

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These specimens will be registered and their data will be computerised. *They are further requested to deposit their type collection positively of ZSI and use the Registration number in their publication of the new taxon.*

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