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TWO NEW HIMALAYAN ANT SPECIES (HYMENOPTERA, FORMICIDAE) RELATED TO *MYRMICA INDICA*

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Two New Himalayan Ant Species (Hymenoptera, Formicidae) Related to *Myrmica indica*. Elmes. W., Radchenko A. G. — *Myrmica weberi* Elmes et Radchenko, sp. n. and *M. alperti* Elmes et Radchenko, sp. n. from the Himalaya are described. Morphometric comparisons of the new species and their close relative *M. indica* Weber, 1950 were made using Principal Component Analysis and Discriminant Analysis.

Key words: ants, Formicidae, taxonomy, *Myrmica*, *ritae*-group, new species, Himalaya.

Два новых вида гималайских муравьев (Hymenoptera, Formicidae), близких к *Myrmica indica*. Элмс Г. В., Радченко А. Г. — Описаны *Myrmica weberi* Elmes et Radchenko, sp. n. и *M. alperti* Elmes et Radchenko, sp. n. из Гималаев. Проведено морфометрическое сравнение новых видов с близким *M. indica* Weber, 1950 с использованием главного компонентного и дискриминантного анализов.

Ключевые слова: муравьи, Formicidae, таксономия, *Myrmica*, группа *ritae*, новые виды, Гималаи.

Introduction

In 2005 Conservation International organised an international team of scientists to make a biological survey of the Makalu-Barun National Park in the Everest region of Nepal (see http: // school. discoveryeducation. com/everest/). One of the expedition team, Gary Alpert (Harvard University, USA), organised a survey of ant species, generally taking fairly large series either from Winkler traps or from nests. In 2006, Alpert kindly sent us sub-samples of the *Myrmica* that included several series which he keyed to *M. indica* Weber, 1950 using our key to Himalayan *Myrmica* (Radchenko, Elmes, 1998, 2001): hereafter these series are referred to as the "Makalu material". Alpert asked us to confirm his identifications and pointed out that the variation among the Makalu material was sufficient for him think that it might comprise two different species (*M. indica* and an unknown "small species"). We agreed with him; although the small specimens are superficially similar to *M. indica* and conformed to no other known species of *Myrmica*, they were nevertheless very easy to separate visually, not least because they were much smaller and somewhat differently coloured, a more glossy black. This led us to re-examine the status of former "*M. indica*"in our previous papers.

M. indica belongs to the *ritae* species-group of the genus *Myrmica* (Radchenko, Elmes 1998). This group was considered to comprise rare and unusual species found only in a few places in the Himalaya and Southeast Asia, but our recent studies have shown that in fact the *ritae*-group is diverse, widespread and locally common in Southern and South-eastern Asia (Radchenko, Elmes, 1998, 2001; Radchenko et al., 2001, 2006). Originally, *M. indica* was described by Weber (1950) from two specimens collected in 1910 by C. W. Beebe from Tonglu in the Darjeeling region of India and preserved in the collection of the Museum of Comparative Zoology, Harvard, USA (MCZ). Prior to the Makalu material, the only significant collection of *M. indica* was held in the Naturhistorisches Museum, Basle (NHMB), comprising about 60 specimens mostly collected during the Museum's Nepal and Bhutan expeditions (Radchenko, Elmes, 1998, 2001). After our revisions a small amount of this Basle material was exchanged and retained in the collections of

G. W. Elmes, UK (ELMES) and the Schmalhausen Institute of Zoology, Kyiv, Ukraine (SIZK), which also hold a few specimens recently collected by other people.

At first sight, the small Makalu specimens appear as if they might be "miniature" workers of *M. indica*, although this is most unlikely because no clear-cut cases of worker-caste dimorphism have been recorded for *Myrmica* ants. However, relative value of several morphometric features standardised by head-width varied between the small and large specimens in the Makalu material, indicating real differences in shape despite similar body sculpture. We then compared these data with the measurements we made previously on 17 "*M. indica*", including the lectotype and paralectotype (means of the data were published in Radchenko, Elmes, 1998). This confirmed that the Makalu material comprises two morphologically distinct forms, but it was less clear as to whether either conformed to *M. indica* as defined by the 17 specimens previously measured; some of the latter specimens overlap the two Makalu groups, whereas others could represent a third form. Consequently, we decided to reappraise the status of *M. indica* by re-examining and measuring all the available "old" material. We report this initial analysis and then outline the more detailed analyses that lead us to describe two new species that are close to, but distinct from *M. indica*.

Material and methods

All the material examined is deposited in the collections of NHMB, MCZ, SIZK and ELMES (see Introduction). The "old" series previously determined as *M. indica* comprised 69 worker specimens and 1 queen, being the 2 type specimens (MCZ), 52 workers and 1 queen (NHMB), 6 workers (SIZK) and 9 workers (ELMES). The Makalu series of *M. indica* that comprised 55 workers from 4 series were shared between the NHMB, SIZK and ELMES collections. The new species in the Makalu material sent to us, comprised 36 workers and 1 queen from 5 series, we designated them as types and shared them between the NHMB, SIZK and ELMES collections. Alpert retained specimens from the above type-series and these can also be considered as paratypes. A second new species comprising 24 workers from 2 series among the "old" material held by NHMB, SIZK and ELMES was redistributed among those collections with single specimens being donated to MCZ and Alpert.

Morphometrics

The following morphometrics (accurate to 0,01 mm) were made:

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

HW maximum width of head in dorsal view behind (above) the eyes.

FW minimum width of frons between the frontal carinae.

FLW maximum distance between the outer borders of the frontal lobes.

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

AL diagonal length of the alitrunk (seen in profile) from anterior end of the neck shield to the posterior margin of propodeal lobes (workers) and from the most anterodorsal point of alitrunk to posterior margin of propodeal lobes (queens).

HTL maximum length of hind tibia, measured from the junction with femur to the junction with the first tarsal joint.

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

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

PW maximum width of petiole in dorsal view.

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

PPL maximum length of postpetiole in dorsal view between its visible anterior and posterior margins.

PPW maximum width of postpetiole in dorsal view.

PPH maximum height of postpetiole in profile from the uppermost to lowermost points, measured perpendicularly to the tergo-sternal suture.

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

ESD distance between the tips of propodeal spine in dorsal view.

SCW maximum width of scutum in dorsal view (queens).

SCL length of scutum+scutellum in dorsal view (queens).

AH height of alitrunk, measured from upper level of mesonotum perpendicularly to the level of lower margin of mesopleuron (queens).

