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Myrmica nefaria sp.n. (Hymenoptera: Formicidae) – a new social parasite from Himalaya

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Abstract

Myrmica nefaria sp.n., a new social parasite, is described from Indian Himalaya with notes on its ecology. Workers, gynes and males of this species, as well as workers of the host species have been collected. The species differs well from all already described socially parasitic species of *Myrmica*, and is the second socially parasitic species recorded from Himalaya. This new species seems to follow Emery's rule in the strict sense, as it somewhat resembles morphologically its host, *Myrmica rupestris* FOREL, 1902, and might have evolved from its host. Based on some other features it appears that this parasitic species is younger than its host. This discovery is bound to contribute a lot in the field of evolutionary biology in terms of speciation and origin of social parasitism.

Key words: Social parasite, ants, *Myrmica nefaria* sp.n., new red list species, *Myrmica rupestris*, *Myrmica ereptrix*, ecology, speciation, evolutionary biology, Palaearctic, Himalaya, India.

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Introduction

Social parasitism in ants has been a subject of interest for biologists since the time of Charles Darwin. Many aspects of evolution and speciation are related to it, nowadays it is also considered as an evidence for sympatric speciation (BUSCHINGER 1986, 1990, 2009, SAVOLAINEN & VEPSÄLÄINEN 2003, JANSEN & al. 2009, 2010, LEPPÄNEN & al. 2011). Recently a comprehensive review on social parasitism in ants has been presented by BUSCHINGER (2009). The parasitic interactions have been categorized into four different types: xenobiosis, where guests are distantly related to host; temporary parasitism, where the parasitic species depends on host only during founding phase of new colonies; permanent parasitism with slavery (dulosis), where the parasitic species depends upon host throughout their life; and eventually inquilinism, where parasitic gynes coexist with host gynes. Various reasons like polygyny, territorial behaviour, predation and, of course, high altitude environmental stress have been thought of, which lead to social parasitism. As per estimates a very small fraction of ants occur as social parasites (about 230) of more than 12,500 ant species known to date (BUSCHINGER 2009).

In the genus *Myrmica*, which in the Old World is represented by 144 valid species, all the known social parasitic species are attributed to *Myrmica* itself (RADCHENKO & ELMES 2010, BHARTI & SHARMA 2011a, b). These socially parasitic species of *Myrmica* were analyzed in detail by RADCHENKO & ELMES (2003). Twelve inquilines are currently recognised in *Myrmica*, of which one (*M. symbiotica* MENOZZI, 1925) is likely a pseudogyne worker (RADCHENKO & ELMES 2003, 2010) and one (*M. microrubra* SEIFERT, 1993, microgyne of *M. rubra*) which was of dubious species status was synonymised by STEINER & al. (2006) and recently its synonymy has been reconfirmed by RADCHENKO & ELMES (2010). An additional questionable inquiline was described based on its aberrant morphology only, *M. schenckioides* BOER & NOORDIJK, 2005, now synonymised with *M. schencki* VIERECK, 1903 by RADCHENKO & ELMES (2010). Five *Myrmica* species are considered as temporary social parasites because they show some of the characters of the inquiline syndrome, although they are mostly found independently (JANSEN & al. 2009).

From Himalaya, to the present date only one parasitic species, *Myrmica ereptrix* BOLTON, 1988 has been reported. This species has extremely exaggerated parasitic characteristics, especially a very conspicuous, extremely wide petiole and post-petiole with well-developed large ventral lobes, and hind tibiae with narrow, conspicuous spurs which are feebly and finely pectinate. Of the Himalayan *Myrmica* fauna about 94% is endemic (BHARTI 2008a, RADCHENKO & ELMES 2001, 2010) and quite distinct from the rest of the Palaearctic *Myrmica* fauna. The Himalaya range forms a formidable isolation barrier that has led to this endemism, especially in the genus *Myrmica*. RADCHENKO & ELMES (2001, 2010) suggested that the species isolated in this region represent "old lineages" which have diversified in situ in this region. This thinking has been substantiated by recent discoveries of new species from the region (BHARTI & SHARMA 2011a, b). Therefore, the already reported socially parasitic *M. ereptrix* from Himalaya (which follows Emery's rule which states that most of the social parasites and their hosts are closely related, having a common ancestor) might have originated and evolved here along with its host species. *Myrmica nefaria* sp.n. seems to follow Emery's rule as well and is morphologically similar to its host *Myrmica rupestris* FOREL, 1902, which is

widely distributed in the Himalayan region. The long scape in case of male of this new species indicates that this parasitic species is quite younger in its origin compared to the host species.

