

## FIRST RECORDS OF TWO SPECIES OF GENUS *MESSOR* FOREL, 1890 (FORMICIDAE: MYRMICINAE) ALONG WITH TROPHIC ASSOCIATIONS WITH APHIDS FROM POTHWAR REGION OF PAKISTAN

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### ABSTRACT

Two species of genus *Messor* Forel, 1890, namely *Messor instabilis* (Smith, 1858) and *Messor himalayanus* (Forel, 1902) have been recorded for the first time from Pothwar region of Pakistan. Trophic associations of both species with aphid partners are reported for the first time from Pakistan. Main identification characters supported with micro-photographs, measurements and distribution are given. A key to both species based on worker caste has also been given.

**Key words:** New records, *Messor*, Hymenoptera, Myrmicinae, Trophic associations, Pothwar, Pakistan

### INTRODUCTION

Genus *Messor* Forel, 1890 can be differentiated from other genera of Myrmicinae (Hymenoptera: Formicidae) on the basis of following typical characters, i.e. head square, striated longitudinally, mesosoma narrower than the head, gaster oval (Bingham, 1903). *Messor* was described for the first time as a subgenus of *Aphenogaster*, later on it was treated as a subgenus of *Stenammina* by Emery (1895). However, Bingham (1903) named *Messor* as a valid genus on the basis of type species *Formica barbara*. Bolton (1982) synonymized the genus *Veromessor* with *Messor*.

Members of *Messor* are considered as micro engineers or soil harvester due to their nest building activities of the soil ecosystem especially in arid region, and also affecting the surface and sub-surface in the rangeland (Ghobadia *et al.*, 2016). Harvester ants of this genus perform the activities of seed collection and storage in the galleries of soil chamber (Hölldobler and Wilson, 1990). As a result of these activities, physical, chemical and hydrological features of the soil are changed (Cammeraat *et al.*, 2002). Moreover, seed predation activity of these ants enhances evolutionary fluctuations in structure and reproductive behavior of plants (Harper *et al.*, 1970; Louda, 1989). These harvester ants are also important from ecological point of view, as they are involved in nutrient recycling and micro-climate modification in plant communities (Boulton *et al.*, 2003; Grasso *et al.*, 2004; Azcárate and Peco, 2007; Martinez - Duro *et al.*, 2010 and Majer *et al.*, 2011).

*Messor* is a widely distributed genus with 118 known species (Bolton, 2018). The species of this genus were mainly reported by many taxonomists from Oriental and Palearctic regions, e.g. Bingham (1903) India, Marko *et al.*, (2006) Israel, Vonshak and Hirsch (2009) Romania and Guénard and Dunn (2012) China. As far as Pakistan is concerned limited work was done on ants by Umair *et al.*, 2012, Bodlah *et al.*, 2016 and Bodlah *et al.*, 2017. So various surveys were conducted to explore the ant fauna of Pakistan. These two species of genus *Messor* are reported for the first time from Pakistan.

**Materials and Methods:** *Messor* specimens were collected from district Attock, Jhelum, Bahawalpur (Uch Sharif), Muzaffargarh (Alipur), Layyah, Mansehra (Balakot) and forest areas of Rawalpindi and Islamabad in 2015-2017 by using aspirator and net sweep. Ants were also collected from plants along with their aphid partners and preserved directly in 75% ethanol. Mounting of ant specimens was done using triangular card. Aphids were identified using Blackman and Eastop (2008) and Blackman and Eastop (2012). *Messor* individuals were identified up to species level with help of Bingham (1903). Measurements and indices of minor and major workers were done using stage and ocular micrometer. Micrographs were prepared with the help of NIKON 1500 SMZ stereo microscope. Identified species have been deposited in Biosystematics Laboratory, Department of Entomology, Pir Mehr Ali Shah Arid Agriculture University Rawalpindi, Pakistan.

### RESULTS AND DISCUSSION

***Messor instabilis*** (Smith, 1858): Fig. 1 (a-c)

*Atta instabilis* Smith, 1858

*Aphaenogaster Barbara*, Linn., var. punctate Forel, 1886

*Aphaenogaster barbara sordida* Forel, 1892

*Formica binodis* Fabricius, 1775

*Formica juvenilis* Fabricius, 1804

*Formica megacephala* Leach, 1825

*Messor barbarus ambiguus* Santschi, 1925

*Myrmica rufitarsis* Foerster, 1850

*Messor barbarus nigricans* Santschi, 1929

**Identification characters:** Head square, as broad as long, opaque, a little striated, ocelli absent. Antennae

shorter, scape little longer than top of head, flagellum gradually thicker toward apex. Eyes somewhat broader in width than length, placed above the middle of head. Clypeus finely carinate. Mandibles long, striated longitudinally, denticulate at inner margin. Mesosoma transversally striated. Pronotum broader than meso and metanotum, mesonotum compressed laterally, metanotum without spines or teeth. Petiole and post petiole equal in width. Gaster smooth and oval.