Indices

In this paper we compare measurements standardised by head-width (e. g. sHL = HL/HW) and do note give the indices we use elsewhere (e. g. Radchenko, Elmes, 1998, 2001 etc.); however, note that some

of our old indices are simply the standardised measurement — in the example given sHL = CI (cephalic index) while sFW = FI (frontal index), sSL = SI2 (scape index-2), sHTL = HTI (hind tibia index), sPPW = = PPI4 (post-petiole index-4), sESL = ESLI (propodeal spine index). If any other index is required it can be estimated from the mean values with very little loss of precision.

Analyses

We used the 16 worker morphometrics (see above) standardised for size (dividing by HW) giving 15 size-standardised variates, thus for example, any differences between the standardised head-length (sHL) of individuals probably represents real differences in relative head shape. Principal Component Analysis (PCA), Discriminant Analysis (DA) and Canonical Variate Analysis (CVA) based on the correlation matrix between the standardised morphometrics were made using the MINITAB and GENSTAT statistical analytical packages In brief, a PCA tries to combine the variates to create the same number of orthogonal Principal Components so maximising the distance between individuals in component space. Usually a large proportion of the total variance is captured by the first 2 or 3 components, so that the data can be summarised by 2 dimensional plots. A PCA makes no assumptions about prior groupings so that if all the specimens were simply drawn at random from the same population, one would expect no pattern in the PCA scores. DA and CVA work in a similar way on pre-defined groups, in this case looks for the discriminant functions that maximise between-group variance and minimise within-group variance. Discrimination can only be made if real differences between groups exist.

Analysis 1. A PCA was made of measurements of 77 specimens: group 1 comprised 17 workers of *M. indica*, including the lectotype and paralectotype, for which we had original measurements previously summarised by A. G. Radchenko and G. W. Elmes (1998: Table 2); group 2 comprised 30 specimens of the smaller form from the Makalu material that we believed might be a new species; group 3 comprised 30 specimens of the larger form from Makalu that we believed most probably was *M. indica*.

Analysis 2. As many as possible of the "old" specimens of *M. indica* (67) were re-measured and a PCA was made on their standardised morphometrics. This indicated three possible groups of "old" specimens, especially when geographic location of the specimens was noted.

Analysis 3. On the basis of the somewhat subjective visual grouping (analysis 2) the 67 specimens were assigned to one of 3 groups (called groups 1a, 1b and 1c) and a DA was made between the groups and the Discriminant Functions recorded. The latter can be used to calculate scores for new specimens from whom they can be assigned to the different groups with a known probability. The 60 Makalu specimens (groups 2 and 3) were thus assigned to one of the 3 groups of "old" specimens (1a-1c).

Analysis 4. We made a PCA on the combined data set of 5 groups (1a, 1b, 1c, 2 and 3) and when it was apparent that the Makalu groups were congruent with two of the groups of "old" specimens we made a final PCA of the three remaining groups. Finally, we looked for and found other consistent morphological differences between these groups (see taxonomic part of this paper below).

Morphometric analyses

Analysis 1. The two first components (fig. 1) jointly account for about 50% of the overall variance, PC3 (not illustrated) accounts for a further 15% but add little extra information. Remembering that the effect of individual size has been more or less removed, it is at once apparent that the specimens comprising group 2 (putative sp. n.) generally have quite different shapes relative to group 3 (putative *M. indica*). However, group 1 (the 17 *M. indica* specimens) does not particularly overlap either of the two Makalu groups, some appear to cluster with group 2 and some with group 3, but many

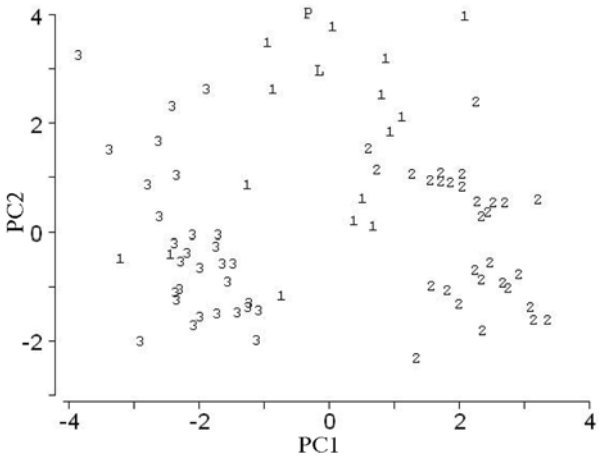

Fig. 1. First two components of a Principal Component Analysis (PCA) of standardised morphometrics (excluding petiole length) made on (1) the 17 specimens of *M. indica* (after Radchenko, Elmes, 1998), including the lectotype (L) and paralectotype (P), and 60 specimens from Alpert's Makalu series, being (2) 30 from the small probably new species, and (3) 30 of the larger specimens, provisionally identified as *M. indica.*

Рис. 1. Первые два компонента главного компонентного анализа (ГКА) стандартизированных морфометрических данных (за исключением длины петиолюса), проведенного по (1) 17 экз. *M. indica* (по данным Radchenko, Elmes, 1998), включая лектотип (L) и паралектотип (P), и 60 экз. из серии Г. Альперта из Макалу, включающие (2) 30 экз. предположительно нового вида, и 30 более крупных экземпляров, предварительно определенных как *M. indica* (3).

of group 1, including the lectotype and paralectotype, are not especially close to either groups of the Makalu material. Thus while it appeared that the Makalu material indeed clearly comprised two morphometrically distinct forms it was less clear which, if either, of the two groups conformed to *M. indica* as defined by the type specimens.

Analysis 2. The first two components (fig. 2) jointly account for almost 70% of the overall variance. At first sight this plot would indicate a morphologically variable species with the paralectotype being somewhat central to the variation, and the lectotype being rather "atypical" (we simply selected the better mounted and preserved of the two specimens when we designated the lectotype — see Radchenko, Elmes, 1998). However, when specimens having the same locality labels (possibly the same nest series) are indicated there is more structure in the plot. Subjectively, there appears to be three clusters in this graph: group 1a (middle and left of the graph) contains the type specimens and by that yardstick are *M. indica*, group 1c lies in the bottom right part of the graph, and a smaller group 1b is more dispersed in the upper right part. Specimens from the same label-series fell in the same visual groups with the exception of two specimens from a series of seven collected from Phulchoki (Nepal) (series 3, fig. 2), that appeared to belong to group 1b, while the remainder of the series fell into group 1c (*M. indica*). However, both specimens were damaged (legs missing) so that tibia-length was not measured; while the analytical method is sufficiently robust to cope with the odd item of missing data (set at the overall average), tibia length was quite important in defining these groups, therefore we omitted them from the final discriminant analyses.

