

ORIGINAL ARTICLE

New synonym and new Japanese record of the ant genus *Ponera* (Hymenoptera: Formicidae)Masashi YOSHIMURA¹, Shingo HOSOISHI¹, Yuzuru KUBOKI¹, Keiichi ONOYAMA² and Kazuo OGATA¹¹Institute of Tropical Agriculture, Kyushu University, Fukuoka, and ²Nishi 21, Minami 4-11-9, Obihiro, Hokkaido, Japan**Abstract**

A new synonym in the ant genus *Ponera*, and a new species-record from Japan are reported following faunal surveys of Yakushima Island, Kagoshima Prefecture. Morphological comparison of type specimens with material collected on Yakushima and mainland Kyushu and Honshu reveals that *Ponera yakushimensis* Tanaka is a junior synonym of *Ponera scabra* Wheeler. Analysis of intraspecific variation in *P. scabra* is reported. Morphological comparison reveals that a recent putative distribution record of *P. scabra* from Yakushima was based on a misidentification of *Ponera alisana* Terayama. This is the first Japanese record of *P. alisana*, which was originally described from Taiwan. Geographic variation between the *P. alisana* types and specimens collected on Yakushima is discussed. A revised key to Japanese *Ponera* species is presented.

Key words: identification key, *Ponera alisana*, *Ponera scabra*, *Ponera yakushimensis*, taxonomy, Yakushima Island.

INTRODUCTION

Ants of the genus *Ponera* Latreille (1804) generally inhabit leaf litter and rotting logs (Taylor 1967; Ward 2000). *Ponera* occurs throughout the world, including the Malagasy region, but excluding the Neotropical and Afrotropical regions. The genus belongs in tribe Ponerini of subfamily Ponerinae, and includes 55 named taxa (Bolton 2003; Bolton *et al.* 2006). *Ponera* is characterized by the possession of single hind tibial spur and an anteroventral fenestra on the subpetiolar process. Since Taylor's (1967) worldwide taxonomic revision, which listed 28 extant species, the number of species has increased to 51 (Bolton *et al.* 2006). This has been due largely to the discovery of new species in eastern Asia, including eleven from mainland China (Xu 2001a,b), two from Taiwan (Terayama 1986) and five from Japan (Tanaka 1974; Terayama 1996). It is clear, however, that a further thorough revision of all known taxa is needed to properly evaluate their status.

Yakushima (30°20'N, 130°31'E) is located in the northern part of the Nansei Islands and its fauna is

closely related to that of mainland Kyushu (Terayama & Yamane 1999). Three of the eight Japanese *Ponera* species have been recorded on Yakushima, namely *Ponera kohmoku* Terayama (1996), *Ponera tamon* Terayama (1996) and *Ponera yakushimensis* Tanaka (1974) (Terayama 2004). The last species was based on specimens from Yakushima Island which were reported to closely resemble *Ponera scabra*, a species commonly distributed on Kyushu, but not then reported from Yakushima. Hosoishi *et al.* (2007) recently recorded four *Ponera* species from Yakushima in a list including both *P. scabra* and *P. yakushimensis*. This was considered an important record evidencing sympatry between these closely similar species. However, Hosoishi *et al.* admitted that some diagnostic characters discussed in previous studies were not applicable to the specimens they recorded as *P. yakushimensis*.

The present study aims to clarify the taxonomic validity of *P. scabra* and *P. yakushimensis* using morphological comparison among their types, and specimens from Yakushima and elsewhere.

MATERIAL EXAMINED

Specimens from the following collections have been examined: Institute of Tropical Agriculture and

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Entomological Laboratory (KUEC), Kyushu University, Fukuoka; National Science Museum (NSMT), Tokyo; and Osaka Museum of Natural History (OMNH), Osaka, Japan. All material other than types was from KUEC, and was collected by hand or with a Winkler extractor used to process litter and humus samples from 50 cm × 50 cm quadrats. Collection data for each specimen are indicated below. Among the study material of “*Ponera scabra*” (sensu Hosoishi *et al.* 2007), 19 individuals were used for the analysis of intraspecific variation in that species. They included two types, ten specimens from Yakushima, and seven from Nagasaki, Yamaguchi or Ibaraki Prefectures.

***Ponera scabra* Wheeler, 1928 (Japanese name: Teranishi-hari-ari) (Figs 1–3,10,11,16)**

Ponera scabra Wheeler (1928): 99–100.

Ponera scabra: Hosoishi *et al.* (2007).