**Coloration:** Head and mesosoma dark shining red; gaster black. Scape of antennae and tarsi pale.



**Fig. 1 (a-c).** External morphology of *Messor instabilis* worker (a) Head in frontal view (b) Habitus in dorsal view (c) Habitus in lateral view.

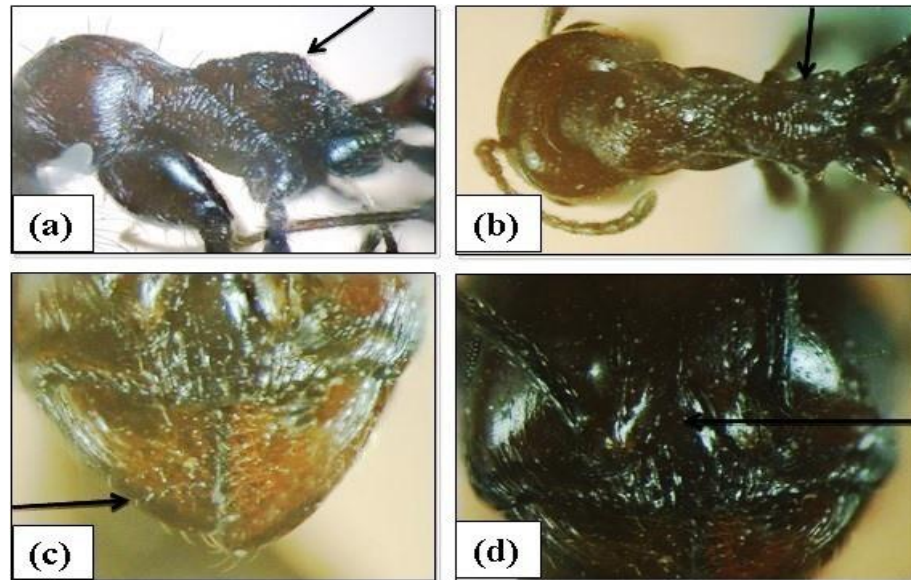


Fig. 2 (a-d). *Messor instabilis* (Smith, 1858) (a) Metanotum unarmed or without teeth like structure, (b) Mesosoma coarsely and transversally striated (c) Mandibles longitudinally striated (d) Clypeus carinate.

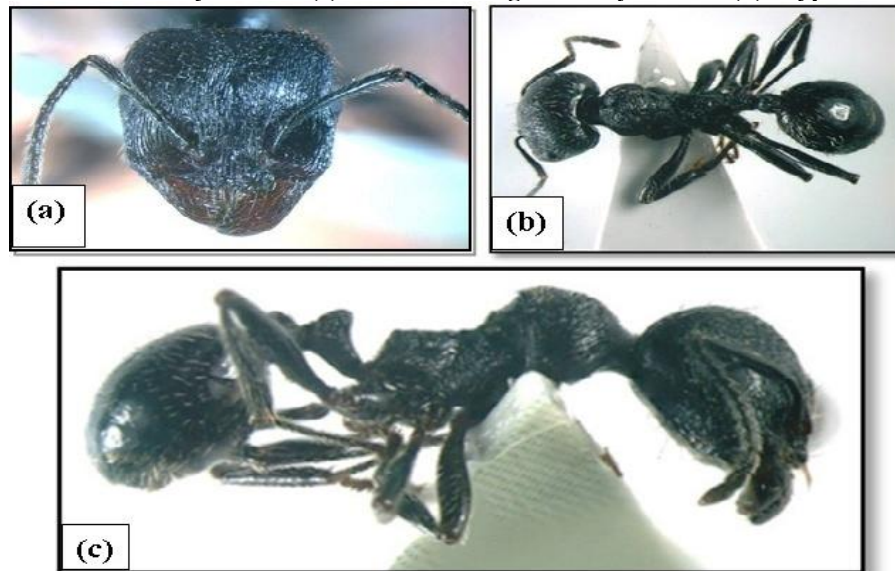


Fig. 3 (a-c). External morphology of *Messor himalayanus* worker (a) Head in full-face view (b) Body in dorsal view (c) Body in lateral view.