Analysis 3. Unsurprisingly a DA produced very clear discrimination between groups 1a, 1b and 1c (fig. 3), but this in itself does not necessarily mean that the groupings represent real biological entities. However, when we used the discriminant functions to assign the Makalu material to one of the three groups, we found that all Makalu group 2 specimens (putative sp. n.) are assigned with high probability to group 1b and all the Makalu group 3 specimens (putative *M. indica*) are assigned to group 1a

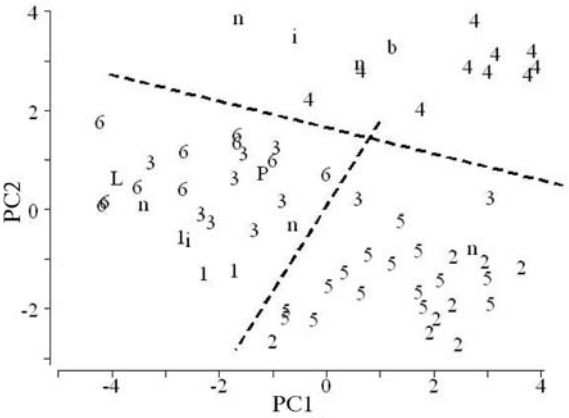

Fig. 2. The first two components of a PCA made on individual morphometrics standardized by head width, for all available material in "old" collections identified as *M. indica* (67 specimens) including the lectotype (L) and paralectotype (P). Series from the same geographical localities are indicated: 1 — Chordung Jiri, Nepal; 2 — Jiri-Thodung, Nepal; 3 — Phulchoki, Nepal; 4 — Sampa Kotoka, Bhutan; 5 — Thodung, Nepal; 6 — Thimphu, Bhutan; n, b, i — specimens from other locations in Nepal, Bhutan and India respectively. Broken-lines separate what subjectively could be 3 distinct groups.

Рис. 2. Первые два компонента ГКА, проведенные по индивидуальным стандартизированным морфометрическим данным для всего доступного «старого» коллекционного материала, определенного как *M. indica* (67 экз.), включая лектотип (L) и паралектотип (P). Серии из одних и тех же географических точек обозначены: 1 — Чордунг Джири, Непал; 2 — Джири-Тходунг, Непал; 3 — Фулчоки, Непал; 4 — Сампа Котока, Бутан; 5 — Тходунг, Непал; 6 — Тхимфу, Бутан; n, b, i — экземпляры из других местонахождений в Непале, Бутане и Индии, соответственно. Пунктирные линии разделяют 3 субъективные группы.

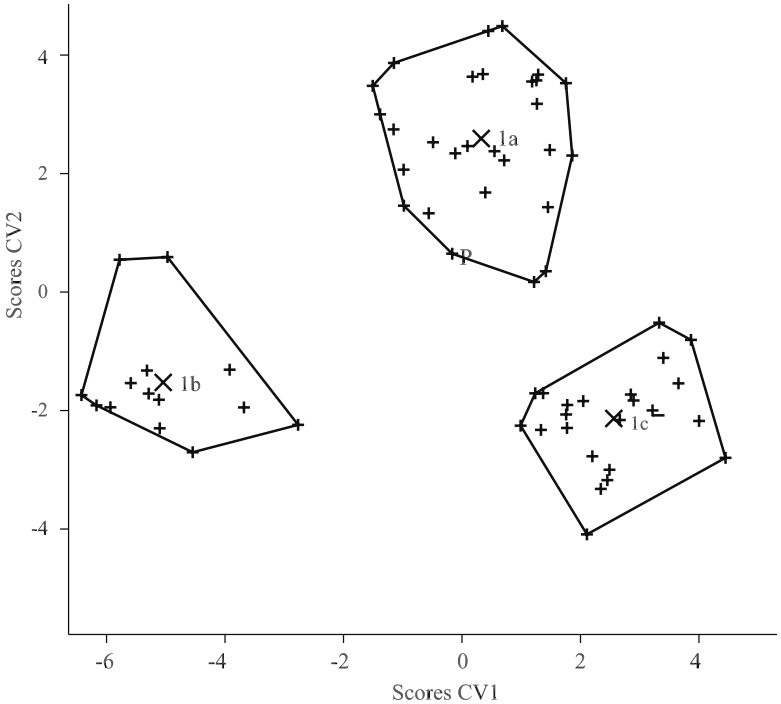

Fig. 3. Result of a Canonical Variate Analysis (CVA) made on the subjective groupings (1a-1c) made of the specimens in fig. 2. Crosses indicate the group means, and the polygons connect the outlying points around each mean.

Рис. 3. Результаты канонического вариантного анализа (КВА), проведенные на основе субъективного помещения экземпляров в группы (1a-1c), как на рисунке 2. Крестики обозначают средние значения для группы, многоугольники соединяют крайние значение вокруг этих средних.

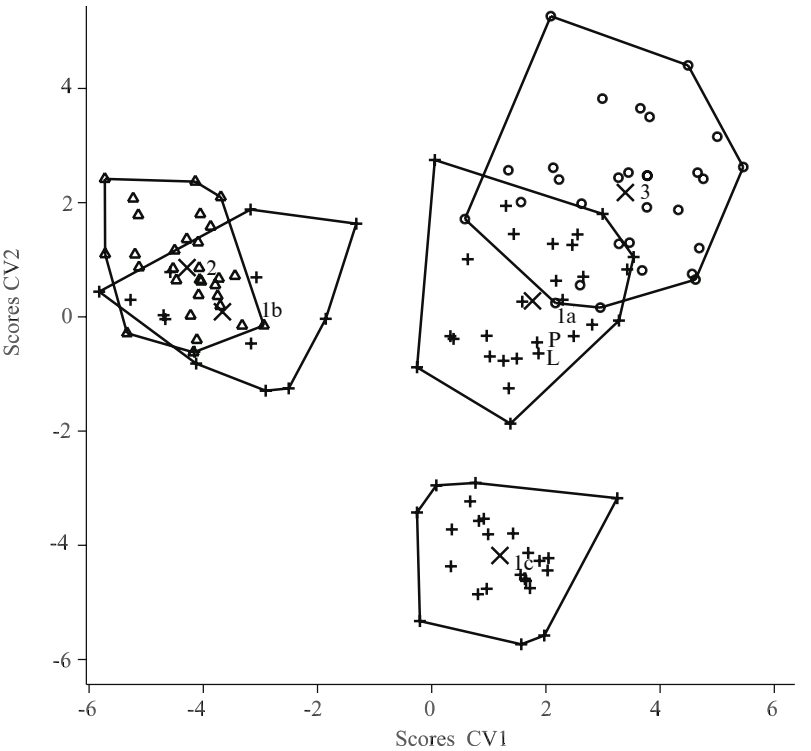

Fig. 4. Results of a CVA of the three groups 1a-1c (determined in fig. 2 and 3), and the small probably new species from Makalu specimens being (triangles, group 2) and probably *M. indica* (circles, group 3). The group means are indicated by a cross, and the polygons connect the outlying points around each mean.

