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## Systematic studies of subgenus *Melandrena* (*Andrena*)

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### Abstract

The subgenus, *Melandrena* is represented in India by three species viz., *Andrena (Melandrena) patella* Nurse, 1903, *Andrena (Melandrena) nitida* (Muller, 1776) and *Andrena (Melandrena) nigroaenea* (Kirby, 1802). These species were first time redescribed here in a more elaborate manner. The diagnostic characters of subgenus, *Melandrena* first time established for Indian species. *Andrena patella* and *A. nitida* only females and in *A. nigroaenea* males were reported. The line drawing and identification keys were also provided. This research will prove quite fruitful for further taxonomic studies on bees of Andrenidae and related family viz., halictidae, colletidae etc.

**Keywords:** *Andrena*, *Melandrena*, India and Andrenidae

### Introduction

Since ancient times, bees have attracted the attention of mankind. Bees are not only important as pollinators of natural vegetation and crops, some of them even produce useful products like honey and wax. Apart from their practical importance, humankind has been fascinated by them due to their social behavior, their interactions and communication patterns, their many adaptations to the innumerable floral diversity, their ability to find food and carry them back to their nests, their ability to relocate their food source, architecture of their nests for storage of their food and brood, their ability to rob other nests etc.

Worldwide 17,000 species of bees under superfamily Apoidea have been described [8]. Bees can be classified into two main groups, short-tongued (ST) and long-tongued (LT) bees based on their mouthparts morphology [8]. Short tongued bees are characterized by their short labial palpi, galea and truncate or acute glossa. On the other hands in the long tongued bees the first two segments of labial palpi are elongated and flattened sheath like. Seven bee families are currently recognized. Out of seven families five are considered as short tongued bees (Stenotritidae, Colletidae, Andrenidae, Halictidae and Melittidae) while remaining two families (Megachilidae and Apidae) are long tongued bees.

Among the short tongued bees, bees belonging to the family Andrenidae are important pollinators of a wide range of agricultural, fodder, pulse, flowers and fruits crops. Their role is essentially important especially in the temperate region where honey bees fail to pollinate due to extremely low temperatures. These bees are morphologically diverse, medium sized, often black and grey in colour but a few bright metallic, brown, black and red coloured forms are also there. The family Andrenidae is currently represented by 4 subfamilies and 5 genera. Genus *Andrena* commonly called as sand bees represents the largest genus of bees [8]. Currently this genus contains about 1400 valid species [5]. Considering that many species of *Andrena* have yet to be described (especially those from the dry regions of Central Asia and Mesoamerica) and that many described subspecies, in particular those named by Warncke, may be raised to species rank, the real number of species of *Andrena* might be at least around 2000 (Warncke, 2000) [22]. This bee genus rightly deserves to be called one of the largest genera of animals at par with *Drosophila* (Diptera), *Atheta* or *Onthophagus* (both Coleoptera) (Mayr and Ashlock, 1991) [14].

Genus *Andrena* exhibits a widespread holarctic distribution ranging from North America to Panama, as well as from Western Europe including Northern Africa via Asia minor, Central Asia eastward to Korea, Japan and the Kamtschatka region. Except for one species which is found in the tropical lowlands of Panama, the occurrence of *Andrena* in apparently tropical regions, such as the East African highlands south to the Cape province, the southern parts of India, China, Japan and Taiwan, as well as Malaysia (Baker, 1995) [3], is clearly restricted to

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the mountainous areas within these regions. *Andrena* is completely absent from South America, main parts of Central Africa and South East Asia and Australia.

Genus *Andrena* can be easily recognized by the following set of characters, viz., the presence of long dense hairs on body especially head and thorax, two subantennal sutures, depressed velvety facial fovea and metasomal hair bands, convex clypeus etc.

Fabricius (1775) [11] first described *Andrena* and listed 14 species. It was the fourth genus of bees to be proposed after *Apis* Linnaeus, 1758, *Eucera* Scopoli, 1770 and *Nomada* Scopoli, 1770. Michener (2007) [18] listed 96 subgenera of *Andrena* while Gusenleitner and Schwarz (2002) [12] recognized 98 subgenera.