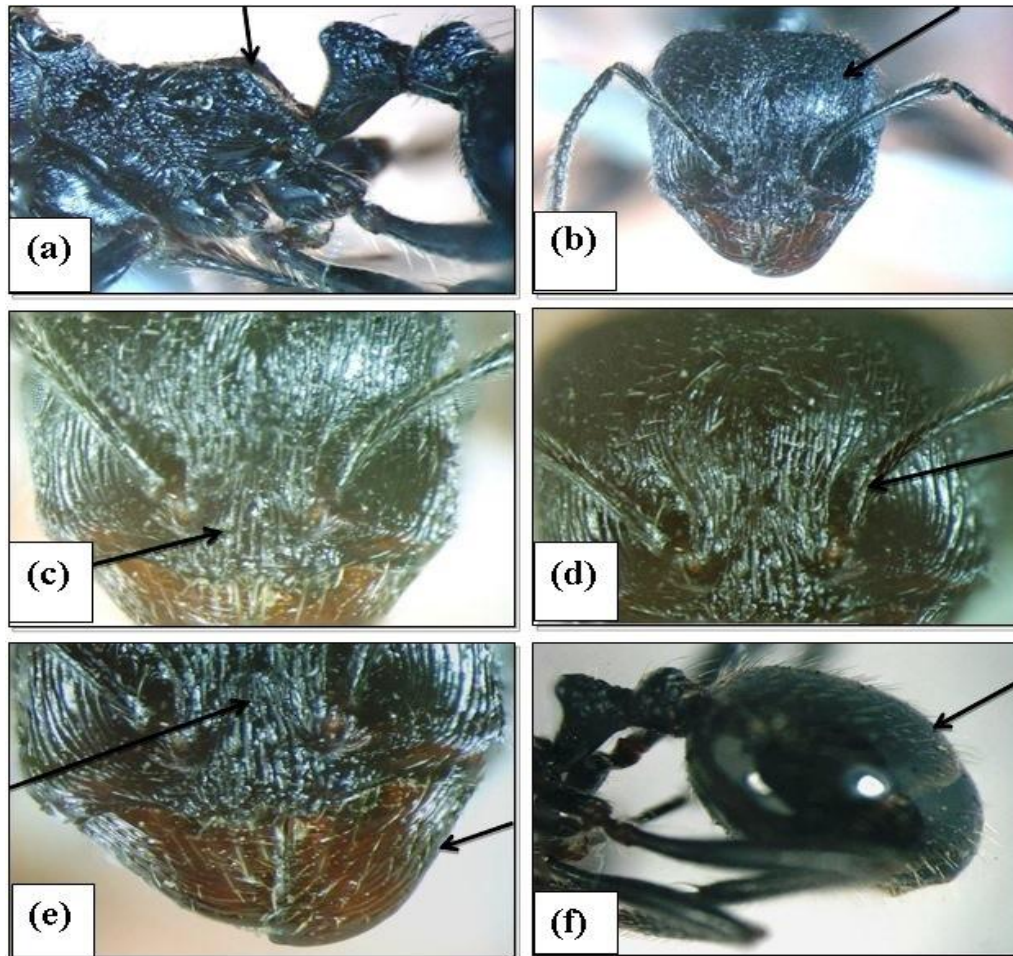


Fig. 4 (a-f). *Messor himalayanus* (Forel, 1902) (a) Metanotum bidentate (b) Head longitudinally striated (c) Clypeus carinate (d) Emarginated frontal carinate (e) Clypeus triangular in shape (f) Gaster covered with yellowish erect hair.

#### Distribution

India, Israel, Romania, China (Bingham, 1903; Marko *et al.*, 2006; Vonshak and Hirsch, 2009; Guénard and Dunn, 2012)

**Measurements (mm) of Worker:** Head length 1.6 mm; Head width 1.6 mm; Scape length 1.3 mm; Eye length 0.36 mm; Eye width 0.38 mm; Mesosoma length: 2.2 mm; Pronotum width 1 mm; Petiole length 0.2 mm; Petiole height: 0.33 mm; Petiole width 0.4 mm; Post petiole length 0.2 mm; Post petiole width 0.4 mm; Post petiole height: 0.5 mm; Gaster length: 1.60 mm; Body length 8.5 mm; Cephalic index: 100; Scape index  $\gamma$ : 81.25; Scape index  $\delta$ : 81.25; Petiole index: 60.60; Post petiole index: 40