Material and methods

The specimens were collected from a nest and were preserved in 70% alcohol. Taxonomic analysis was carried out on a Nikon SMZ-1500 stereo zoom microscope. Digital images were captured using Auto-Montage software (Syncroscopy, Division of Synoptics, Ltd). Later, images were cleaned as per requirement with Helicon Filter five and Adobe Photoshop CS. For morphological measurements (in mm) and indices I used the definitions below, following RADCHENKO & ELMES (2010):

Measurements:

AH Height of alitrunk, measured from upper level of mesonotum perpendiculary to level of lower margin of mesopleuron (queens and males).

AL Diagonal length of alitrunk seen in profile, from anterior end of neck shield to posterior margin of propodeal lobes (workers) and from most anteriodorsal point of alitrunk to posterior margin of propodeal lobes (queens and males).

ESD Distance between tips of propodeal spines in dorsal view.

ESL Maximum length of propodeal spine in profile, measured along spine from its tip to deepest point of propodeal constriction at base of spine.

FLW Maximum distance between outer borders of frontal lobes.

FW Minimum width of frons between frontal carinae.

HL Maximum length of head in dorsal view, measured in a straight line from anterior point of clypeus (including any carina or ruga, if they protrude beyond anterior margin) to mid-point of occipital margin.

HW Maximum width of head in dorsal view behind eyes.

PH Maximum height of petiole in profile, measured from uppermost point of petiolar node perpendicularly to imaginary line between anteroventral (just behind subpetiolar process) and posteroventral points of petiole.

PL Maximum length of petiole from above, in dorsal view, measured from posterodorsal margin of petiole to articulation with propodeum. The petiole should be positioned so that measured points lay on the same plane.

PNW Maximum width of pronotum in dorsal view (workers).

PPH Maximum height of post-petiole in profile from uppermost to lowermost point, measured perpendicularly to tergo-sternal suture.

PPL Maximum length of post-petiole in dorsal view between its visible anterior and posterior margins.

PPW Maximum width of post-petiole from above / in its dorsal view.

PW Maximum width of petiole in dorsal view.

SCL Length of scutum + scutellum in dorsal view (queens and males).

SCW Maximum width of scutum in dorsal view (queens and males).

SL Maximum straight-line length of scape from its apex to articulation with condylar bulb.

Indices:

Cephalic	CI = HL / HW
Frontal	FI = FW / HW
Frontal lobe	FLI = FLW / FW
Petiolar-1	PI_1 = PL / PH
Petiolar-2	PI_2 = PL / HW
Petiolar-3	PI_3 = PW / HW
Post-petiolar-1	PPI_1 = PPL / PPH
Post-petiolar-2	PPI_2 = PPH / PPW
Post-petiolar-3	PPI_3 = PPW / PW
Post-petiolar-4	PPI_4 = PPW / HW

Propodeal spine length, ESLI = ESL / HW

Propodeal spine width, ESDI = ESD / ESL

Scape-1	SI_1 = SL / HL
Scape-2	SI_2 = SL / HW

Acronyms of depositories:

BMNH The Natural History Museum, London (= British Museum Natural History), U.K.

PUAC Punjabi University Patiala, Ant Collection at Department of Zoology and Environmental Sciences, Punjabi University, Patiala, Punjab, India.

Description of *Myrmica nefaria* sp.n.
(Figs. 1 - 17, Tabs. 1, 2)

Type material: Holotype (alate gyne) and paratypes (62 alate gynes, five workers and four alate males, collected together with 42 host workers, all from the same nest): India, Himachal Pradesh, Solang Valley (32.312° N, 77.1556° E), 2469 meters a.s.l., 20.VI.2010, leg. H. Bharti. Holotype and paratypes together with host series are in PUAC (DST code-1594) and some of the paratypes will be deposited in BMNH.