Рис. 4. Результаты КВА первых трех групп 1a-1c (обозначенных на рисунке 2 и 3), и экземпляров из Макалу, относящиеся к мелкому предположительно новому виду (треугольники, группа 2), и предположительно *M. indica* (кружочки, группа 3). Средние значения для групп обозначены крестиками, многоугольники соединяют крайние значение вокруг этих средних.

(*M. indica* as defined by the types). This is illustrated in figure 4, when a DA is made using all five groups.

Analysis 4. From the above we conclude that the old "*M. indica*" series actually comprised three similar and probably closely related species: the larger Makalu specimens and 27 of the "old" specimens are *M. indica* (as defined by the type specimens); the smaller Makalu specimens and 14 of the "old" specimens are a new species that we name *M. weberi* Elmes et Radchenko; the remaining 24 specimens of the old series of "*M. indica*" are not congruent with either of these species, and we believe them to be a third species, that we call *M. alperti*. The clear morphometric separation of the three species is illustrated by a plotting of the two components of a CVA (fig. 5). Note that *M. indica* remains the most variable species with 7 (12%) of the specimens being outside the 95% confidence limit.

Descriptions of new species

Myrmica weberi Elmes et Radchenko, **sp. n.**

Material. Holotype worker, NPL28 (No. 11 — Elmes coll. label), Nepal, Sankhawalava Maghang, Kharka, Makalu Barun Conservation Area, 27°36'18.5" N 87°7'30" E, 2634 m, 7.11.2005 (Alpert, Alonso and Subedi), CK−3, yak meadow under rocks, under stones (NHMB). Paratypes: 15 workers and 1 queen with same label as holotype; 7 workers, NPL25, Nepal, Sankhawalava Maghang, Kharka, Makalu Barun Conservation Area, 27°35'36.6"N 87°7'20.7"E, 2548 m, 5.11.2005 (D. Emmett and Subedi), MK 21−283, Winkler trap; 3 workers, NPL 31, Nepal, Sankhawalava Makalu Barun Conservation Area, MK−4, 27°35'24.8"

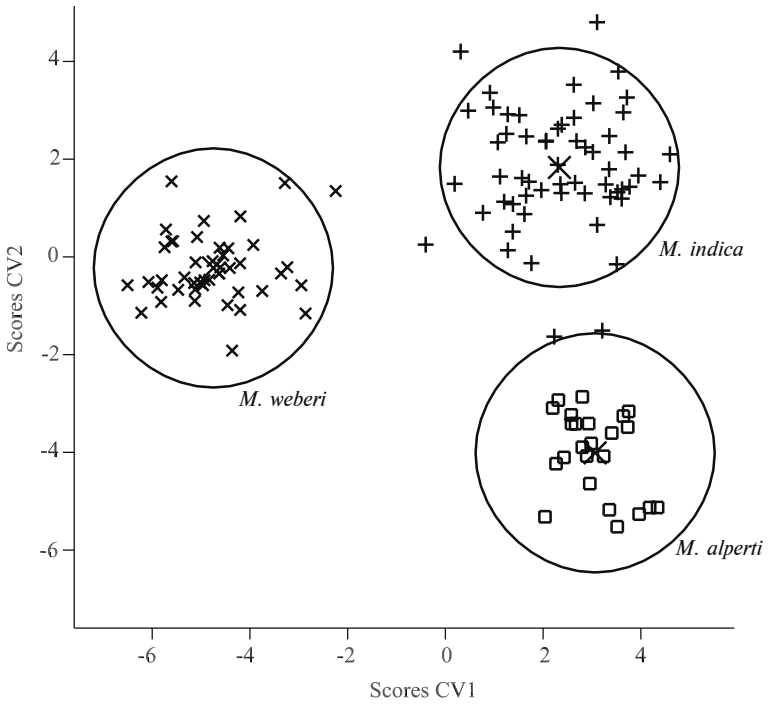

Fig. 5. The results of a final CVA on *M. indica* (plus signs — groups 1a + 3), M. *weberi* (crosses, groups 1b + 2) and *M. alperti* (open squares — group 1c). The circles indicate the 95% confidence limits around the group means (large cross). Note that more than twice as many than expected *M. indica* lie outside the 95% confidence limits.

Рис. 5. Результаты окончательного КВА *M. indica* (знак «+» — группы 1a + 3), *M. weberi* (крестики — группы 1b + 2) и *M. alperti* (квадратики — группа 1c). Окружности показывают 95% достоверную границу данных вокруг средних (крупные крестики). Характерно, что за пределами 95% границы достоверности лежат более чем в 2 раза больше экземпляров *M. indica*, чем предполагалось.

N 87°7'18.7"E, 2563 m, 3.11.2005 (G. Alpert), on rock under moss, large colony with 2 queens; 3 workers, NPL 32, Nepal, Sankhawalava Makalu Barun Conservation Area, MK−6, 27°35'24.8" N 87°7'18.7" E, 2563 m, 3.11.2005 (G. Alpert), open meadow, under logs; 7 workers, NPL 33, Nepal, Sankhawalava, Makalu Barun Conservation Area, MK W17, 7.11.05, Winkler trap; (SIZK, NHMB, ELMES); 1 worker, India, Darjeeling Distr., Tiger Hill, 2500 m, 27.05.1975 (W. Wittmer), "*M. indica* Weber det. Radchenko and Elmes" (NHMB); 1 worker, Kosi, Chauki, 2°11−12'N 87°27−28'E 2000−3000 m, 22−24.06.01, NHMB Exped. Npl. 2001 (NHMB); 1 worker, Bhutan, Nolding, 41 km O Wangdi, 2800 m, Nat.-Hist. Museum Basel — Bhutan Expedition, 1972, "*M. indica* Weber det Radchenko and Elmes" (SIZK); 1 worker, NPL2.1, Nepal, Rigmo, H. Tabata, 7.06.1978, "*M. indica* Weber det Radchenko and Elmes" (ELMES). Additional material: 10 10 workers, Bhutan, Sampa-Kotoka, 1400−2600 m, 9.06, Nat-Hist. Museum Basel — Bhutan Expedition, 1972, "*M. indica* Weber det Radchenko and Elmes" (NHMB, ELMES).