**Material examined:** 15♀, Forest area, under stone surface, Trail 5 (Islamabad) (N 33°45.247 E 73°05.146), 2070 ft. elev., 12. iii. 2015; 35♂, Forest area, under stone surface, Murree (Rawalpindi) (N 33°51.008 E 73°19.162), 3800 ft. elev., 27. vi. 2015; 12♀, Forest

area, under stone surface, Trail 5 (Islamabad) (N33°45.247 E73°10.69), 2070 ft. elev., 21. v. 2016; 20♀, Forest area, tree bark, Pir Sohawa (Islamabad) (N33°78.82 E73°05.146), 3432 ft. elev., 09. vi. 2016; 35♂, Forest area, tree bark, Kachnar Park (Islamabad) (N33°40.602 E73°04.574), 1978 ft. elev., 05. viii. 2016; 17♀, Forest area, tree bark, Neela Sand (Rawalpindi) (N33°09.516 E73°22.007), 3027 ft. elev., 04. ix. 2016; 25♀, Forest area, under stone surface, Trail 6 (Islamabad) (N36°14.359 E74°30.037), 2095 ft. elev., 11. ix. 2016; 21♀, Forest area, under stone surface, Chattrar (Rawalpindi) (N33°39.433 E73°17.607) 1777 ft. elev., 12. x. 2016; 10♀, Forest area, under stone surface, Modeih Sayedan (Rawalpindi) (N33°39.43 E73°22.007), 2145 ft. elev., 25. iii. 2017; 21♀, Agricultural field, Uch Sharif (Bahawalpur) (N29°23.274 E71°07039), 384 ft. elev., 02. v. 2017; 12♀, Agricultural field, Uch Sharif (Bahawalpur) (N29°23.274 E71°07039), 384 ft. elev., 23. vi. 2017; 08♀, Agricultural field, Uch Sharif (Bahawalpur) (N29°23.274 E71°07039), 384 ft. elev., 28.

vi. 2017; 11♂, Tree bark, Pindi Gheb (Attock) (N33°1424.83 E72°15 57.9), 1020 ft. elev., 08.vii. 2017; 26♂, Soil galleries, Fateh Jang (Attock) (N33°755.74 E72°362.47E), 1679 ft. elev., 22. vii.2017; 12♂, Forest area, under stone surface, Balakot (Mansehra) (N34°898.42 E73°747.79), 3242 ft. elev., 11. x. 2017.

**Trophic associations with aphids:** 5♂, Kamrial (Attock): (N33°54.762 E72°28.237), 1846ft. elev., 21.xi.2016 *Setaria viridis* (Green Foxtail); 3♂, Kamrial (Attock): (N33°54.762 E72°28.237), 1846ft. elev., 2.x.2016 *Setaria viridis* (Green Foxtail)

**Comments:** This species was collected from Murree (Rawalpindi), Kachnar Park (Islamabad), Uch Sharif (Bahawalpur), Balakot (Mansehra), Pindi Gheb (Attock) and Fateh Jang (Attock). During present study it was observed performing harvesting activities like seed dispersion. Nest was observed under the ground surface near dense vegetation and water source.

*Messor instabilis* was found associated with black bean aphid (*Aphis fabae*) on *Setaria viridis* (Green Foxtail) from Kamrial area of district Attock. Ants were found getting honey dews secretion from aphid cornicles. All the collected specimens were identified and found similar to the published description of species by (Bingham, 1903). *M. instabilis* is reported for the first time in association with an aphid species from Pakistan, so it is a new country record.

#### Key to the species of genus *Messor* of Pakistan based on worker caste

1 Metanotum without spines or teeth (Fig.2a); Scape of antennae little longer than top of head (Fig. 1a); Head and mesosoma dark reddish (Fig. 1a, b) ..... *Messor instabilis* (Smith, 1858)

— Metanotum denticulate or sub bi-dentate dorsally (Fig. 3a); Scape of antennae shorter than top of head (Fig. 3a); whole body black and shining (Fig.3c).....*Messor himalayanus* (Forel, 1902)

***Messor himalayanus* (Forel, 1902):** Fig. 3 (a-c)

*Stenammina* (*Messor*) *barbarum himalayanum* Forel (1902)

**Identification characters:** Head somewhat shiny, rectangular, longer than width with emarginated frontal carina, without ocelli, and finely longitudinally striated. Eyes longer than broader placed in the middle of head. Clypeus finely longitudinally striated forming a triangular shape with distinct clypeal carina. Mandibles striated longitudinally and reddish brown. Scape of antennae shorter than top of head, flagellum slightly thickened toward apex. Pronotum broader than meso and metanotum, mesonotum slightly raised metanotum transversally striated and bidentate. Petiole slightly longer in length than width having reticulate striation.