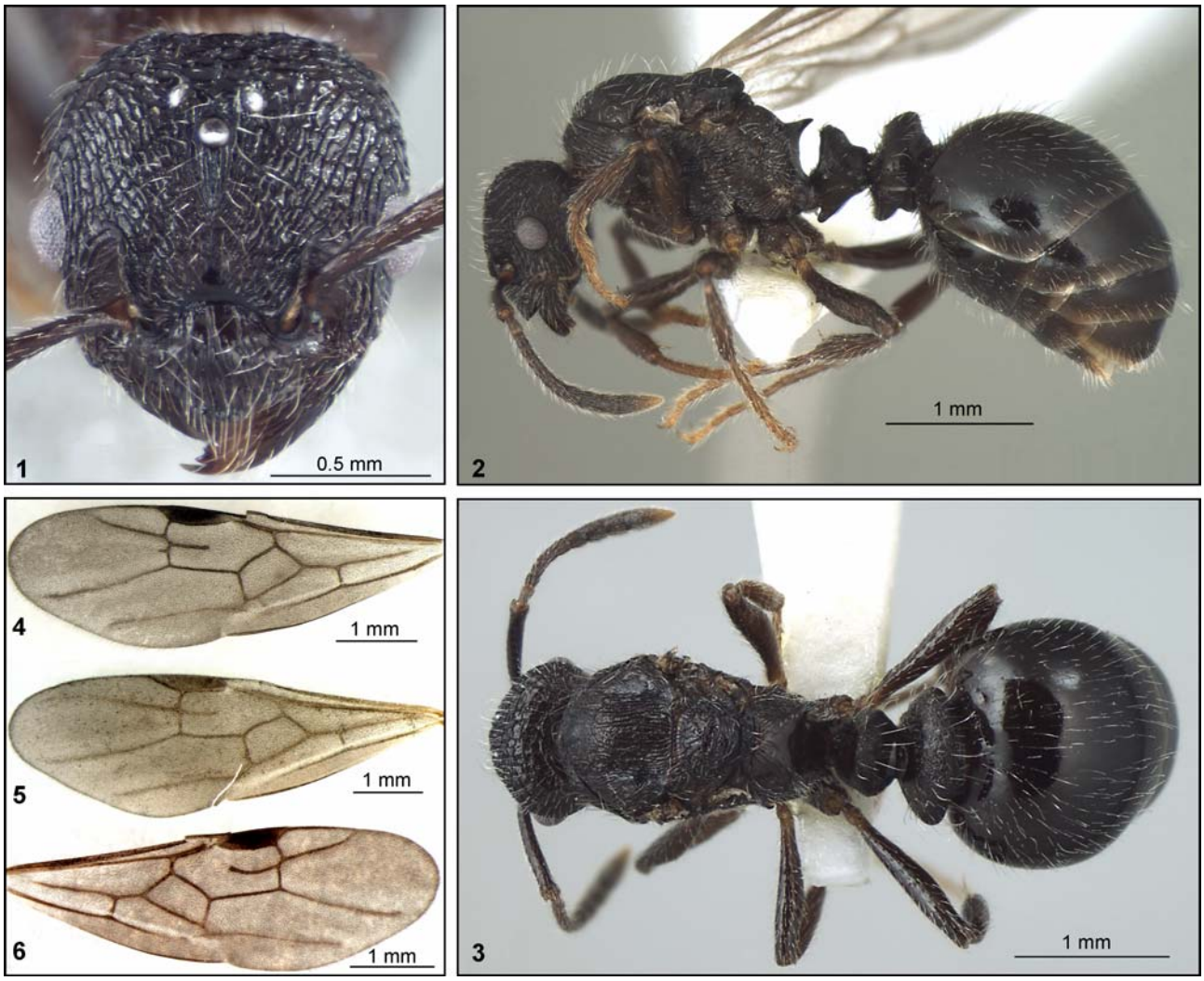
Description of gyne (Figs. 1 - 6): Head much longer than broad, little broader posteriorly than anteriorly, occipital margin straight, sides convex. Mandibles with seven teeth (apical tooth largest, preapical larger than 3rd one, remaining teeth small), mandibles finely longitudinally rugulose and with punctures. Surface of head densely and quite coarsely rugoso-reticulate, with very fine sculpture diverging from frontal triangle, and at level of anterior margin of eyes rupturing into reticulations with shallow punctures between them, reticulations becoming wider, irregular on rest of head. Clypeus convex, shiny, longitudinally rugulose, rugulae absent on posterior region, spaces between them minutely punctured but shiny, median portion of clypeus raised; anterior clypeal margin slightly prominent medially, without notch. Frontal triangle deep, smooth and shiny; longitudinal groove from tip of triangle to anterior ocellus with deep pit at midlength; frontal carinae short, curving outwards, merging with rugae that surround antennal sockets. Antennae 12-segmented, densely punctated except for scape and first funicular segment, which is minutely punctated; scape slender, narrow, weakly curved at base without any trace of angle or carina, widening towards apex, just extending beyond posterior margin of head, antennae with oblique short hairs and with pubescence on apical five segments. Eyes large, situated almost at midlength of head. Dorsal surface of head covered by long, barbulate hairs, interspersed with short subdecumbent hairs, similar pattern observed on ventral surface of head; thick and long setae present on anterior clypeal margin; both outer and inner surfaces of mandibles with dense pilosity, some of the hairs are also barbulate.

Tab. 1: Mean, standard deviation (SD), minimum and maximum values (all in mm) of the measurements made on samples of *Myrmica nefaria* sp.n. (gynes, workers and males). The measurement codes are as indicated in the Material and methods section and the numbers of individuals measured are mentioned in parenthesis.