Work on this genus from India is scanty. Bingham (1897) [5] described 13 species of genus *Andrena* under family Apidae along with all other types of bees both social and non social. All other species described from India are in scattered publications by specialists who worked abroad (Bingham, 1897; Cameron, 1904; Nurse, 1903, 1904; Cockerell, 1906, 1920; Kuhlmann, 1998; Tadauchi and Matsumura, 2007) [5, 7, 19, 20, 8, 9, 13]. A few exploratory studies on diversity of bees with special emphasis on non *Apis* pollinators in some natural and agricultural plants have been conducted in various parts of India (Abrol *et al.*, 2012; Belavadi and Ganeshaiyah, 2013; Anand *et al.*, 2007) [1, 4, 2] wherein they only recorded genus *Andrena* along with several other genera.

Descriptions of Indian species were based on superficial characters like shape of the tongue and nature and colour of the integument and pubescence on the body, nesting habits, segmentation of maxillary and labial palpi etc. which caused errors in their identification. Therefore an attempt was made to identify stable characters and use them in the descriptions which in turn would put the identities of the species on a firm footing.

So, the present study was formulated to bridge this gap and explore the diversity of these bees with the following objectives "Systematic studies of subgenus *Melandrena* (*Andrena*)".

## Materials and methods

This study was undertaken at an Indian agricultural research institute, New Delhi during the period of 03-08-2012 to 25-01-2016. The base materials for present studies were based on specimens who were obtained from the National Pusa Collection (NPC) and Personal collection which were obtained from different parts of the country. Specimens obtained from such a way were processed [6, 7]. The whole specimens were studied in detail under LEICA EZ4 stereo zoon binocular microscope. Where ever needed dissections were made. In case of mouth parts, genitalia and hidden sterna (Sternum 7 and Sternum 8) require dissection. First, specimens were softened in a moist relaxing box for overnight. For preparation of mouthparts, the head was removed after removing both antenna from the body and put in 10% KOH for about 4-5 hours at room temperature. After washing in distilled water first mandibles were removed then, labium and a pair of maxilla was removed and studied in 75% ethanol. After that all structures of proboscis were stored in 75% ethanol. Male genitalia, S7 and S8 were removed from the abdomen of fresh or relaxed specimens using a hooked insect pin and were put in 10% KOH for about 5-6 hours at room temperature. Genitalia, S7 and S8 were cleared and examined and then stored in 75% ethanol. For photographs

LEICA DFC 425C stereo-zoom microscope using LAS3.8 software was used. All files were processed with Microsoft publisher [6, 7]. Morphological terms used in this paper mainly followed Michener (2007) [18]. Abbreviations used were as follow: AS: antennal segment (scape = AS1), BL: body length, FWL: length of forewing, FOV: facial fovea, DLP: dorsal part of lateral propodeum, LP: lateral part of propodeum, LICD: lower inter compound eye distance, UICD: upper inter compound eye distance, PMX: maxillary palpus, PLB: labial palpus, PLR: process of labrum, PT: propodeal triangle, S: metasomal sternum and T: metasomal tergum.

## Results and discussion

Subgenus *Andrena* (*Melandrena*) was erected by Perez (1890) based on type species *Apis thoracica* Fabricius, 1775. It is represented in India by seven species viz., *A. limata*, *A. cussariensis*, *A. cineraria*, *A. nitida*, *A. patella*, *A. induta* and *A. nigroaenea*. In the present investigation three species, *A. nitida*, *A. patella* and *A. nigroaenea* were redescribed.

### Diagnosis characters of Subgenus *Andrena* (*Melandrena*):

**Female:** Body bright deep black, large and stout, head partially or wholly covered with brownish black hairs. PMX2 longer than PMX1, PLB as long as glossa. PT not carinated, finely rugose basal 1/3<sup>rd</sup> length, apical 2/3<sup>rd</sup> length tessellated with minute punctations. Inner hind tibial spurs 3/4<sup>th</sup> till from base uniformly broadened, remaining narrow, apex pointed, straight in dorsal view. Metasoma smooth and shiny, pygidial plate densely punctate, triangular, without raised area medially.

**Male:** Body deep black, large and stout. PLR trapezoidal with slight emargination. Inner hind tibial spurs uniformly broadened till 3/4<sup>th</sup> from base, remaining narrow, apex pointed. Pygidial plate absent. S7 with hollow finger shaped emargination on basal lower side medially; dorsal lobe of gonocoxite weakly developed, inner margin of dorsal lobe parallel sided; lateral margin (dorsal view) of penis valve parallel sided basally, apically converging.

