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Short Communications

Rediscovery of *Bombus rufipes* Lepeletier 1835 (Hymenoptera: Apoidea: Bombidae) on Mount Slamet

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ABSTRACT

Bombus rufipes Lepeletier 1835 (Hymenoptera: Bombidae) is the only species of Bombidae found in Java. Recent information suggests that it occurs in Java on Mounts Salak 1200 m asl., Mt. Halimun, Mt. Pangrango Gede Complexes, Mt. Cernai, (West Java) Mt. Slamet, Mt. Merapi, Mt. Merbabu, Mt. Telomoyo (Central Java) and Mt. Argopuro (East Java), at altitudes above 1,500 m asl. We sought to rediscover this species on Mount Slamet by surveying natural forests at altitudes of 1,500–2,500 m asl on the eastern slopes of Mount Slamet, from August to October 2020 and August to October 2021. Descriptive and morphometric data were obtained and analyzed. The survey revealed five colonies nesting on the ground at an average depth of ca. 70 cm; the colonies contained 18–24 individuals and 22–36 cells (brood, honey, and pollen cells). Based on morphometric measurements and the description of Frison (1930), the species was identified as *Bombus rufipes* Lepeletier 1835. Therefore, *Bombus rufipes* still occurs on Mount Slamet. These results provide basic information that should aid further research on this species.

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Bumble bees (*Bombus* Latreille) are important pollinators of many wild flowering plants, and are also of agricultural importance (Liang et al. 2020). Their large bodies, relatively long glossae, abundance of plumose setae, and ability to sonicate porous anthers rapidly by contracting their thoracic flight muscles make them effective pollinators (Velthuis & van Doorn 2006). Twenty different bumble bee species have been identified as significant pollinators for a variety of food crops worldwide (Kleijn et al. 2015), and several bumble bee species have been domesticated to provide pollination services to food plants (Strange 2015). Despite the value of bumble bees as pollinators, the populations of several species around the world have decreased over the past few decades.

Bombus (Hymenoptera, Apoidea, Bombidae) is very rare in Southeast Asia (Williams 1998; Naeem et al. 2018). Four species occur on Greater Sunda Islands, usually scattered in high mountains (Sakagami 1976). The few of *Bombus* species in Southeast Asia is due to this family being distributed in sub-tropical areas with lower daily temperatures as opposed to tropical areas.

One species occurs on the island of Java, *Bombus rufipes* Lepeletier 1835 (Sakagami 1976). In 1930, Frison discovered this species on Mounts Halimun, Cermai, and Slamet at altitudes of 1,500–2,500 m asl. Michener & Amir (1977) found *B. rufipes* only in West and Central Java; in West Java, it occurred on Mount Salak 1200 m asl., Mt Gede Pangrango complex (Puncak Pass, Telagawarna 1450-1500 m asl., Cibodas 1400-2900 m asl., Mt. Lebak 2400 m asl., Mt Pangrango 2800-300 m asl, Ciberem 1700 m asl., Cisarua 1000 m asl., Mt. Tangkuban Perahu, 1200-1300 m asl, Mt Papandayan 2200 m asl., Mt. Patuha 2450 m asl and Mt Pangalengan 1250 m asl. Recently, Kahono et al. (2009) also found *B. rufipes* in the Mount Cermai area, West Java, while in Central Java it was found on Mount Slamet 1500 m asl., Mt Telomoyo, 1900 m asl., Dieng Plateau, Kawah Sibanteng 2400 m asl., Telaga Warna 2090 m asl., and Mt Merapi, the Dieng Plateau, and Mount Merapi at altitudes of 1,500–2,400 m asl. Kato et al. (1992) found colonies of *Bombus rufipes* in Cibodas (West Java) at an altitude of 1400-1600 m asl, and in Lake Talang (West Sumatra) at an altitude of 1200-1300 m asl. Based on this information, it appears that the findings of Kato et al. (1992) are the most comprehensive information about this species. The time span of discovery and information about *Bombus rufipes* in Java occurs in a very long period of time.

According to Williams et al. (2020), *Bombus rufipes* Lepeletier 1835 has five synonyms: *Bombus rufipes* Lepeletier de Saint-Fargeau, [1835], *Bombus flavipes* Handlirsch, 1888, *Bombus rufipes* var. [subsp.] *obscuripes* Friese, 1914: *Bombus rufipes* var. [subsp.] *intermissus* Friese, 1918, *Bremus rufipes* var. [subsp.] *richardsi* (Frison 1930). *Bombus rufipes* and *B. eximius* are now considered to belong to the subgenus *Melanobombus*. Morphologically, the black wings, black hair of the male face, they usually (but not always) have orange mid and hind tibiae (taxon *obscuripes*), while the individuals from Java usually have predominantly black mid and hind tibiae.