Morphometric character	Holotype Gyne	Gynes (n = 63)			Workers (n = 5)			Males (n = 4)		
		Mean ± SD	Min	Max	Mean ± SD	Min	Max	Mean ± SD	Min	Max
HL	1.17	1.13 ± 0.02	1.10	1.17	1.02 ± 0.06	0.99	1.08	0.76 ± 0.02	0.74	0.78
HW	1.02	1.01 ± 0.01	0.99	1.02	0.83 ± 0.08	0.78	0.86	0.69 ± 0.03	0.66	0.71
SL	0.88	0.87 ± 0.03	0.82	0.92	0.77 ± 0.06	0.72	0.83	0.54 ± 0.03	0.50	0.56
PL	0.48	0.51 ± 0.02	0.48	0.52	0.38 ± 0.01	0.38	0.39	0.39 ± 0.03	0.36	0.42
PH	0.53	0.54 ± 0.01	0.53	0.54	0.38 ± 0.03	0.36	0.41	0.39 ± 0.02	0.38	0.41
PW	0.58	0.60 ± 0.03	0.58	0.66	0.41 ± 0.04	0.38	0.45	0.39 ± 0.02	0.38	0.41
PPL	0.45	0.45 ± 0.02	0.41	0.49	0.35 ± 0.03	0.32	0.38	0.38 ± 0.03	0.36	0.42
PPH	0.81	0.81 ± 0.04	0.78	0.89	0.56 ± 0.02	0.55	0.58	0.50 ± 0.03	0.47	0.53
PPW	0.91	0.95 ± 0.02	0.91	0.97	0.63 ± 0.04	0.60	0.67	0.57 ± 0.04	0.53	0.60
FLW	0.53	0.51 ± 0.02	0.49	0.53	0.42 ± 0.04	0.38	0.45	0.17 ± 0.00	0.17	0.17
FW	0.55	0.53 ± 0.01	0.52	0.55	0.43 ± 0.02	0.41	0.44	0.25 ± 0.00	0.25	0.25
ESL	0.21	0.21 ± 0.01	0.19	0.21	0.22 ± 0.01	0.21	0.23	0.04 ± 0.02	0.02	0.05
SCW	1.06	1.03 ± 0.02	1.00	1.06	–	–	–	0.84 ± 0.03	0.81	0.86
SCL	1.25	1.21 ± 0.03	1.14	1.25	–	–	–	0.96 ± 0.03	0.93	0.98
AL	1.79	1.77 ± 0.02	1.74	1.78	1.42 ± 0.10	1.33	1.53	1.35 ± 0.01	1.35	1.36
ESD	0.57	0.54 ± 0.03	0.46	0.57	0.43 ± 0.03	0.40	0.46	0.29 ± 0.01	0.28	0.30
PNW	–	–	–	–	0.63 ± 0.04	0.60	0.67	–	–	–
AH	1.07	1.09 ± 0.032	1.06	1.14	–	–	–	0.87 ± 0.005	0.87	0.88

Tab. 2: Mean, standard deviation (SD), minimum and maximum values of the indices in *Myrmica nefaria* sp.n. calculated from the measurements given in Table 1.

Indices	Gynes (n = 63)			Workers (n = 5)			Males (n = 4)		
	Mean ± SD	Min	Max	Mean ± SD	Min	Max	Mean ± SD	Min	Max
CI	1.12 ± 0.02	1.11	1.15	1.23 ± 0.07	1.17	1.27	1.10 ± 0.01	1.10	1.12
FI	0.53 ± 0.02	0.51	0.54	0.52 ± 0.02	0.50	0.53	0.36 ± 0.02	0.35	0.38
FLI	0.96 ± 0.05	0.94	1.02	0.98 ± 0.06	0.93	1.02	0.68 ± 0	0.68	0.68
PI_1	0.94 ± 0.06	0.91	1.00	1.00 ± 0.07	0.95	1.06	0.99 ± 0.14	0.88	1.08
PI_2	0.50 ± 0.02	0.48	0.51	0.45 ± 0.02	0.49	0.45	0.56 ± 0.02	0.55	0.59
PI_3	0.59 ± 0.04	0.58	0.65	0.49 ± 0.02	0.49	0.52	0.56 ± 0.02	0.54	0.58
PPI_1	0.55 ± 0.06	0.49	0.58	0.62 ± 0.06	0.57	0.66	0.76 ± 0.11	0.68	0.84
PPI_2	0.85 ± 0.04	0.86	0.92	0.89 ± 0.03	0.92	0.87	0.88 ± 0	0.88	0.88
PPI_3	1.58 ± 0.07	1.57	1.46	1.54 ± 0.05	1.57	1.49	1.46 ± 0.04	1.40	1.46
PPI_4	0.94 ± 0.04	0.92	0.98	0.76 ± 0.03	0.73	0.78	0.82 ± 0.03	0.80	0.85
SI_1	0.77 ± 0.04	0.75	0.81	0.76 ± 0.04	0.73	0.79	0.71 ± 0.06	0.68	0.77
SI_2	0.86 ± 0.04	0.83	0.90	0.94 ± 0.03	0.92	0.97	0.78 ± 0.02	0.76	0.79
ESLI	0.21 ± 0	0.21	0.21	0.27 ± 0	0.27	0.27	0.05 ± 0.02	0.03	0.07
ESDI	2.61 ± 0.43	2.38	3.00	1.91 ± 0.12	1.83	2.00	9.17 ± 5.65	6.00	14.00



Figs. 1 - 6: *Myrmica nefaria*, gynes. (1) Head, frontal view (holotype); (2) body, lateral view (holotype); (3) body, dorsal view (holotype); (4, 5) left wings of two specimens; (6) right wing.