Gaster smooth, highly polished having yellowish erect hairs.

**Coloration:** ♀ Maj. Whole body black and shiny. Mandibles brownish. ♀ Med. Body is not black shining. ♀ Min. A little black, shining than med♀ .

**Distribution:** India, China (Bingham, 1903; Guénard and Dunn, 2012)

**Measurements (mm) worker:** Total length 4.5-8.5 mm; Head length 1.4-2.0 mm; Head width 0.27-2.2 mm (including eyes in width); Eye length 0.2-0.4 mm; Eye width 0.17-0.27 mm; Prothorax width 0.8-1.2 mm; Thorax length 1.8-2.3 mm; Petiole length: 0.56-0.85 mm; Petiole height: 0.52-0.62; Petiole width: 0.4-0.6 mm; Post petiole length: 0.3-0.4 mm; Post petiole width: 0.3-0.5 mm; Post petiole height: 0.67-0.70 mm; Scape length: 1.1-1.5 mm; Cephalic index: 90.90-518; Scape index 1: 75-78.57; Scape index 2: 68.18-407.40; Petiole index: 107.69-137.0; Post petiole index: 44.77-57.14.

**Material examined:** 17♂, Forest area, under stone surface, Pir Sohawa (Islamabad) (N33°44.4170 E73°24.47), 2701 ft. elev., 22. ix. 2015, leg; 26♂, Forest area, Neela Sand (Rawalpindi) (N33°39.516 E73°23.007), 2153 ft. elev., 29. x. 2015 leg; 10♂, Forest area, under stone surface, Kotli sattian (Rawalpindi) (N33°41.902 E73°30.612), 4136 ft. elev., 19. xi. 2015; 06♂, Forest area, soil nest, Osia (Murree) (N33°43.255 E73°02.150), 4861 ft. elev., 17. ii. 2016; 16♂, Forest area, soil nest, Pir Sohawa (Islamabad) (N33°7882 E73°10.69), 4861 ft. elev., 18. iv. 2016; 10♂, Forest area, soil nest, Neela Sand (Rawalpindi) (N33°9.516 E73°22.007), 3027 ft. elev., 21. v. 2016; 10♂, Forest area, soil nest, Neela Sand (Rawalpindi) (N33°51.008 E73°19.162), 4861 ft. elev., 26. iv. 2017.

**Trophic associations with aphids:** 8♂, Neela Sand (Rawalpindi) (N33° 9.516 E 73°22.007) 3027ft. elev., 09.iv.2016 *Parthenium hysterophorus* (Parthenium weed); 4♂, Chara Pani (Rawalpindi) (N33°51.013E73° 19.156)3809ft.elev.,11.xi.2016 *Parthenium hysterophorus* (Parthenium weed), 2♂, Neela Sand (Rawalpindi) (N33°9.516E73°22.007) 3027ft.elev., 19. iii.2016 *Parthenium hysterophorus* (Parthenium weed); 7♂, Chara Pani (Rawalpindi) (N33°51.013E73° 19.156) 3809ft.elev., 21.xi.2016 *Parthenium hysterophorus* (Parthenium weed).

**Comments:** *M. himalayanus* closely related to *M. instabilis* but can be separated distinctly; metanotum posteriorly dentate or sub-dentate in *M. himalayanus*, while metanotum wholly unarmed in *M. instabilis* (Bingham, 1903). This species was mostly observed in forest areas of Rawalpindi and Islamabad. During

collection, ants were observed under stone surface forming long interconnected galleries.

This ant species was found in association with *Aphisgossypii* on *Parthenium hysterophorus* (Parthenium weed) from forest area of Neela Sand and Charapani of district Rawalpindi. Aphids were present in abundance on the buds and leaves sucking sap. Ants were moving on the branches and also present along the group of aphids for getting honey dew secretion from them. All the observed specimens were collected, identified and found similar to the species description by Bingham (1903). *M. himalayanus* is reported for the first time in association with an aphid species from Pakistan, so it is added to the fauna as new country record.

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