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New faunal records of dung beetles from district Sialkot, Punjab, Pakistan

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Abstract

The study was carried out to explore the dung beetle fauna from district Sialkot, Punjab, Pakistan with emphasizes on the abundance and richness of species, distribution and description from cropland and pastures. Dung beetles specimens were sampled randomly from various parts District Sialkot. The specimens were collected by hand picking within the dung pat and by digging under and near the dung pats in natural pastures and croplands during 2014 - 2015. Specimens were subjected to identification by using standard morphological keys. Total 595 specimens were recorded from the study site belonging to 2 families, 5 tribes, 9 genera, and 25 species out of which four species *Tiniocellus (Tiniocellus) modestus* (Roth, 1851), *Aphodius (Calaphodius) Moestus* (Fabricius), *Aphodius* (*Calamosternus*) *granarius* (Linnaeus, 1767) and *Onthophagus troglodyta* (Wiedemann, 1823) were amongst new records from pakistan. The study emphasized on further exploration of fauna of Scarabaeidae family in the district Sialkot with special reference to ecological parameters.

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Introduction

Dung beetles (Coleoptera: Scarabaeidae; Scarabaeinae) functionally as well as taxonomically very important element of the terrestrial ecosystem (Kakar and Gupta, 2009). Dung beetles are useful as indicators in conservation and global warming studies owing to their specialized regional and local distribution patterns. Beetles in the subfamilies Scarabaeinae and Aphodiinae, are commonly referred as Dung beetles are one of the key insect group that perform various ecological roles such as nutrient cycling, soil aeration, seed dispersal and regulation of enteric parasites and dung breeding dipteran pests (Estrada & Estrada 1991; Mittal 1993; Larsen 2004; Chandra and Gupta, 2013).

The data on systematic studies, spatial and temporal distribution have been reported in the first half of the current decade accounting for major works about dung beetles from this region by Arrow (1931). Dung beetles are distributed globally, with their rich diversity in tropical and savannas (Hanski and Cambefort, 1991).

Dung beetles have been reported from different parts of the world and are represented by, about 8500 species (Halffter and Edmonds, 1982).

A review of available literature stipulates that dung beetle fauna from Pakistan had been poorly explored in the past, however, during last two decades some more works have been carried out in order to explore the dung beetle fauna from Pakistan (Table 1).

The composition and abundance of dung beetle (Coleoptera: Scarabaeidae; Scarabaeinae) fauna from Pakistan has been studied and few taxonomic studies have been found in the literature reporting few more species from Pakistan (Noureen, *et al.*, 2015a). The explorative studies on dung beetle fauna need to be conducted to work out the present status of dung beetles in the various parts of the Pakistan having variability in cropping patterns and systems with varied farming practices. The study site has not been explored for the dung beetle fauna and its impact in the rice growing belt previously which signifies the impact of study. The studies on systematics of dung beetles is necessary to understand bio-indication, decomposition activities and to design a conservation strategy for dung beetles in these areas. Thus, the current study was undertaken in order to explore the dung beetle fauna from district Sialkot for recording dung beetles species diversity, abundance and richness.

Table 1. New Records of Dung beetles Reported from Pakistan during 2014-15.

Species reported	Author (s)
Copris fricator (Fabricius 1787)	Siddiqui *et al*, 2014
Gymnopleurus cyaneus (Fabricius 1798)	
Paragymnopleurus sinuatus ssp. *assamensis* (Waterhouse 1890)	
Garreta dejeanii (Laporte 1840), *Garreta mundus* (Wiedemann 1819)	
Onitis excavatus Arrow 1931,	
Onitis lama Lansberge 1875,	
Onitis punctatostriatus Janssens 1937,	
Onitis singhalensis Lansberge,	
Onitis virens Lansberge 1875	
Sisyphus longipes (Olivier 1789)	
Sisyphus crispatus ssp. *hirtus* Wiedemann 1823.	
Dorcus curvidens Hope (Lucanidae: Dorcinae)	Ahmed and Ratcliffe, 2015
Heteronychus annulatus Bates (Scarabaeidae: Dynastinae	
Rhomborrhina microcephala Westwood (Scarbaeidae: Cetoniinae)	