This study sought to rediscover *Bombus rufipes* Lepeletier 1835, on Mount Slamet, and to obtain additional important information on this species. This study was conducted in natural forests on the eastern slopes of Mount Slamet (7°14'44"S, 109°14'42"E), BKPH (Sub District Forest Management), Gunung Slamet Timur KPH (District Forest Management), East Banyumas, at altitudes of 1,500–2,500 m asl. Sampling was conducted from August to October 2020 and 2021 using a random sampling method with line transects at altitudes of 1,500–2,800 m asl. Nesting sites were sought by observing individual bumble bees visiting flowers. When bees were found, a bee nest on the ground was sought. The depth of the nest and numbers of individuals and cells (including brood and honey cells and pollen cells) in the nest were determined. Adult individuals were captured for measurement and morphological observations. From each colony, two adult bees were taken.

During the study from August to October 2020, we found five colonies scattered in primary forest at elevations of 1,500–2,500 m asl. and from August to October 2021 at the same place we found seven colonies. In Southeast Asia, bumble bees tend to nest in primary or protected highland

forests (Koch & General 2019). Nests are found on the ground under higher trees, at depths of ca 68–70 cm. This discovery turned out to be nothing new and specific because in general the *Bombus* nests in the ground, only specific species has found at surface nester. All *Megalobombus* (including *Bombus rufipes*) nest in the ground (Sakagami 1976). The entrance is disguised with moss or dry leaves and the nest materials include moss and dry leaves (Figure 1 a,b,c and d,e,f). This finding was in line with Kato et al. (1992) some nests have been found at abandoned underground nest of small mammals, the entrance nest was covered with shrubs, but the deep of the nest was 40 cm, shallower than what was found in this study. This finding is in line with Hines et al. (2018) who stated that bumble bee nest in the ground with varying sizes and depths.

The nest of *B. ruficeps* found at Mt. Slamet consisted of 8 to 12 brood cells, 5 to 8 honey cells, and 5 to 6 pollen cells (Figure 2), and differ from the findings of Kato et al. (1992) which showed the number of colonies found to be up to 46 cells. *B. rufipes* has small colonies compared to other *Bombus* species in Southeast Asia (Liang et al. 2020).



Figure 1. Nest structure: a) nest hollow, b) nest material with moss, c) worker in the nest d) location, e) entrance, and f) nest composition.



Figure 2. Nest composition: a) brood cell, b) honey cell, and c) pollen cells.

Morphological observations showed that the body is black, the wing tips are brown, the wings reflect a metallic blue. forelegs, middle and back parts of the tibia and tarsus are orange (Figure 3a and 4a). Mid legs, femur, tibia and tarsus are lights brown (Figure 3b and 4b) and the hind legs femur, tibia and tarsus are brown (Figure 3c and 4 c). Front of the heads is black (Figure 4d.). However, our weakness is that we are not able to distinguish between working queens and males, so the data is displayed without any information on caste or gender. Sample body length ranged from 19 – 22 mm (table 1).

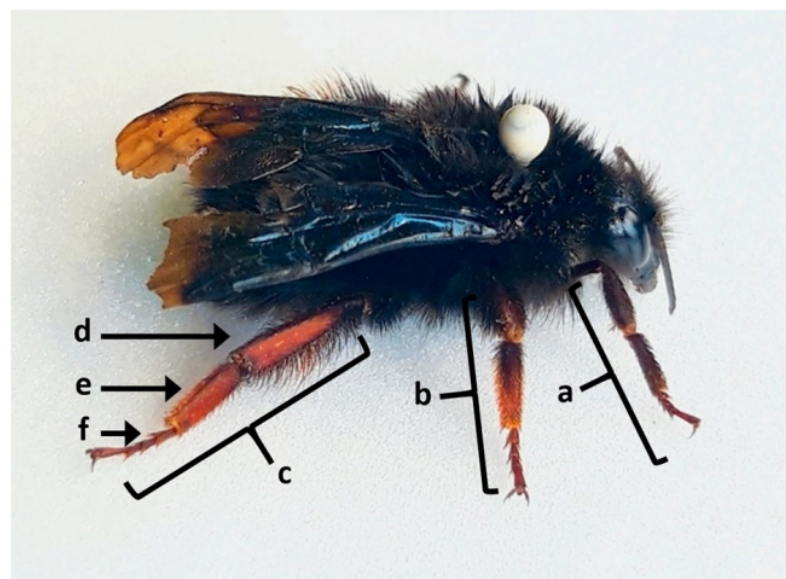


Figure 3. a. front legs, b. mid legs, c. hind legs, d. femur, e. tibia, f. tarsus.

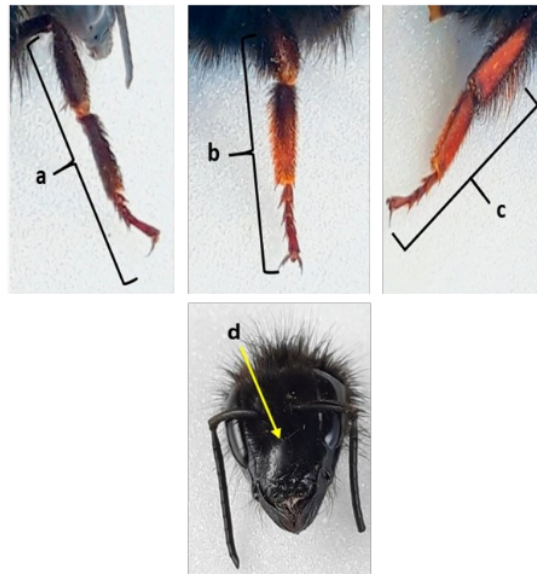


Figure 4. a. fore legs, b. mid legs, c. hind leg, and d. front of *Bombus rufipes*.