### Key to the species belonging to subgenus *Andrena* (*Melandrena*)

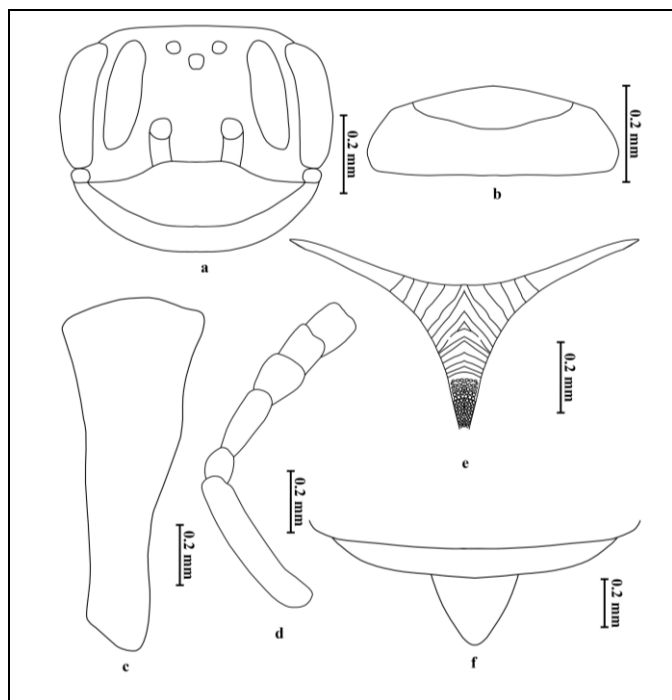
#### Females:

1. Prepygidial and pygidial fimbriae brownish black; pygidial plate broad with apex rounded ..... *A. nitida*
- Prepygidial and pygidial fimbriae dark black; pygidial plate narrow with apex truncate ..... *A. patella*

### 1. *Andrena* (*Melandrena*) *patella* Nurse, 1903

#### Female: (Fig. 1)

**Head:** Head Oval, 1.19x wider than long. Mandibles normally long, slightly crossing over each other at repose, slightly curved, bidentate. PLR without emargination, PLR W/L = 3.37. UICD/LICD = 0.9. Apex of galea pointed, apical part of galeal blade concave; PMX slightly longer than galea, PMX2 longer than PMX1, PMX slightly longer than galea; PLB as long as glossa, PLB4 longer than PLB3. Malar space present. Clypeus convex, weakly rugose with minute indistinct punctations, 2.02x wider than long. FOV long, narrow, entirely depressed, outer margin slightly convex, inner concave, FOV 4.09x longer than wide. AS3/AS1 = 0.6. Hind margin of vertex rounded.



**Fig 1:** *Andrena patella* Nurse (female): (a) Head, (b) process of labrum, (c) Mandible, (d) Antenna, (e) Propodal triangle and (f) Pygidial plate.

**Mesosoma:** Scutum and scutellum rough, dull to weakly shiny, punctations distinct, dense and medium sized; mesepisternum tessellated with minute dense punctations. Metanotum dull to weakly shiny, indistinctly punctate, metepisternum smooth, shiny, medium large with sparse punctations. PT basal 2/3<sup>rd</sup> finely rugose, apical 1/3<sup>rd</sup> dense tessellated with distinct small punctations; DLP finely rugose, tessellated; LP tessellated, rough, weakly shiny, posterior 2/3<sup>rd</sup> rugose. Apex of fore and mid tibial spurs pointed, hind tibial spurs distinctly broadened nearly whole length, finally serrate, claws bidentate.

**Metasoma:** Metasoma smooth and shiny, depression of marginal zone absent. Pygidial plate shiny dense tessellated with small, indistinct punctations, triangular without raised triangular area medially, apex truncate.

**Integument colour:** Whole body deep black, wings grey colour. Mandibles basally black, reddened apically; glossa yellowish white, labial palpi reddish brown; galea black, brown apically; cardo black, stipes brownish black.

**Pubescence:** Body pubescence black, bilaterally branched. Head, facial fovea with long dense black hairs. Galeal blade with normal straight hairs, hairs on stipes sparse. Scutum and scutellum with yellow pubescence. PT and DLP silvery white. LP, legs, tibial scopa, trochanter flocculus of hind legs black, complete, tibial scopa with simple hairs. Tergum sparse hairy with short hairs. Metasomal hair bands weakly developed. Prepygidial and pygidial fimbriae deep black.