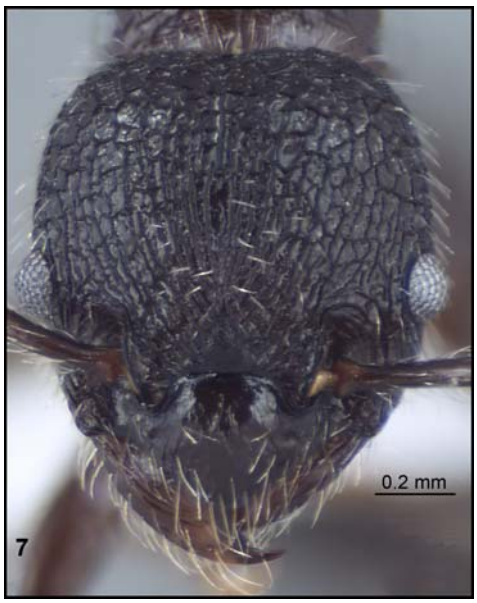
Alitrunk, petiole and post-petiole: pronotum transversally rugulose, its sides densely longitudinally rugulose, with a few faint cross-meshes. Scutum anteriorly convex, posteriorly depressed, finely longitudinally striate including V- shaped patch. Scutellum dorsally irregularly rugulose, posteriorly transversally rugulose. Propodeal dorsum with divergent rugosity, declivity smooth and highly polished; propodeal spines thick, elongate-triangular, not pointed, narrowly rounded at tip, diverging outward when seen from above. Sides of alitrunk coarsely rugose including anepisternum; metapleural glands moderately large, with conspicuous orifice dorsally on bulla. Tibiae of hind and middle leg with well-developed pectinate spur. Petiole and postpetiole much wider than long, transversally striate dorsally, petiole very shallowly concave dorsally, post-petiole short, evenly convex dorsally, in profile petiole high and narrow, with short anterior peduncle and large keel-like subpetiolar process, anterior face of petiole smooth, opaque, and that of post-petiole opaque and shagreenate. Alitrunk, petiole and post-petiole furnished with numerous short and long suberect to subdecumbent hairs directed posteriorly, thick tuft of such hairs on post-petiole, few of the hairs barbulate apically.

Gaster smooth, highly polished and shiny. Tergites and sternites with short, suberect pubescence between longer suberect hairs, few barbulate hairs on last tergite of gaster like those on head and alitrunk, petiole and post-petiole.

Colour: Head, alitrunk, petiole and post-petiole dark brown; scape, mandibles (except black masticatory margin) and legs reddish yellow.

Right and left forewing venation (Figs. 4 - 6): Cells (1+2r)+rm and m-cu closed; free floating proximal abscissa of Rs showing upward tilt in right wing.

Description of worker (Figs. 7 - 9): Head much longer than broad, sides not strongly, but distinctly convex; occipital margin straight. Mandibles with six teeth (apical and preapical ones largest, basal tooth broader than 3rd, 4th and 5th tooth); mandibles finely longitudinally rugulose and with punctures. Clypeus convex, longitudinally rugulose, anterior clypeal margin prominent and rounded medially, sculpture absent on its posterior region, space between rugae minutely punctated and shiny. Frontal triangle somewhat deep, weakly shagreenate but shiny; frontal carinae, short almost straight, curving outwards to merge with rugae that surround antennal sockets. Antennae 12-segmented, all segments densely punctated except for scape and first funi-



Figs. 7 - 9: *Myrmica nefaria*, worker. (7) Head, frontal view; (8) body, lateral view; (9) body, dorsal view.