Ponera yakushimensis Tanaka (1974): 32–36, fig. 1 (Holotype examined) **syn. nov.**

Specimens examined. Specimens used for the analysis of intraspecific variation (see Remarks section) are indicated in the list below by an asterisk following the specimen code. Individuals extracted from a single quadrat are thought probably to be members of a single colony. Such sets are listed enclosed in brackets.

Types examined. A syntype worker of *P. scabra* (MCZT_20482*) Mount Maya, Kobe?, Japan, 28. vi. 1925, F. Silvestri; Holotype worker of *P. yakushimensis* (OMNH: OMNH TI 219*, Figs 1–3), Ohsugidani (ca 1200 m a.s.l.), Yaku Island (Island Yakushima), Kagoshima, Japan, 5. viii. 1970, M. Tanaka.

Non-type specimens (KUEC). Japan. Honshu. (3 w [IBRK 01*, 02*, 03]), Kitaibaraki (650 m a.s.l.), Ibaraki, 30. vii. 2006, Y. Kuboki; (3 w [IBRK 04, 05, 06*]), same locality, 31. vii. 2006, Y. Kuboki; (8 w [YMGC 01-03, 04*, 05, 06*, 07, 08]), Shuho (280 m a.s.l.), Mine, Yamaguchi, 1. vi. 2005, Y. Kuboki. Kyushu. (4 w [NGSK 01, 02, 03*, 04*]), Matsuura (170 m a.s.l.), Nagasaki, 2. x. 2003, Y. Kuboki. Island Yakushima, Kumage, Kagoshima. 7 w (YKSB 01-03*, 05, 06, 07*, 08*), 1 dealate female (YKSB 04), Seibu forest path (180 m a.s.l.), 12. x. 2005, Y. Kuboki *et al.*; 2 w (YKSB 09, 10), same locality, 24. viii. 2004, K. Ogata *et al.*; 2 w (YKNT 01*, [02]), Nagata (280 m a.s.l.), 21. viii. 2006, Y. Kuboki *et al.*; 9 w (YKLD 01, 02, 03-05*, 06, [07], [08*], [09]), Yakusugi Land (1160 m a.s.l.), 22. viii. 2006, Y. Kuboki *et al.*

Remarks. High quality photographs of a syntype of *P. scabra* from the type specimens database of the Museum

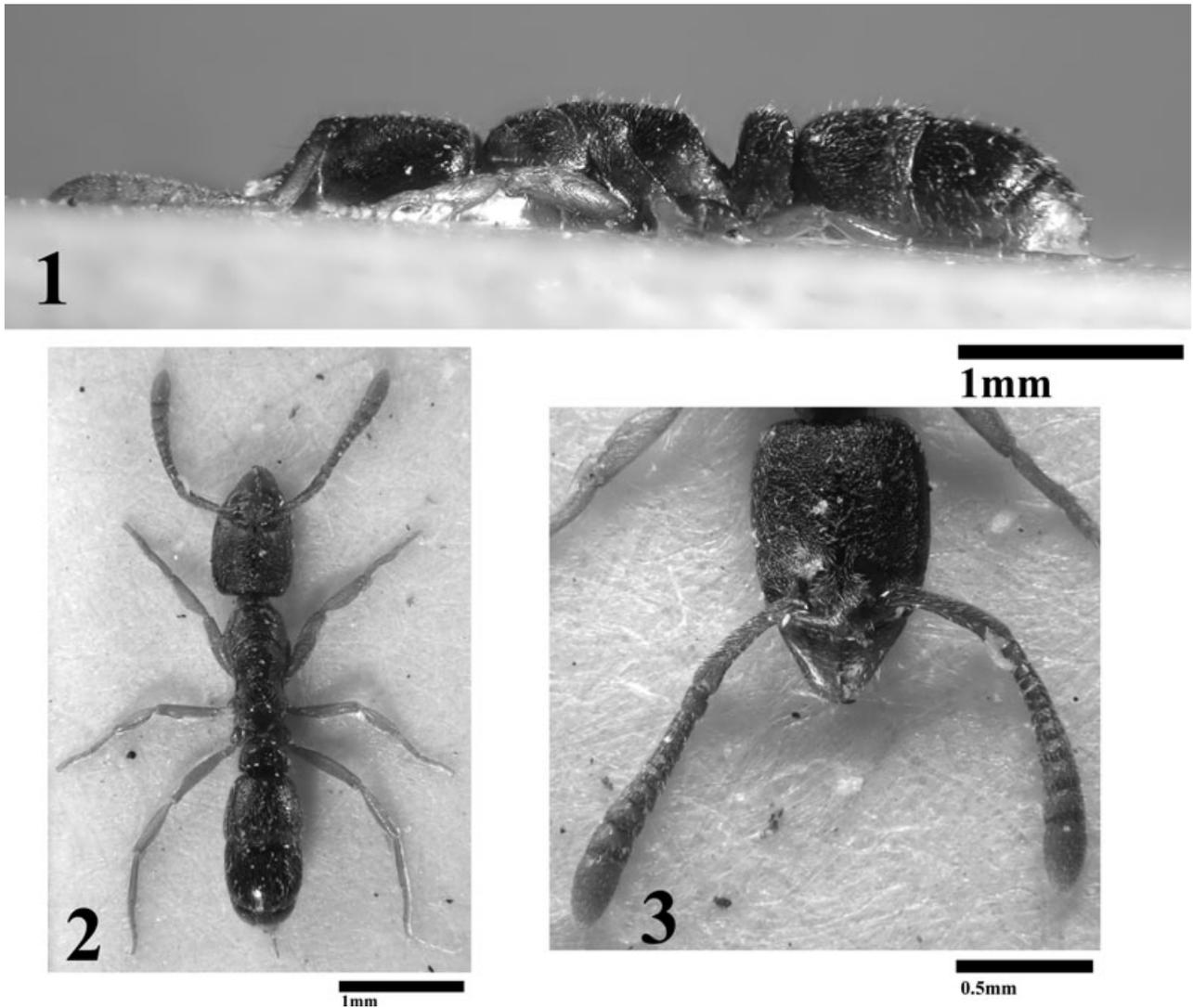
of Comparative Zoology, Harvard University, were used here *in lieu* of an actual specimen.