**Male:** Unknown

**Measurements (in mm):** ♀ BL: 13.757; FWL: 9.595; Head Length: 3.535 Head Width: 4.212; Clypeus Length: 1.240; Clypeus Width: 2.502; UICD: 2.664; LICD: 2.965; PLR Length: 0.191; PLR Width: 0.644; Length of AS1: 0.937;

AS2: 0.214; AS3: 0.562; AS4: 0.240; AS5: 0.227; FOV Length: 2.245; FOV Width: 0.559.

**Specimens examined:** INDIA, 3 ♀♀, Kashmir: Shadimarg (Pulwama), 19.IV.2013, Sajad Coll.

**Distribution:** Jammu and Kashmir

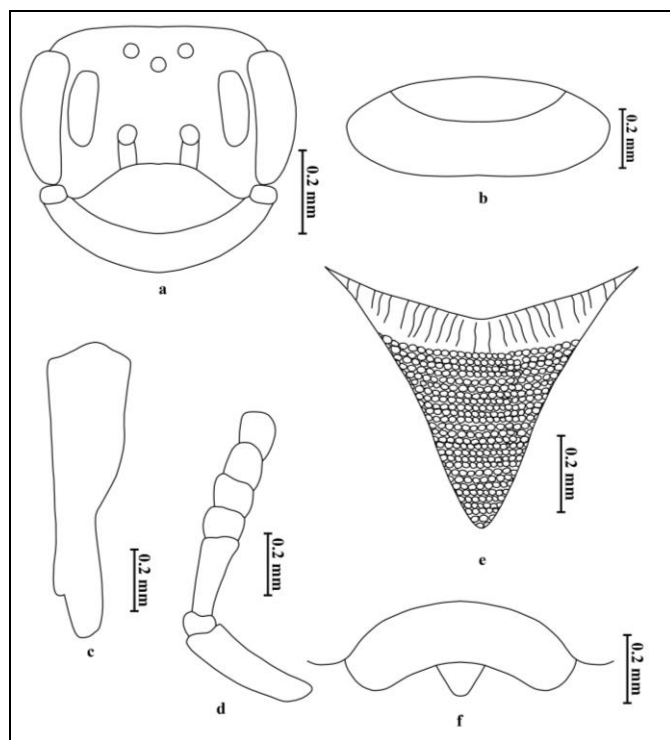
**Floral record:** Apple

## 2. *Andrena (Melandrena) nitida* (Muller, 1776)

*Andrena pubescens* Olivier, 1789:136.  
*Apis nigriventris* Gmelin, 1790: 2789.  
*Andrena velutina* Lepeletier, 1841: 240.  
*Andrena consimilis* Smith, 1847: 2214.  
*Andrena nitens* Schenck, 1869: 30.

### Female: (Fig. 2)

**Head:** Oval, 1.25x wider than long. Mandibles long, crossing each other at repose, bidentate. PLR trapezoidal without emargination. PLR W/L = 2.98. Apex of galea rounded, slightly convex on outer margin, PMX distinctly longer than galea, PMX2 longer than PMX1; PLB as long as glossa, shape of PLB2 club like, PLB4 longer PLB3. Clypeus rough and dull, 2.39x wider than longer, punctations distinct, small and dense, disc convex. UICD/LICD = 0.93. FOV velvety, long, broad, depressed along the entire length, upper margin (hind) reaching upper margin of compound eye, lower margin (anterior) distinctly below upto antennal socket, outer margin straight, inner margin without distinct constriction, 2.95x longer than wide. AS3/AS1 = 0.39. Hind margin of vertex rounded in frontal view.



**Fig 2:** *Andrena nitida* (Muller) (Female), (a) Head, (b) Process of labrum, (c) Mandible, (d) Antenna, (e) Propodeal triangle and (f) Pygidial plate.

**Mesosoma:** Rough and dull. Pronotum shiny and smooth with small sparse punctations, without humeral angle, lateral part rounded. Scutum and scutellum small, indistinct with

dense punctations. Metanotum dense punctate with indistinct minute punctations. Mesepisternum and metepisternum rough, dull, dense punctate. PT not carinate, finely rugose basal 1/3<sup>rd</sup>, apical 2/3<sup>rd</sup> length tessellated with minute punctations; DLP finely, indistinctly rugose; LP tessellated with minute punctations. Apex of fore and mid tibial spurs pointed; inner hind tibial spurs 3/4<sup>th</sup> uniformly broadened, remaining narrow, apex pointed; dorsal view straight, claws bidentate.