Based on the observed morphological character seems to be in accordance with the character characterized by Williams et al. (2020). Queens have very large body length 23–30 mm, workers 13–20 mm. They can be distinguished by their combination of wings yellow with the vein orange (cf. *B. rufipes*), the hair and integument of mid and hind tibiae and of all basitarsi

Table 1. Morphometrics character from *Bombus rufipes* from My Slamet.

No	Measurements (mm)	1	2	3	4	5	6	7	8	9	10	
1	Length of the body	19	20	19	19	20	22	22	22	19	21	20,3
2	Width of head	5,44	5,35	4,59	4,5	4,63	4,45	5,34	4,6	4,65	4,56	4,811
3	Length of head (Clypeal apex-vertex)	5,16	5,5	4,57	4,39	4,63	4,41	5,07	4,75	4,65	4,5	4,763
4	Length of compound eye	2,88	3,43	3,05	2,88	2,89	2,83	3,38	2,87	2,78	2,67	2,966
5	Width of compound eye	1,01	1,2	1,06	1,13	1,26	0,87	1,28	1,17	1,05	1,09	1,112
6	Alveolorbital distance	0,79	0,99	0,64	0,73	0,87	0,82	0,6	0,64	0,82	0,51	0,741
7	Alveolacellar distance	1,65	2,08	1,8	1,53	2,02	1,75	1,79	1,67	1,86	1,71	1,786
8	Alveolar Diameter	1,49	1,17	1,08	1,08	0,87	1,14	1,43	1,63	1,26	1,31	1,246
9	Length of clypeus	1,58	1,6	1,65	1,57	1,93	1,35	1,56	1,7	1,59	1,5	1,603
10	Maximum width of clypeus	2,24	2,49	2,38	2,32	2,85	2,22	2,55	1,99	2,25	2,44	2,373
11	Intertentorial distance, width of clypeus	1,63	1,7	1,24	1,4	1,49	1,21	1,37	1,22	1,51	1,38	1,415
12	Length of malar space	1,12	0,97	0,77	0,99	0,98	0,83	0,81	0,75	0,83	0,87	0,892
13	Length of scape	2,08	2,34	2,05	1,94	1,99	1,91	1,98	1,91	2,05	2,17	2,042
14	Length of mandible	2,47	2,34	1,27	1,37	1,45	1,8	2,29	1,62	1,4	1,31	1,732
15	Width of mandible	0,88	0,89	0,69	0,61	0,75	0,58	0,84	0,8	0,93	0,81	0,778
16	Tegula	1,23	1,04	1,1	0,93	0,95	0,91	1,14	1,02	0,81	0,96	1,009
17	WL2	3,21	0	3,39	3,77	4,28	3,32	4,51	3,88	3,8	4	3,416
18	Hamuli	22	0	15	16	25	23	25	24	25	23	19,8
19	Length of mesoscutum	4,24	4	3,85	3,73	4,17	3,97	4,17	3,81	3,48	4,11	3,953
20	Width of mesoscutum	4,6	4,59	4,38	4,72	4,5	4,56	4,68	4,24	4,35	4,71	4,533
21	Width of scutellum	0,89	0,55	0,63	0,45	0,9	0,67	0,74	0,6	0,57	0,61	0,661
22	Length of scutellum	3,83	4,42	3,81	3,27	3,96	3,24	3,61	3,4	3,24	3,21	3,599
23	Length of tibia III	4,71	5,65	5,04	5,1	5,44	4,65	5,48	5,12	4,52	4,59	5,03
24	Width of tibia III	1,51	1,96	1,63	1,54	1,77	1,69	1,68	1,77	1,35	1,77	1,667
25	Length of Basitarsus III	3,07	3,63	3,37	3,21	3,44	2,81	3,66	3,17	3,23	3,39	3,298
26	Width of Basitarsus III	1,13	1,65	1,06	1,34	1,52	1,31	1,34	1,51	1,43	1,55	1,384

orange (cf. some *B. rufipes*). In terms of morphology, the black wings, black hair of the male face, *Bombus* found at Mt Slamet are more in line with individuals from Sumatra, which usually (not always) have the mid and hind tibiae orange (taxon *obscuripes*), compared to the individuals from Java, which more usually have the mid and hind tibiae predominantly black (taxon *rufipes* s. str.).

Based on the matching nesting and morphological characteristics, we conclude that the *Bombus* species found was *Bombus rufipes*, and that it still occurs on Mount Slamet.

AUTHORS CONTRIBUTION

IW designed the study, analyzed the data, and wrote the manuscript. TH, EP, EY and ES collected data and wrote the manuscript.

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³ CONFLICT OF INTEREST

The authors report no conflicts of interest regarding this research.

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