Morphological comparison of the *P. yakushimensis* holotype and specimens from Yakushima used in compiling the recent faunal report by Hosoishi *et al.* (2007) reveals that the identification of *P. yakushimensis* in that report was incorrect. The “*P. yakushimensis*” records were based on misidentified specimens of *Ponera alisana* Terayama (1986) (see *P. alisana* section below). Also, the specimens they identified as “*P. scabra*” were in fact representative of the species formerly referred to as *P. yakushimensis*. *P. scabra* and *P. yakushimensis* are therefore not sympatric on Yakushima as reported by Hosoishi *et al.*

Ponera yakushimensis was originally distinguished from *P. scabra* by the following characters (Tanaka 1974): (A) dorsal outline of mesosoma in lateral view more convex and arched; (B) posterodorsal projection of mesepisternum more convex; (C) posterolateral corners of propodeum and petiole in dorsal view less angled; (D) propodeal declivity more gently inclined; (E) posterior margin of petiole in dorsal view less concave; (F) sculpture of antennal scapes, pronotum, mesonotum, propodeum, petiolar node, and abdominal tergum III and IV (especially IV) designated using imprecise language, such as “little or much,” “whole or partial,” “sparse and/or shallow”; and (G) in their key, Onoyama and Terayama (1989) also separated *P. yakushimensis* from *P. scabra* by shallower and sparser punctures on abdominal tergite IV, compared with those on tergite III.

Previous diagnoses of *P. yakushimensis* cited relative differences in morphology compared with *P. scabra*. The latter is widely distributed from Iwate (ca 39°42'N 141°09'E) to Kagoshima (ca 31°34'N, 130°33'E) prefectures in Japan, and much variation can be observed. Moreover, re-examination of the putative differences in most characters is difficult without applying more properly detailed criteria for comparison. To test the distinction of *P. yakushimensis* from *P. scabra*, digitized criteria were designated for the present study, as follows. Characters observed in *P. yakushimensis* are given as (1), and those in *P. scabra* as (0). Each criterion was fundamentally derived from previous diagnoses. However, expressing the characters of “(C)” in those diagnoses proved difficult, and they are here presented as components of other criteria (see IPS and PMP).

(A) Dorsal outline of the mesosoma (DOM). An arched outline of the mesosomal dorsum is observed, primarily due to poor development of the pronotum. The characters were classified into two categories based on whether the dorsal-most point of the mesonotum was considered lower (1) or higher (0)



Figures 1–3 Holotype worker of *Ponera yakushimensis* Tanaka. 1 head to abdomen in lateral view; 2 head to abdomen in dorsal view; 3 head in full-face view.

than that of the pronotum when the ventral margins of the meso- and metapleurae are viewed horizontally.