Workers (fig. 6, *a-e*)

Head distinctly longer than broad, with very feebly convex sides, nearly straight occipital margin and narrowly rounded occipital corners, its upper latero-ventral corners pointed; anterior clypeal margin very feebly convex, notched medially. Mandibles with 8−9 teeth. Frontal carinae curved outwards to merge with the rugae, which surround antennal sockets. Frons wide, frontal lobes not extended, somewhat raised vertically (i. e. perpendicular to the head surface). Scape of moderate length, usually shorter or only slightly longer than head length, gradually and weakly curved at the base.

Alitrunk long and low, with very feebly convex promesonotal dorsum (seen in profile), promesonotal suture indistinct (seen from above); metanotal groove ranges from nearly absent to well developed, but always shallow and not very distinct; metapleural

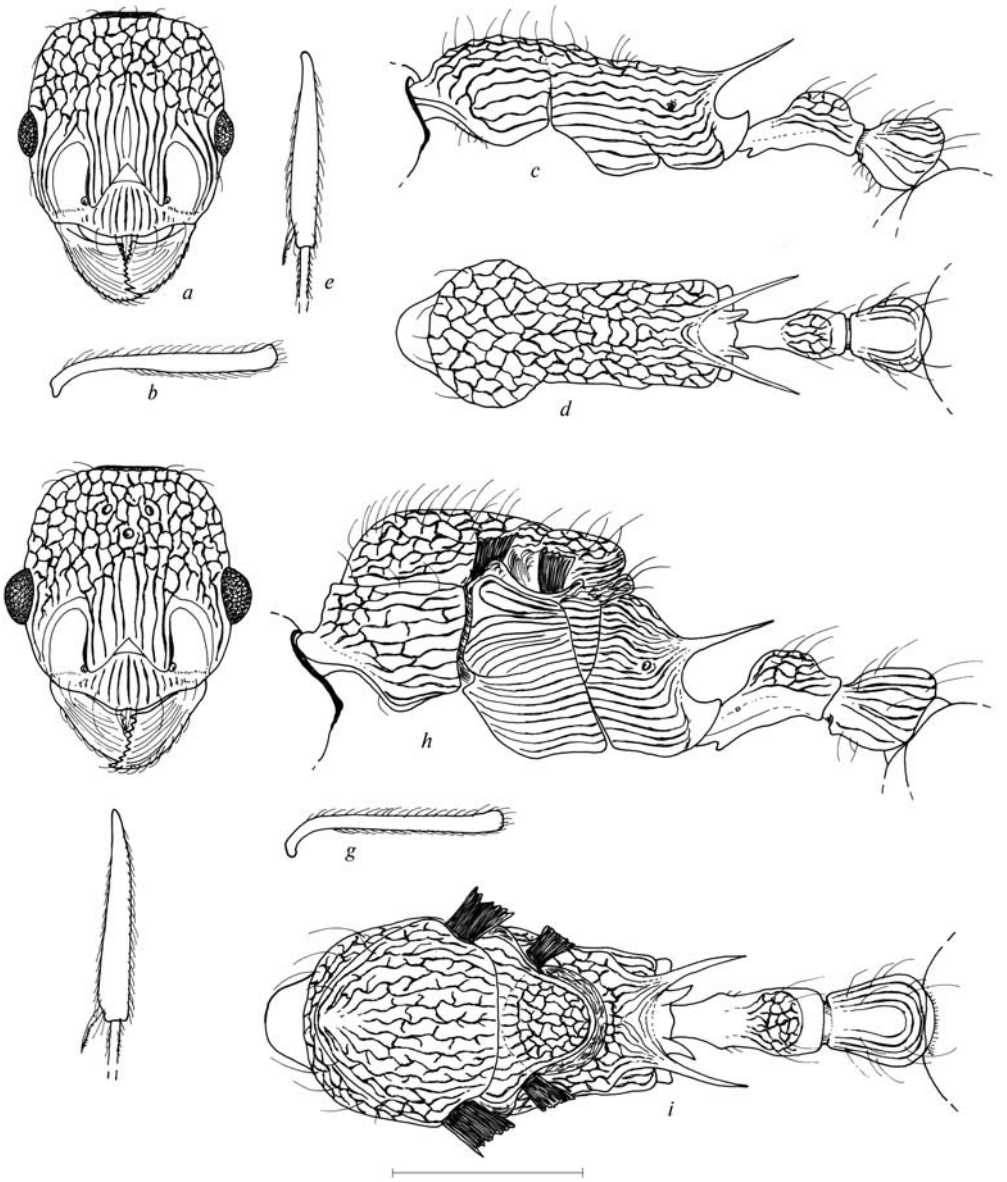

Fig. 6. Details of structure of *M. weberi* (*a-e* — holotype worker; *f-j* — paratypes queen): *a*, *f* — head, dorsal view; *b*, *g* — scape, lateral view; *c*, *h* — alitrunk and waist, lateral view; *d*, *i* — alitrunk and waist, dorsal view; *e*, *j* — hind tibia. Scale bar 1 mm.

Рис. 6. Детали строения *M. weberi* (*a-e* — голотип, рабочий; *f-j* — паратип, самка): *a*, *f* — голова сверху; *b*, *g* — скапус сбоку; *c, h* — грудь и стебелек сбоку; *d*, *i* — грудь и стебелек сверху; *e*, *j* — задняя голень. Масштабная линейка 1 мм.

lobes projecting apically to form sharp teeth. Propodeal spines very long, not widened at the base, thin, slender, straight and sharply pointed. Petiole long, low and narrow, with long node; its anterior surface concave, node dorsum very feebly convex; postpetiole fig-shaped (seen from above), longer than high, its anterior surface not steep, almost straight and slightly transversally depressed in the middle, node dorsum narrowly rounded (seen in profile). Spurs on middle and hind tibiae well developed and pectinate.