**Metasoma:** Disc of metasomal terga shiny, dense and distinctly punctate, T1 marginal zone depression absent, T2, T3, T4 strongly developed. Pygidial plate weakly shiny, dense punctate, triangular, without raised area medially, apex rounded. Sternum rough and dull; S1, S2, S3 and S4 marginal zone well developed.

**Integument colour:** Head black. Mandibles black basally reddened apically. Antenna brownish black. Compound eyes pale white. FOV black. Mesosoma black. Legs reddish brown. Wings greyish brown. Disc of metasomal terga black, marginal brown. Pygidial plate reddish brown.

**Pubescence:** Body pubescence of unilaterally branched on both sides. Clypeus, paraocular area bare. Frons with dense black hairs. Vertex sparse hairy. Scutum, scutellum and metanotum dense hairy with bright brown hairs. DLP, LP, mese and metepisternum dense hairy with long silvery white hairs. Trochanter flocculus of hindlegs complete, silvery white; tibial scopa of brownish hairs. Metasomal hair bands absent. Tuft of white hairs on both sides on first three metasomal segments. Prepygidial, pygidial fimbriae brownish black. Sternal marginal zone sparse hairy with long blackish hairs.

**Male:** Unknown

**Measurements (in mm):** ♀ BL: 13.432; FWL: 8.954; Head Length: 3.101; Head Width: 3.882; Clypeus Length: 0.951; Clypeus Width: 2.274; UICD: 2.565; LICD: 2.769; PLR Length: 0.260; PLR Width: 0.774; Length of AS1: 0.961; AS2: 0.225; AS3: 0.571; AS4: 0.249; AS5: 0.239; FOV Length: 1.870; FOV Width: 0.634.

**Specimens examined:** INDIA, ♀, Bihar: Pusa, 00.IV.1941, (NPC); 2♀♀, Bihar: Pusa, 09.IV.1945, (NPC).

**Distribution:** North India, Pusa (Bihar).

### 3. *Andrena (Melandrena) nigroaenea* (Kirby, 1802)

*Melitta nigroaenea* Kirby, 1802:109.

*Andrena splendens* Imhoff, 1832:1203.

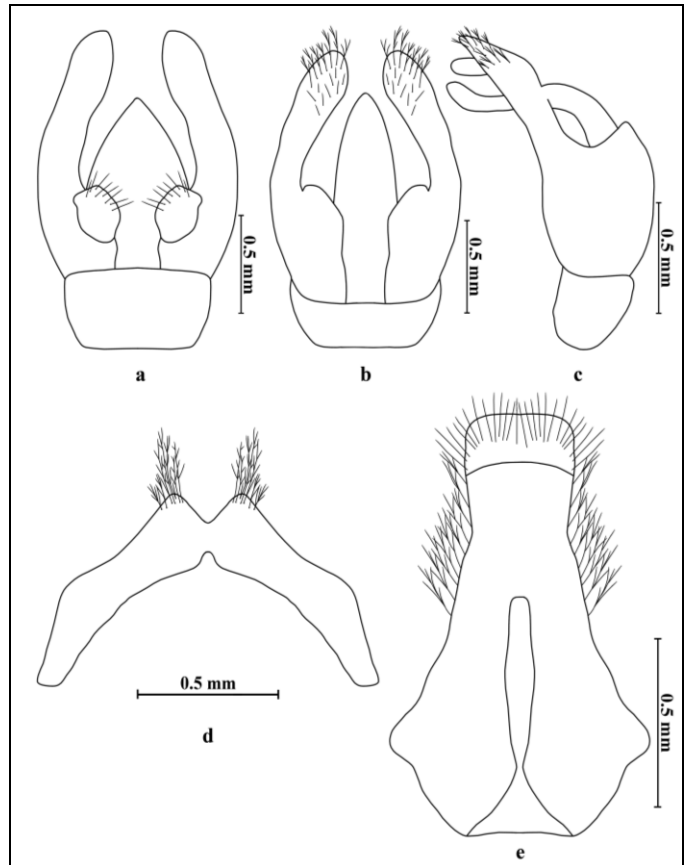
*Andrena bipartita* Lepeletier, 1841:246.

*Andrena serotina* DeStefani, 1889:204.

*Andrena nigroaenea* var *tergestensis* Graeffe, 1902:130.

#### Male: (Fig.3)

**Head:** Head Oval, 1.33x wider than long. Mandibles long, crossing each other at repose, bidentate. PLR trapezoidal with slight emargination. PLR W/L = 2.00. Clypeus rough, dull, weakly finely rugose, 2.14x wider than long, punctations of disc indistinct, minute, dense. UICD/LICD = 0.94. AS3/AS1 = 0.47. Hind margin of vertex rounded.