Species reported	Author (s)
Heliocopris bucephalus	Abbas *et al.* 2015
Oniticellus pallipes (Fabricius, 1781)	Ali *et al.* 2015
Oniticellus spinipes (Roth, 1851)	
Oniticellus cinctus (Fabricius,1775)	
Drepanocerus setosus (Wiedemann, 1823)	
Catharsius (Catharsius) sagax (Quenstedt, 1806),	Noureen *et al.* 2015b
Tiniocellus (Tiniocellus) spinipes (Roth, 1851),	
Oniticellus (Oniticellus) cinctus (Fabricius, 1775)	
Aphodius (Paraphodius) crenatus (Harold, 1862)	

Material and methods

Study Area

The sampling was carried out in the district Sialkot (32°29′33″ N, 74°31′52″ E) which is located at north-east of the Punjab, Pakistan. The characteristic climate of the area is hot and humid during the summer and cold during the winter. Average maximum temperature reaches 46 °C whereas minimum temperature may falls to 22 °C. The average rainfall of the area is about 980 milliliters.

Sampling

The sampling was carried out randomly from different localities during the year 2014-2015. The dung beetles were collected from different habitats that mainly include croplands, pastures and canal banks through pitfall (Larsen and Forsyth, 2005) and handpicking method from district Sialkot, Punjab, Pakistan. Pitfall traps used for capturing dung beetles were placed 25 m apart from each other at each sampling site within the study area.

Insect collection and preservation

The specimen collected were killed by using potassium cyanide (KCN) killing bottle and preserved by using standard techniques for further studies in the Systematics and Pest Management Laboratory, University of Gujrat. The specimens were preserved in the insect collection box after subjecting to identification.

Specimen identification

The sample identification was carried out by examining the samples under binocular microscope (CZM-6) and high resolution digital camera was used to capture the microscopic images of the small beetles.

Insects were identified by using dichotomous keys and literature (Arrow, 1931;Jessop, 1986; Noureen *et al.* 2015b). After identification and labelling the specimens were deposited in the Systematics and Pest Management Laboratory, University of Gujrat.

Results and discussion

A total of 595 dung beetle specimens were collected during the sampling that included specimens from all three guilds i.e. tunnelers, dwellers and rollers. The specimens studied belong to 25 species, representing 2 families, 5 tribes and 9 genera. This comprehensive data reported four new species, *Tiniocellus* (Tiniocellus) *modestus* (Roth, 1851), *Aphodius* (*Calaphodius*) *moestus* Fabricius, *Aphodius* (*Calamosternus*) *granarius* (Linnaeus, 1767) and *Onthophagus troglodyte*, reported first time from Pakistan. According to functional guild tunnellers were dominant species throughout the sampling area which may be attributed to the availability of better moisture, dung of preference and soil type that serves as better nesting habitat for the tunnellers. The attraction to a specific dung type may be attributed to age, size, water content and texture of the dung matter (Anderson and Coe 1974; Sowig and Wassmer 1994).The variations in climatic conditions affects the distribution and diversity of dung beetles and the species appearing throughout the year differs with the temperature variations. The comparative abundance of tunnelers and rollers may be attributed to fragmentation of agricultural land, low mammalian diversity and dung availability, and the texture of the soil (Venugopal, *et al.* 2012).

The data showed maximum number of species collected belong to Scarabaeinae: *Onitis* (5 species), *Catharsius* (3 species), *Onticellus* (3 species), *Onthophagus* (5 species), *Tiniocellus* (1 specie), *Drepanocerus* (3 species), *Helicopris* (2 species) and 3 species representing family Aphodiinae:

The study indicated that a comprehensive survey of dung beetles fauna need to be conducted in adjacent districts of Punjab to explore the basic diversity, abundance and richness of dung beetles in these areas to exploit their ecological value. The study also emphasized that there is variations in the species diversity, abundance and richness in different areas of the country explored by various researchers indicating impact of different ecological conditions and human activities on the dung beetle faunal status (Siddiqui *et al*, 2014; Ahmed and Ratcliffe, 2015; Abbas *et al*. 2015; Ali *et al*. 2015; Noureen *et al*. 2015b). The dung beetle fauna explored from this area in dicated variability in the species composition and abundance need to be explored extensively.

Systematics of newly reported dung beetle species from Sialkot, Punjab, Pakistan

Subfamily Aphodiinae Leach, 1815

Tribe Aphodiini Leach, 1815

Subtribe Aphodiina Leach, 1815

Key to the species of genus Aphodius

1. Head not tuberculate in middle; not uniformly coloured; pronotum black with lateral sides yellow; elytra yellow with black strips.....*Aphodius* (*Calaphodius*) *moestus* Fabricius

- Scutellumpentagonal and narrowed at base,; head with tubercles on frontal suture; Pronotum with distinct, complete basal margin.....*Aphodius* (*Calamosternus*) *granaries* (Linnaeus)

1. Aphodius (Calaphodius) Moestus (Fabricius)

Material Examined:

Sialkot (32°29′33″ N, 74°31′52″ E), 1.IV.2015 (3♂,5♀), 6.V.2015 (2 ♂, 1♀).23.VI.2015 (4 ♂,3♀.)