Anterior (lower) half of frons with coarse longitudinal rugae, at least 6 between frontal carinae level with the eyes, remainder of head dorsum (posterior to eyes) with

Table 1. The morphometrics (mean ± SD) of workers: 59 *M. indica* (30 Makalu specimens plus 29 "old" specimens, including lectotype and paralectotype), 30 *M. weberi* (holotype + paratypes) from Makalu material and 24 *M. alperti* (holotype + paratypes) from the "old" material

Таблица 1. Морфометрические данные (средние ± SD) рабочих: 59 *M. indica* (30 экз. из Макалу плюс 29 «старых» экз., включая типы), 30 *M. weberi* (голотип + паратипы) из Макалу, и 24 *M. alperti* (голотип + паратипы) из «старого» материала

Morphometric	*M. indica* (59)	*M. alperti* (24)	*M. weberi* (30)	Standardised by HW	*M. indica* (59)	*M. alperti* (24)	*M. weberi* (30)
HW	1,167 ± 0,080	1,264 ± 0,059	0,919 ± 0,042				
HL	1,354 ± 0,084	1,427 ± 0,050	1,098 ± 0,038	sHL = CI	1,161 ± 0,029	1,130 ± 0,019	1,196 ± 0,026
FW	0,460 ± 0,026	0,496 ± 0,021	0,369 ± 0,014	sFW = FI	0,395 ± 0,015	0,393 ± 0,010	0,402 ± 0,011
FLW	0,492 ± 0,028	0,536 ± 0,023	0,400 ± 0,016	sFLW	0,422 ± 0,019	0,425 ± 0,011	0,436 ± 0,013
SL	1,481 ± 0,095	1,460 ± 0,062	1,097 ± 0,037	sSL = SI2	1,270 ± 0,034	1,155 ± 0,024	1,195 ± 0,025
AL	2,106 ± 0,130	2,159 ± 0,081	1,671 ± 0,075	sAL	1,806 ± 0,039	1,709 ± 0,035	1,819 ± 0,045
HTL	1,352 ± 0,103	1,360 ± 0,058	0,952 ± 0,036	sHTL = HTI	1,161 ± 0,047	1,077 ± 0,022	1,036 ± 0,029
PNW	0,859 ± 0,060	0,922 ± 0,033	0,705 ± 0,031	sPNW	0,736 ± 0,019	0,730 ± 0,015	0,767 ± 0,015
PL	0,739 ± 0,039	0,768 ± 0,027	0,588 ± 0,025	sPL = PI3	0,634 ± 0,024	0,609 ± 0,019	0,640 ± 0,022
PW	0,310 ± 0,021	0,378 ± 0,025	0,255 ± 0,013	sPW	0,266 ± 0,011	0,299 ± 0,012	0,278 ± 0,010
PH	0,386 ± 0,029	0,436 ± 0,026	0,286 ± 0,019	sPH	0,331 ± 0,017	0,345 ± 0,010	0,311 ± 0,013
PPL	0,489 ± 0,030	0,508 ± 0,026	0,410 ± 0,017	sPPL	0,420 ± 0,021	0,403 ± 0,018	0,446 ± 0,018
PPW	0,471 ± 0,033	0,523 ± 0,022	0,354 ± 0,016	sPPW = PPI4	0,404 ± 0,018	0,415 ± 0,014	0,386 ± 0,012
PPH	0,500 ± 0,043	0,551 ± 0,021	0,381 ± 0,019	sPPH	0,423 ± 0,017	0,437 ± 0,014	0,414 ± 0,021
ESL	0,707 ± 0,059	0,711 ± 0,047	0,587 ± 0,038	sESL = ESLI	0,606 ± 0,030	0,562 ± 0,025	0,638 ± 0,023
ESD	0,579 ± 0,064	0,689 ± 0,054	0,516 ± 0,043	sESD	0,496 ± 0,039	0,545 ± 0,033	0,561 ± 0,035

coarse reticulation. Clypeus with coarse longitudinal rugae, mandibles rugulose. Whole alitrunk dorsum with coarse reticulation extending to upper parts of propleura and sides of propodeum, mesopleura with almost straight longitudinal rugae, and remainder of sides with coarse sinuous longitudinal rugae. Petiole with coarse, short, sinuous longitudinal rugae and some reticulation, postpetiole with less coarse longitudinal, slightly sinuous rugosity. Surface on body between rugae smooth and shiny.

Occipital margin with some fairly long, suberect hairs, sides of head above eyes without or at most with 1–2 such hairs; alitrunk and waist with sparse long hairs. Scape and tibiae with subdecumbent hairs.

Alitrunk and head black to blackish-brown, gaster dark brown, though appendages distinctly lighter, brownish-yellow, contrasting with dark colour of body.

Measurements see table 1.

Queen (fig. 6, *f-j*)

Generally resembles workers by body sculpture, by the shape of head, propodeal spines and waist, by the character of pilosity on the body and appendages, and by colour. Scutum is distinctly convex, alitrunk is relatively high. It is relatively small, even smaller than the largest workers (compare HL and HW below with Table 1).

Measurements (mm) of queen: HL 1,16, HW 0,98, FW 0,42, FLW 0,45, SL 1,11, AL 1,96, HTL 1,06, PL 0,69, PW 0,32, PH 0,38, PPL 0,46, PPW 0,47, PPH 0,48, ESL 0,62, ESD 0,60, AH 1,16, SCL 1,36; SCW 0,92.

Etymology. The species name is dedicated to the memory of the American myrmecologist, Dr. N. A. Weber, who made the first major taxonomic revision of the genus *Myrmica*.

Distribution and ecology. This species is probably restricted to the southern slopes of the Central Himalaya (Nepal, India and Bhutan), where it lives between at 2000 and 3000 m asl. Alpert's collection data suggests that it might be a rather reclusive species that nests under moss, dead wood and rocks, and forages close to the ground and in litter.