**Fig 3:** *Andrena nigroaenea* (Kirby) (male), (a) Genitalia dorsal view, (b) Genitalia ventral view, (c) Genitalia lateral view, (d) S7 and (e) S8

**Mesosoma:** Pronotum rough and dull, tessellated with dense minute punctations, without humeral angle, lateral part rounded. Scutum, scutellum and metanotum rough and dull with scattered small punctations. PT not carinate, narrow, basal 1/3<sup>rd</sup> finely rugose, apical 2/3<sup>rd</sup> tessellated with small punctations; DLP, LP and mesepisternum finely rugose, tessellated with indistinct minute punctations. Apex of fore and mid tibial spurs pointed; inner hind tibial spurs 3/4<sup>th</sup> uniformly broadened, remaining narrow, apex pointed, dorsal view straight; claws bidentate.

**Metasoma:** Terga smooth and shiny with small, distinct, sparse punctations, marginal zone depression weakly developed. Pygidial plate absent. S7 homogeneously fused, apically undivided, apical lobes with two distinct developed lobes, apex of apical lobes pointed, conspicuous hair fringe of long hairs medioapically, hollow finger shaped emargination on lower side medially; apical process of S8 more or less of uniform width, without emargination, width of apical process distinctly narrower than basal part, ventrally flat; inner margins of gonocoxite joined by penis valve; dorsal lobe of gonocoxite weakly developed; apical margin rounded; inner margin parallel sided; apical margin of gonoforecepts wider than base (dorsal view), apical margin distinctly narrower than base (ventral view), inner margin of apical part straight to slightly convex and without emargination; shape of penis valve more or less triangular, narrowing apically, apex (dorsal view) rounded, (lateral view) more or less rounded, lateral margin (dorsal view) of basal penis valve parallel sided basally, converging apically.

**Integument colour:** Head black. Compound eyes brown. Mandibles black basally reddened apically. Antenna brownish black. Mouth parts reddish brown. Mesosoma black. Disc of metasomal terga black, marginal brown. Wings greyish brown. Legs reddish brown.

**Pubescence:** Body pubescence unilaterally branched on both sides. Clypeus, SGA and SCA with long dense pale white hairs. POA with long dense black hairs. Vertex and frons with sparse black hairs. GA upper half with dense long black hairs, lower half with pale white hairs. Scutum, scutellum and metanotum dense hairy with dense long pale white hairs. PT bare. DLP, LP, mese and metepisternum with long dense silvery white. Trochanter flocculus of hindlegs incomplete, silvery white. Metasomal hair bands weakly developed. Prepygidial, pygidial fimbriae brownish black colour. Sternum with sparse pale white hairs.

**Female:** Unknown

**Measurements (in mm):** ♂ Body Length: 11.013; Forewing Length: 7.052; Head Length: 2.455; Head Width: 3.275; Clypeus Length: 0.939; Clypeus Width: 2.013; UICD: 2.233; LICD: 2.384; PLR Length: 0.181; PLR Width: 0.362; Length of AS1:0.508; AS2: 0.142; AS3: 0.239; AS4: 0.226; AS5: 0.249.

**Specimens examined:** INDIA, 1♂, Bihar: Pusa, 00.IV.1942, (NPC); 1♂, Bihar: Pusa, 00.V.1944, (NPC).

**Distribution:** Pusa (Bihar).

### Conclusion

The subgenus, *Melandrena* is represented in India by three species viz., *Andrena (Melandrena) patella* Nurse, 1903<sup>[19]</sup>, *Andrena (Melandrena) nitida* (Muller, 1776) and *Andrena (Melandrena) nigroaenea* (Kirby, 1802). These species were first time redescribed here in a more elaborate manner. The diagnostic characters of subgenus *Melandrena* first time established for Indian species. *Andrena patella* and *A. nitida* only females and in *A. nigroaenea* males were reported. The line drawing and identification keys were also provided. We have described only females in case of *A. patella* and *A. nitida* and males in case of *A. nigroaenea*. So, it will open the doors for andrenids bees' investigators to find out and description of males in *A. patella* and *A. nitida* and females in *A. nigroaenea*, respectively. Simultaneously, other species belonging to this subgenera from India. This research will prove quite fruitful for further taxonomic studies on bees of Andrenidae and related family viz., halictidae, colletidae etc.

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