(B) Posterolateral projection of the mesepisternum (PPM). Strong posterolateral projection of the mesepisternum is due to the development of a cover-like plate on the mesothoracic spiracle. Two categories are recognized based on whether the mesothoracic spiracle is distinct, so that the area is present as a plate isolated from the mesepisternum (1), or indistinct, where the area appears to be a part of the mesepisternum (0).

(D) Inclination of the propodeal slope (IPS). The characters are expressed by ranking the degree of

inclination. The angle of the posterolateral corner of the propodeum (cited as (C) in previous diagnoses) is included in this criterion because the angle is in fact difficult to measure due to its variability, which depends on the depth of the applicable measurement site. This variation is influenced by development of the posterolateral carinae of the propodeum, which form a slope when viewed laterally.

(E) Concavity of the posterior margin of the petiole (PMP). This character is expressed as a ranking based upon the depth of the concavity. The angle of the posterolateral corner of the petiole (cited as (C) in the previous diagnoses) was included in this

Table 1 Analyses for intraspecific variation of *Ponera scabra*

No.	Specimen Code	Characters						Note
		DOM	PPM	IPS	PMP	PPD	PA4	
01	MCZT_20482	1	1?	1	4	0	?	Syntype of <i>Ponera scabra</i> 650 m
02	IBRK06	0	0	2	5	0	1	
03	IBRK01	1	1	4	2	0	1	650 m
04	IBRK02	0	1	7	3	0	1	650 m
05	YMGC04	0	0	9	12	0	1	280 m
06	YMGC06	1	0	19	8	0	1	280 m
07	NGSK03	1	0	3	16	0	1	170 m
08	NGSK04	0	0	5	18	0	1	170 m
09	YKSB01	1	1	13	10	1	1	180 m
10	YKSB02	0	0	15	9	0	1	180 m
11	YKSB03	1	0	14	14	1	1	180 m
12	YKSB07	1	1	11	19	0	1	180 m
13	YKSB08	1	1	6	11	0	1	180 m
14	YKNT01	0	0	10	1	0	1	280 m
15	YKLD03	1	1	16	17	1	1	1160 m
16	YKLD04	0	1	8	7	1	1	1160 m
17	YKLD05	0	0	12	15	1	1	1160 m
18	YKLD08	0	1	17	13	1	1	1160 m
19	OMNH TI 219	0	0	18	6	1	1	Holotype of <i>Ponera yakushimensis</i> ; 1200 m

Characters examined are abbreviated: DOM, dorsal outline of the mesosoma; PPM, posterolateral projection of the mesepisternum; IPS, inclination of a propodeal slope; PMP, concavity of the posterior margin of the petiole; PPD, punctures on the posterior portion of the propodeal dorsum; PA4, punctures on abdominal tergite IV. A detailed definition of each character is given in the Remarks section above under *P. scabra*. Specimens numbered 01–06 are from Honshu, 07–08 are from Kyushu, and 09–19 are from Yakushima Island. Individuals from the same colony are placed in a dashed-line box. Characters which could not be classified are indicated by a question mark. The altitude where each specimen was collected is also given in the “Note” column.

criterion because the angle is in fact difficult to measure due to its variability, which depends on the depth of the applicable measurement site. The relative degree of concavity is the main factor of variation in perceived angles of the posterolateral corners of the petiole.