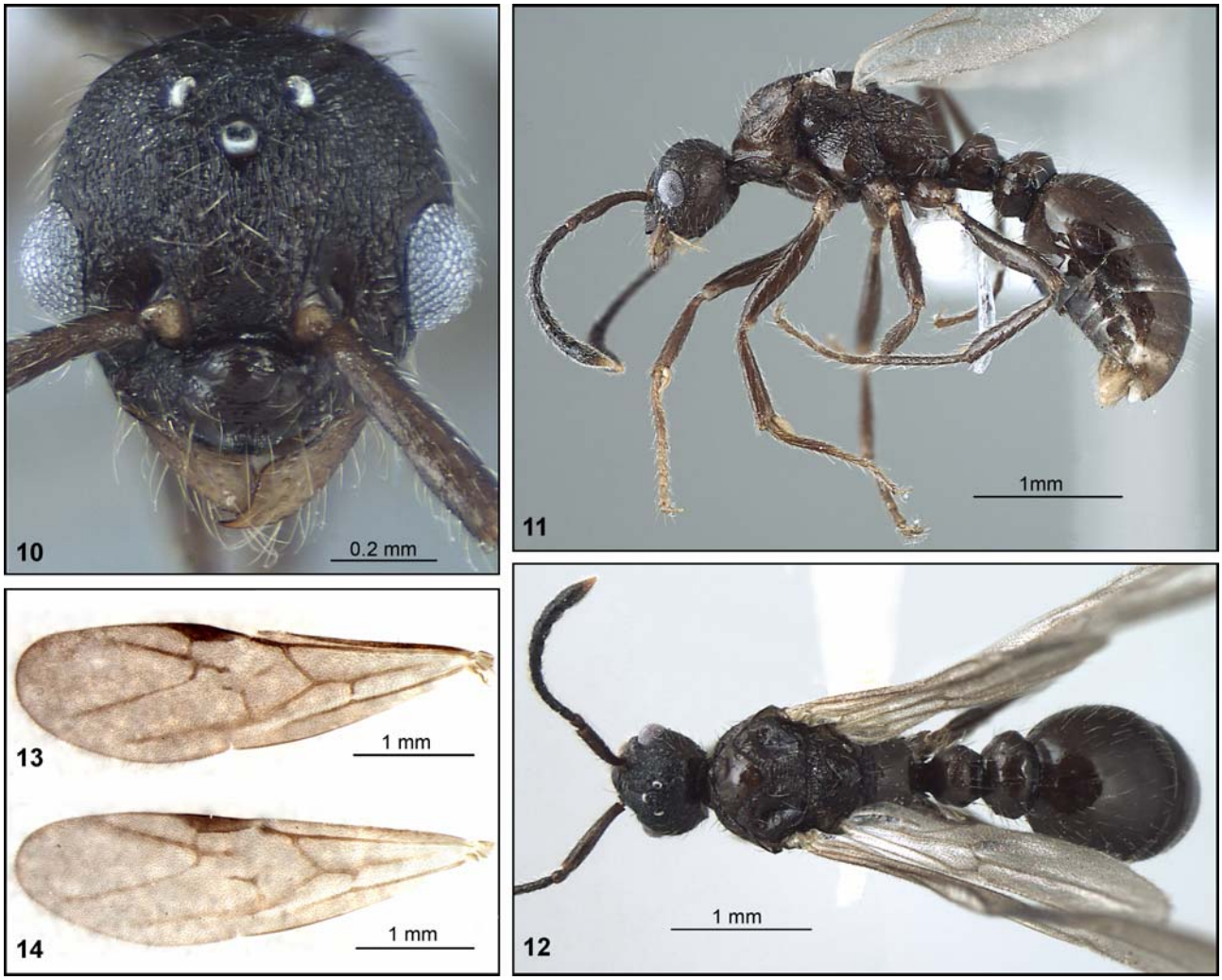
cular segment, which are minutely punctate; scape slender, narrow, weakly curved at base, without any trace of angle or carina, widening towards apex, just extending beyond the upper margin of head; antennae with oblique short hairs and with pubescence on apical five segments. Eyes large, placed almost at midlength of head. Head sculpture finer, more reticulate than in gynes; anterior clypeal margin fringed with setae. Head with abundant long suberect hairs, few of long and short hairs minutely barbulate apically.

Alitrunk, petiole and post-petiole: Alitrunk dorsum feebly convex, promesonotal suture shallow but distinct, metanotal groove broad, deep. Pronotum with transverse rugosity and reticulation, rounded anteriorly. Mesonotum irregularly rugulose, slightly depressed medially. Propodeal dorsum rectangular, with reduced transverse sculpture; declivity smooth and highly polished; propodeal lobes rounded apically. Sides of alitrunk longitudinally rugose, with sides of pronotum rugulose. Propodeal spines rather short, sharp, projected upward and divergent. Tibiae of hind and middle leg with well-developed pectinate spur. Shape of petiole and post-petiole like in gynes; petiole high and narrow, with short anterior peduncle, broader than long, transverse dorsally, post-petiole short, evenly convex, both with transverse rugosity dorsally, anterior face of petiole smooth and of post-petiole shagreenate and shiny, ventral processes of petiole and post-petiole shiny. Whole body very hairy, with long standing hairs, few of them minutely barbulate apically, petiole with long subdecumbent hairs directed backwardly, but posterior face of post-petiole without such hairs.

Gaster and colour like in gynes.

Description of male (Figs. 10 - 14): Head suboval, slightly longer than broad, little broader posteriorly, with convex sides. Mandibles with apical and preapical teeth only, punctated and very weakly striated. Clypeus finely irregularly rugulose. Frontal triangle deep, shagreenate but shiny; broad longitudinal groove from tip of triangle to anterior ocellus; frontal lobes reduced and condylar bulb completely visible. Antennae 12-segmented, densely punctated like in gynes and worker; scape long and slender, almost equal to seven following funicular segments, extending beyond upper margin of head, slightly curved from base to three fourths of length, widening towards apex, with moderately defined four-segmented antennal club, antennae with oblique short hairs and with pubescence only on apical four segments. Eyes large, placed somewhat anterior of midlength of head. Head sculpture fine, hair pattern similar to that of gynes but hairs not barbulate and subdecumbent.