Diagnostic Characters

Elytra pale yellow in color, with black markings clearly visible on elytra. Head completely black. Centre of pronotum, scutellum also black. Scutellum elongate and pointed towards apex with surface coriaceous having few minute punctures at base. Elytra with fourth interval in last half and sixth in anterior two third black, smooth and moderately shining. Margins and base of pronotum is pale yellow, pronotum finely and sparsely punctuate. (Fig. A).

Male female ratio: 18 specimens: 9 ♂: 9 ♀ (1♂:1♀)

Fig. A. *Aphodius moestus.*

2. Aphodius (Calamosternus) granaries (Linnaeus, 1767)

Sialkot (32°29′33″ N, 74°31′52″ E), 4.IV.2015 (1 ♂, 2 ♀), 11.V.2015 (3 ♂,4♀).17. VI.2015 (3 ♂, 4 ♀.), 15. VII.2015 (2 ♂, 2 ♀), 21.VII.2015 (2 ♂, 1♀).

Diagnostic Characters

Length 4-6 mm. See subgenus diagnosis above. A highly variable species as indicated by the large synonymy. Males have broad pronotum and smoother clypeus; females have narrower pronotum and rugose clypeus. Elytral intervals very finely punctuate. Black in color and shining. Body convex and short, about 7mm length. Pronotum with sparsely placed punctured, deep punctures. Head with median interrupted tubercle.♂ Broad pronotum and smoother clypeus; ♀ have narrower pronotum and rugose clypeus.

Male female ratio: 24 specimens: 11♂: 13♀
Subfamily Scarabaeinae Latreille, 1802
Tribe Onthophagini

Meta tibiabearing single spur, middle coxae jointed, not far apart.....1
1 Four posterior tarsi not broadly dilated; Terminal margin of fore tibiae generally oblique; anterior angles of pronotum not hollowed beneath.....*Onthophagus* Latreille

- Elytra bears minute granules at intervals, pronotum densely punctured..... *Tiniocellus* Peringuey.

Fig. B. *Aphodius granarius.*

3. Onthophagus troglodyte (Wiedemann, 1823)
Material Examined
Sialkot (32°29′33″ N, 74°31′52″ E), 2.IV.2015 (2 ♂, 1 ♀), 27.V.2015 (2 ♂, 3♀), 19. VI.2015 (1♂, 2 ♀.)

Diagnostic Characters
Elytra pale yellow with black markings of zigzag pattern. Body covered with setae. The pronotum is metallic black with distinct punctures. Head is shining with clypeus feebly emarginated. The pygidium is pitted (Fig. C).

Male female ratio: 24 specimens: 05 ♂: 06 ♀
Subfamily Scarabaeinae Latreille, 1802
Tribe Oniticellini (d´Orbigny, 1916)

Fig. C. *Onthophagus troglodyta.*

4. Tiniocellus (Tiniocellus) modestus (Roth, 1851)
Sialkot (32°29′33″ N, 74°31′52″ E), 19. V.2015 (1♂, 2 ♀.), 24. VI.2015 (3♂, 2 ♀.), 24. VI.2015 (2♂, 1 ♀.)

Diagnostic Characters
Black pronotum with greenish metallic lustre. Elytra brown with dull black patches. Pronotum finely punctured and bear a median basal depression. Elytral apex bears hair like setae of white color. (Fig. D).
Male female ratio: 24 specimens: 06 ♂: 05 ♀

Fig. D. *Tiniocellus modestus.*

Conclusion

Dung beetles sampled from various parts District Sialkot, Punjab, Pakistan recognized the presence of species that have not been reported from this part of the world. The data collection indicated the presences of 24 species were found belonging to 2 families, 5 tribes, 9 genera. *Tiniocellus (Tiniocellus) modestus* (Roth, 1851), *Aphodius (Calaphodius) Moestus* (Fabricius), *Aphodius* (*Calamosternus*) *granarius* (Linnaeus, 1767) and *Onthophagus troglodyta* (Wiedemann, 1823) were new records from Pakistan. The study emphasizes that dung beetle fauna in various ecological zones of the country need to be explored extensively.

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