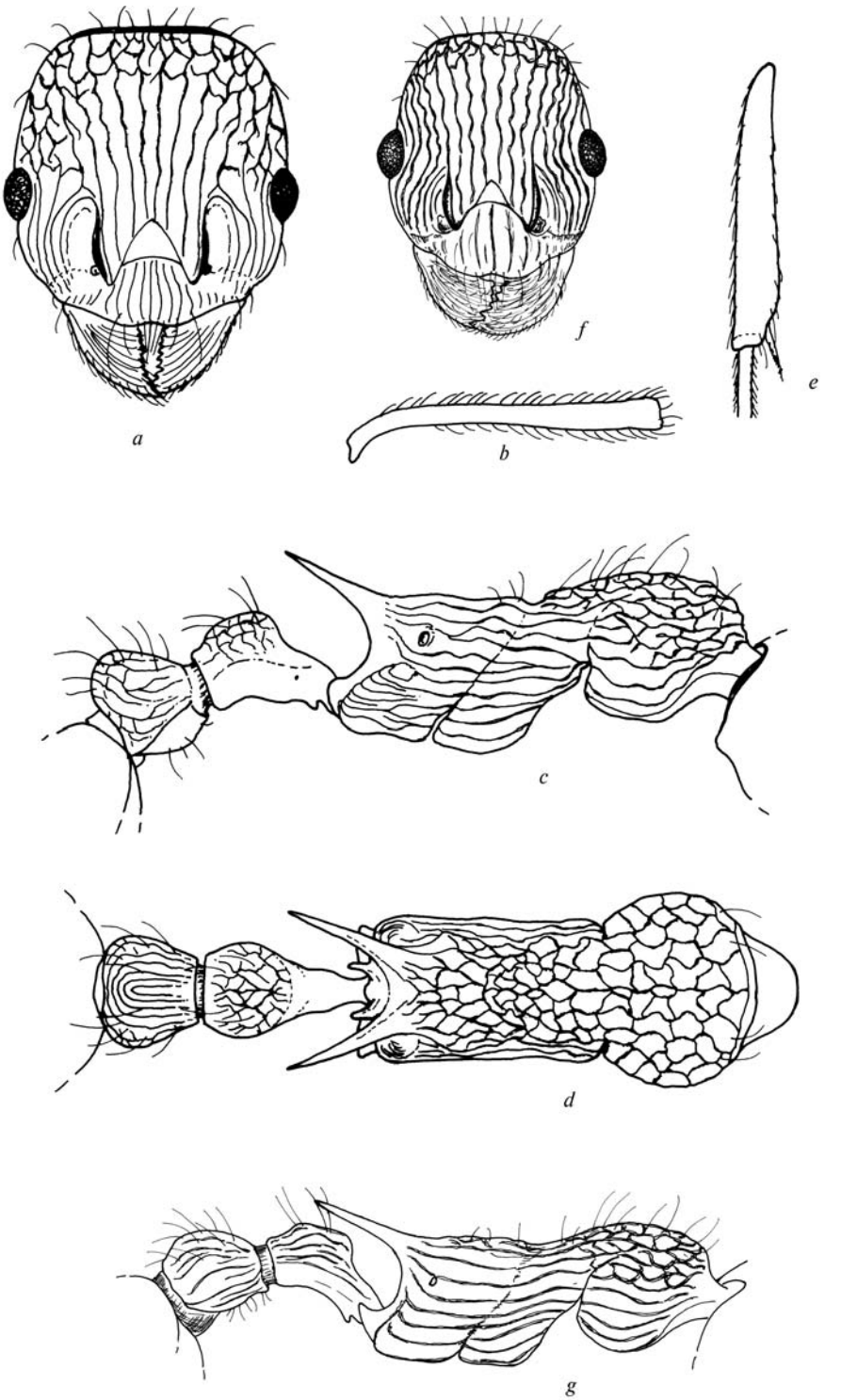

Fig. 7. Details of structure of *M. alperti* (*a-e* — holotype worker) and *M. indica* (*f*, *g* — lectotype worker): *a*, *f* — head, dorsal view; *b* — scape, lateral view; *c*, *g* — alitrunk and waist, lateral view; *d* — alitrunk and waist, dorsal view; *e* — hind tibia. Scale bar 1 mm.

Рис. 7. Детали строения *M. alperti* (*a-e* — голотип, рабочий) and *M. indica* (*f*, *g* — лектотип, рабочий): *a*, *f* — голова сверху; *b* — скапус сбоку; *c*, *g* — грудь и стебелек сбоку; *d* — грудь и стебелек сверху; *e* — задняя голень. Масштабная линейка 1 мм.

Myrmica alperti Elmes et Radchenko, **sp. n.**

Material. Holotype worker, Nepal, 3200 m, Thodung, 2–9.04.1973 (J. Martens), Coniferenwald, "*M. indica* Weber det Radchenko and Elmes", [6] (NHMB). Paratypes: 14 workers with same labels; 9 workers, Nepal, Jiri-Thodung, 28.05.1976 (W. Wittmer and C. Baroni Urbani), "*M. indica* Weber det Radchenko and Elmes" (one with abdomen missing, not measured); 1 worker, Nepal, Shiralaybis, Jiri-grat, 2200 m, 8.06.1973 (J. Martens), "*M. indica* Weber det Radchenko and Elmes" (NHMB, SIZK, ELMES).

Workers (fig. 7, *a-e*)

Head longer than broad, with convex sides, nearly straight occipital margin and rounded occipital corners, its upper latero-ventral corners pointed; anterior clypeal margin feebly convex, notched medially. Mandibles with 8–9 teeth. Frontal carinae usually curved outwards to merge with the rugae, which surround antennal sockets (but this character is somewhat variable between specimens). Frons wide, frontal lobes not extended, somewhat raised vertically (i. e. perpendicular to the head surface). Scape of moderate length, equal or only slightly longer than head length, gradually and weakly curved at the base.

Alitrunk relatively short (here and below — compare to correspondent features of related species, discussed in this paper), with feebly convex promesonotal dorsum (seen in profile), promesonotal suture indistinct (seen from above); metanotal groove distinct, but not very deep; metapleural lobes do not projecting apically, rounded or at most slightly angulated, do not form sharp teeth. Propodeal spines relatively short, widened at the base, straight or slightly curved down and pointed.

Petiole relatively short and wide, its anterior surface strongly concave, node dorsum feebly convex; postpetiole fig-shaped (seen from above), somewhat shorter than high.

Frons with coarse longitudinal sinuous rugae, at least six between frontal carinae level with the eyes, posterior and lateral parts of head dorsum with coarse reticulation. Clypeus with coarse longitudinal rugae, mandibles rugulose. Alitrunk dorsum with coarse reticulation, sides of alitrunk with coarse sinuous longitudinal rugae. Petiole with coarse, short, sinuous longitudinal rugae and reticulation, postpetiole with less coarse longitudinal, slightly sinuous rugosity. Surface on body between rugae smooth and shiny.

Occipital margin with not abundant, quite long suberect hairs, sides of head above eyes without or at most with 1–2 such hairs; alitrunk and waist with sparse long hairs. Scape and tibiae with subdecumbent hairs.

Body reddish-brown to dark brown, appendages somewhat lighter, but not contrasting with the colour of body.

Measurements see table 1.

Etymology. This species is dedicated to Dr. Gary Alpert of Harvard University USA, who collected the new material that precipitated this study.

Distribution and ecology. Known only from the Thodung region of Nepal, where it lives between 2000 and 3000 m asl. Nothing is known of its ecology.