Alitrunk: Pronotum like in gynes but with weak sculpture. Scutum convex, punctated, not longitudinally rugose,



Figs. 10 - 14: *Myrmica nefaria*, male. (10) Head, frontal view; (11) body, lateral view; (12) body, dorsal view; (13) right wing; (14) left wing.

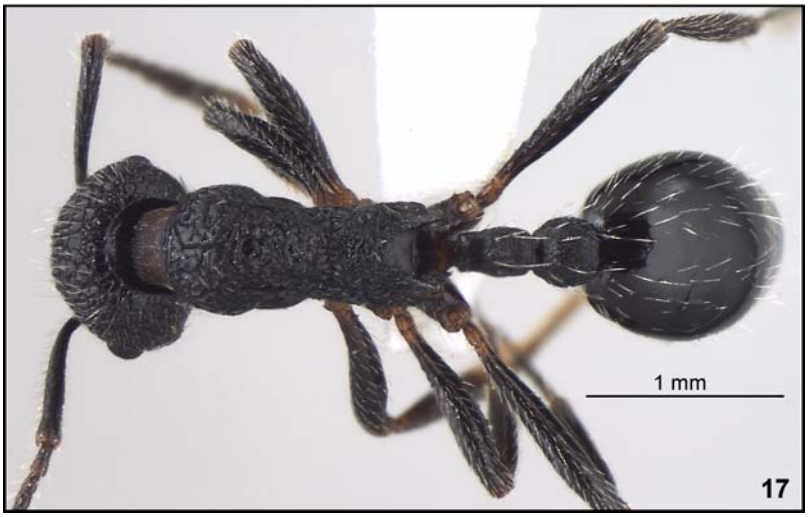
somewhat smooth, shiny, but V-shaped patch longitudinally striated. Scutellum weakly irregularly striate, punctated and transversally striate posteriorly. Propodeum dorsum divergently rugulose, with its middle portion smooth and shiny, declivity smooth, highly polished; propodeum with blunt tubercles. Metapleural lobes rounded. Tibiae of hind and middle leg with well-developed pectinate spur. Sculpture of sides of alitrunk less dense than in gynes. Petiole and post-petiole much broader than long, petiole dorsally convex, post-petiole evenly rounded (unlike gynes where petiole is very shallowly concave dorsally and post-petiole only convex dorsally); petiole finely transversally striate, punctated, while post-petiole smooth and shiny. Hair pattern similar to gynes except for absence of subdecumbent and barbulate hairs.

Gaster smooth, highly polished, hair pattern similar to gynes except for absence of subdecumbent and barbulate hairs.

Fore wing venation (Figs. 13, 14): Free floating proximal abscissa of Rs present; veins Rs+m and m reduced. Thus cells (1+2r)+rm and m-cu open, vein m-cu complete.

Etymology: From the Latin adjective *nefaria* that means "criminal".

Comparative diagnosis: By the shape of petiole and post-petiole that are very wide and with big ventral processes, *Myrmica nefaria* sp.n. is clearly distinct from the rest of socially parasitic species that have antennal scape only smoothly curved at the base, with no lobe or carina. These parasitic species have much narrower petiole and post-petiole in gyne ($PPI_4 < 0.70$ *vs.* > 0.90 in *M. nefaria* sp.n.). Similar bizarre shape of petiole and post-petiole has been observed only in one socially parasitic species described to date, *Myrmica ereptrix*, which also has been reported from Himalaya (PPI_4 of queen 0.92). Gynes of *M. nefaria* sp.n. are somewhat similar to *M. ereptrix*, but can be easily distinguished from the latter by a number of characters. In *Myrmica nefaria* sp.n. the head is very densely ruguloso-reticulate and the whole scutum is finely longitudinally rugose, while in *Myrmica ereptrix* the head dorsum is with divergent longitudinal sculpture and reticulate sculpture is present only on the sides and behind the posterior ocellus, and on scutum sculpture is completely absent in the antero-median V-shaped patch, which is entirely shiny. Posterior part of scutellum and propodeal dorsum are with divergent sculpture, which diverges from centre and curves upward in *Myrmica nefaria* sp.n., but in



Figs. 15 - 17: *Myrmica rupestris*, host worker. (15) Head, frontal view; (16) body, lateral view; (17) body, dorsal view.

M. ereptrix these regions are transversely rugose. Similarly, petiole and post-petiole are strongly sculptured with transverse rugosity in *Myrmica nefaria* sp.n., but very weak sculpture is present on both these segments in *M. ereptrix.* Another conspicuous feature is the middle tibia with a well-developed pectinate spur in *Myrmica nefaria* sp.n., while middle tibia lacks a spur in *M. ereptrix.* Propodeal spines are much longer in *M. ereptrix* than in *M. nefaria* sp.n.: ESLI 0.36 in *M. ereptrix* vs. mean ESLI 0.21 in *M. nefaria* sp.n. Other morphometric differences are: PPI_1 0.36 in *M. ereptrix* vs. 0.55 in *M. nefaria* sp.n. (range 0.49 - 0.58); CI 1.32 in *M. ereptrix* vs. 1.12 in *M. nefaria* sp.n. (range 1.11 - 1.15); SI_1 0.72 in *M. ereptrix* vs. 0.77 in *M. nefaria* sp.n. (range 0.75 - 0.81); SI_2 0.81 in *M. ereptrix* vs. 0.86 in *M. nefaria* sp.n. (range 0.83 - 0.90).

Ecology: The nest of the host species *M. rupestris* with *M. nefaria* sp.n. was found under a stone, in open grassland with bushes, shrubs, broadleaf trees and widely scattered coniferous trees; the recorded air temperature was 30°C and the relative humidity was 68% at the site. Topographically, this valley has two very distinct areas, which differ quite significantly in their environmental conditions. The area which is directly exposed to sun is rock-strewn, dry, with only patches of grass (without herbs or shrubs) and harbors maximum abundance of *Formica* species. The other area is comparatively wet, shady, with ample vegetation, and has more *Myrmica* species together with some patches occupied by *Temnothorax*, *Lasius*, and *Formica* species. The region of Solang valley represents the temperate zone of Himalaya and remains snow covered from December to March. Additionally, the region typifies the transitional zone between Greater Himalaya and Trans Himalaya and harbors a rich diversity of flora of both ecological conditions mentioned and is rich in endemic plants. Unfortunately, the area has lots of anthropogenic activities, is listed as fragile ecosystem, and is in dire need of conservation of bio-resources (KUMAR & al. 2011).

Conservation status: Yet to be ascertained, but *Myrmica nefaria* sp.n. appears to be a potential red list species (being social parasite) as it was encountered only once, from a habitat which is under stress due to great deal of anthropogenic activities as mentioned above. However, the host *Myrmica rupestris*, which is widely distributed in Himalaya, has been collected extensively during the surveys to Himalaya by the author in the past years.

Discussion

Myrmica nefaria sp.n. is quite unique in its characters compared to already described socially parasitic species from the Palaearctic. Altogether different sculpture of head, alitrunk, petiole, and post-petiole, presence of well developed pectinate spurs on mid and hind tibia are some of the significant distinctive features, apart from being distinct morphometrically. Its evolutionary tendencies seem novel. The host, *Myrmica rupestris* (Figs. 15 - 17), belongs to the primitive *M. rugosa* species group, while this parasitic species

can be placed to the more advanced, younger *M. smythiesii* FOREL, 1902 group (RADCHENKO & ELMES 2001, 2010). Generally the species groups have been set up to be phylogenetically meaningful (RADCHENKO & ELMES 2010), but this may not necessarily apply in all instances (G.W. Elmes, pers. comm., September 2011). More exploration of the Himalayan *Myrmica* fauna and further analyses, ideally including molecular genetic analyses, will be needed to definitely clarify the situation. Based on various characters and length of scape in male, *M. rugosa* group is considered to be primitive in Himalaya, while *M. smythiesii* group is considered to be more advanced and younger (RADCHENKO & ELMES 2001). In *M. nefaria* sp.n. scape length of male (SI_1) and shape of the frontal carinae of female castes that merge with rugae surrounding the antennal sockets clearly fits to its inclusion in *M. smythiesii* group. Thus it is understandable that the parasite is reasonably younger than its host in origin. This fact is supplemented by wing venation as well. The venation in males of *M. nefaria* sp.n. (Figs. 13, 14) is different from that of other socially parasitic males reported so far in having open (1+2r)+rm cell, whereas it is closed in others. A free-floating proximal abscissa of Rs is present in *M. nefaria* sp.n. males (mostly absent in other species). Furthermore, vein m-cu is complete, m-cu cell is open and veins Rs+m and m are reduced. In case of female (Figs. 4 - 6), vein Rs instead of bending downwards towards vein m (as in normal species and social parasites as well), shows an upward tilt in the right wing. As stated earlier, the Himalayan *Myrmica* fauna is exceptional with most species being endemic. It diversified from ancestral forms concentrated in Himalaya, and remained isolated for some 25 million years (BHARTI 2008a, b, RADCHENKO & ELMES 2001, 2010). It is quite logical that the younger parasitic species might have diversified in a sympatric fashion from its host. Moreover, this species represents one of the rare cases where inquilines are not completely workerless, but still have the potential to produce their own workers.

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