Myrmica indica Weber, 1950

Material. Lectotype worker (designated by Radchenko and Elmes, 1998), [India] Tonglu, Darjeeling distr., E. Himalayas, 10,000 ft., 22.04. [19]10 (C. W. Beebe) (MCZ). Paralectotype: worker, with same label (MCZ). Additional material: specimens det. as *M. indica* by A. G. Radchenko and G. W. Elmes (1998): 12 workers, Nepal, Phulchoki, 2600 m, 11–14.06.1976 (W. Wittmer and C. Baroni Urbani); 3 workers, Nepal, Chordung, Jiri, 2900 m, 1.04.1973 (J. Martens); 1worker, Nepal-364, Prov. Taplejung, Simbua Khola, vic. Lassetham, 3000–3150 m, 15.05.1988 (J. Martens and W. Schawaller); 1 worker, Nepal-324, Prov. Dorhar Kharka, 10.4. 88, 2700 m (J. Martens and W. Schawaller); 1 worker, Zentral-Nepal, Zw. Tare-Pati, u. Gasaikunde, Sept. — Okt. 1971 (H. Franz); 1 worker, Darjeeling Distr., India, Tiger Hill, 2500 m, 27.05.1975 (W. Wittmer); 10 workers, Bhutan, Thimphu, 31.05, Nat. — Hist. Museum Basel — Bhutan Expedition, 1972. Plus the following Makalu material determined here as *M. indica*: 11 workers, NPL 24, Sankhawalava Maghang Kharka, Makalu Barun Conservation Area, 27°35'36.6" N 87°7'20.7" E, 2548 m, 5.11.2005 (D. Emmett and Subedi), MK 21–283 Winkler trap; 8 workers, NPL 27, Sankhawalava Maghang Kharka, Makalu Barun Conservation Area, 27°34'9.1" N 87°7'30" E, 2634 m, 5.11.2005 (Alpert, Alonso and

Subedi), MK 21–283 Winkler trap; 26 workers, NPL 29, Sankhawalava Maghang Kharka, Makalu Barun Conservation Area. 27°36'18.5" N 87°7'30" E, 2634 m, 7.11.2005 (D. Emmett), MK–LA5, secondary forest, in mammal trap at bait; 10 workers, NPL 30, Sankhawalava Maghang Kharka, Makalu Barun Conservation Area. 27°36'18.5" N 87°7'30" E, 2634 m, 7.11.2005 (Alpert and Alonso), 0397, near river in meadows and woods (NHMB, SIZK, ELMES).

Measurements and indices see table 1.

Distribution and ecology. *M. indica* appears to be fairly widespread in the southern slopes of the Himalaya (Nepal, India, Bhutan), where it lives in open forest at about 2500 m asl.

Comparison of the species

The Malaku material has led us to conclude that the *M. indica* series determined by A. G. Radchenko and G. W. Elmes (1998, 2001) contained a mixture of three rather similar species that live sympatrically on the southern slopes of the Himalaya. *M. weberi* clearly is a distinct species from *M. indica* being much smaller (tabl. 1) and "finer" with generally a more reticulate sculpture on the head, and frontal carinae that curve outwards to merge with the few rugae, which surround antennal sockets (compare fig. 6, *a-e* with 7, *a-g*). Even when standardised for size there is a clear difference between these two species (making no allowances for multiple comparisons most means are very significantly different – in most cases $P < 0{,}00001$ by simple t-test): taking the standardised measurements that deviate from those for *M. indica* by > 5% (table 1) *M. weberi* has relatively shorter appendages (compare sSL and sHTL), a less high but wider petiole, and narrower but longer postpetiole combined with longer and more divergent propodeal spines (compare sESL and sSED).

M. alperti is a more enigmatic species because it is known only from two series from the same local geographic area in Nepal. It is somewhat more stocky than *M. indica* having a relatively shorter alitrunk and shorter appendages (compare sAL, sHTL and sSL in Table 1), a distinctly more robust petiole and longer propodeal spine (compare sPH, sPW and sESL). The differences in the waist region are obvious visually (compare fig. 7 *c* and 7 *g*): striking differences are the bluntly rounded metapleural lobes that are quite distinct from those of *M. indica* and *M. weberi*, and waist nodes that are more rounded with more reticulation and less striation than *M. indica*. In some respects, *M. alperti* more resembles *M. weberi* by its relatively short appendages, but apart from the huge difference in body size (on average HW of *M. alperti* is 38% larger than that of *M. weberi*), they are easily separated by their very different waist region (see above).

Based on our current understanding of variability in the *ritae* species-group we expect that the Indian fauna might comprise one or two widespread species and many local endemics that are restricted to different mountain systems. *M. indica* as recognised here and *M. weberi* are clearly good species and might be widespread in the Himalaya. *M. alperti* is probably a local endemic close to *M. indica*. Even when the *M. weberi* and *M. alperti* specimens that were included originally to *M. indica* by A. G. Radchenko and G. W. Elmes (1998) are excluded, *M. indica* as recognised here remains morphometrically variable (note the larger than expected number of individuals falling outside the 95% confidence limits in fig. 5). We suspect that the "old" material might still comprise two (or even more) species. The two type specimens come from the Darjeeling region and are small and not particularly "typical" of the majority of *M. indica* material. We have very few other specimens from this region and there remains a possibility that when more are available for study, *M. indica* from Darjeeling will prove to be a different species to the Nepal and Bhutan specimens. A similar problem occurred with a series of 10 workers collected from Sampa Kotoka, Bhutan that mostly are larger than typical for *M. weberi*, but smaller than *M. indica* workers and could be an endemic Bhutan form close to *M. weberi*. We identify them as *M. weberi* because all 10 clustered with

M. weberi using morphometric analysis, although only 2 specimens clearly conformed to this species using visual discrimination (above). For this reason we not include these specimens to the type series of *M. weberi*.

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Radchenko A. G., Elmes G. W. Taxonomic revision of the ritae species-group of the genus Myrmica (Hymenoptera, Formicidae) // Vestnik zoologii. — 1998. — **32**, N 4. — C. 3–27.

Radchenko A., Elmes G. W. Taxonomic revision of the Himalayan Myrmica (Hymenoptera, Formicidae) // Entomol. Basiliensia. — 2001. — **23**. — P. 237–276.

Radchenko A., Zhou S., Elmes G. W. New and rare Myrmica species (Hymenoptera, Formicidae) from Southern China // Ann. Zool. — 2001. — **51**, N 2. — P. 211–219.

Radchenko A., Elmes G. W., Viet B. T. Ants of the genus Myrmica (Hymenoptera, Formicidae) from Vietnam, with a description of a new species // Myrmecol. Nachricht. — 2006. — N 8. — P. 35–44.