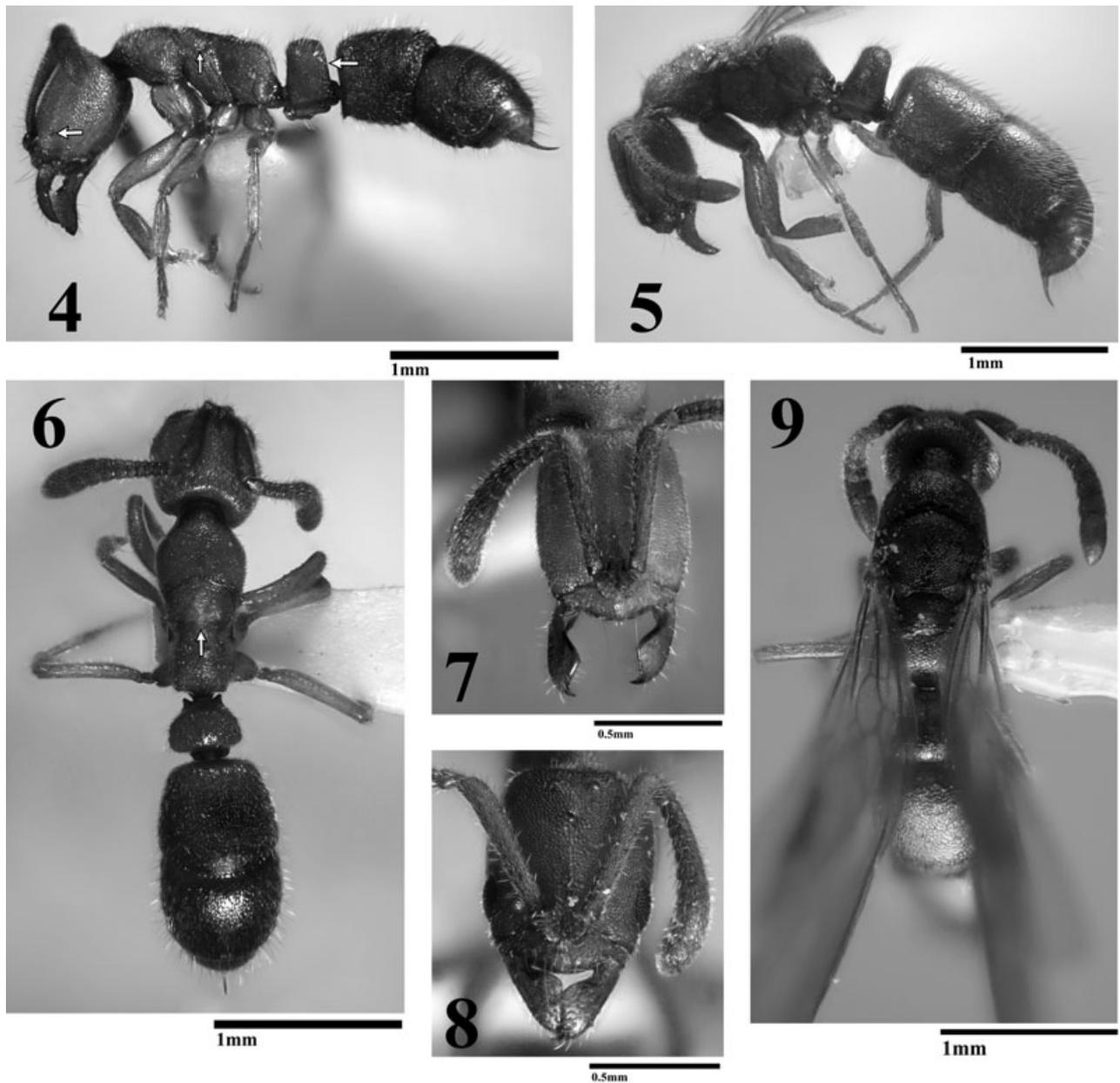
(F) Punctures on the posterior portion of the propodeal dorsum (PPD). Reduction of the punctures in a particular portion is correlated with those on the whole surface of the body. The characters are classified in two categories based on whether the punctures on the posterior portion of the propodeal dorsum are sparse, so that most of the area is unsculptured and smooth (1), or dense (0). Punctures on this area are generally not visible when those on the whole surface are reduced.

(G) Punctures on abdominal tergite IV (PA4). The two categories of this character are based upon whether the punctures on abdominal tergite IV are sparser than (1), or as dense as (0) those on tergite III.

The results of our analysis are given in Table 1. They reveal that large variations are present, not only

among specimens collected from Honshu and Kyushu, but also among those from Yakushima. In fact, no distinct differences in morphological characteristics were found between the holotype of *P. yakushimensis* and specimens collected from Yakushima. Also, specimens collected from Yakushima are similar to those from Honshu and Kyushu. Moreover, among the diagnostic characters, both conditions of DOM appeared as intra-colonial variations in specimens from Honshu and Kyushu. Both character variations of PPM were found among Yakushima specimens, and development of the projection on the mesothoracic spiracle was observed even in specimens from Honshu. The range of variation in IPS among specimens from Yakushima fell within that of specimens from Honshu, and the range of variation in PMP among specimens from Honshu and Kyushu fell within that of specimens from Yakushima. Sparser punctures on abdominal tergite IV compared with tergite III were common among all specimens examined (Figs 10,11).

The same diagnostic condition of the PPD character was shared among specimens from Honshu and Kyushu,



Figures 4–9 *Ponera alisana* Terayama collected from Yakushima. 4, 6, 7 worker; 5, 8, 9 alate female. 4, 5 head to abdomen in lateral view; 6, 9 head to abdomen in dorsal view; 7, 8 head in full-face view.

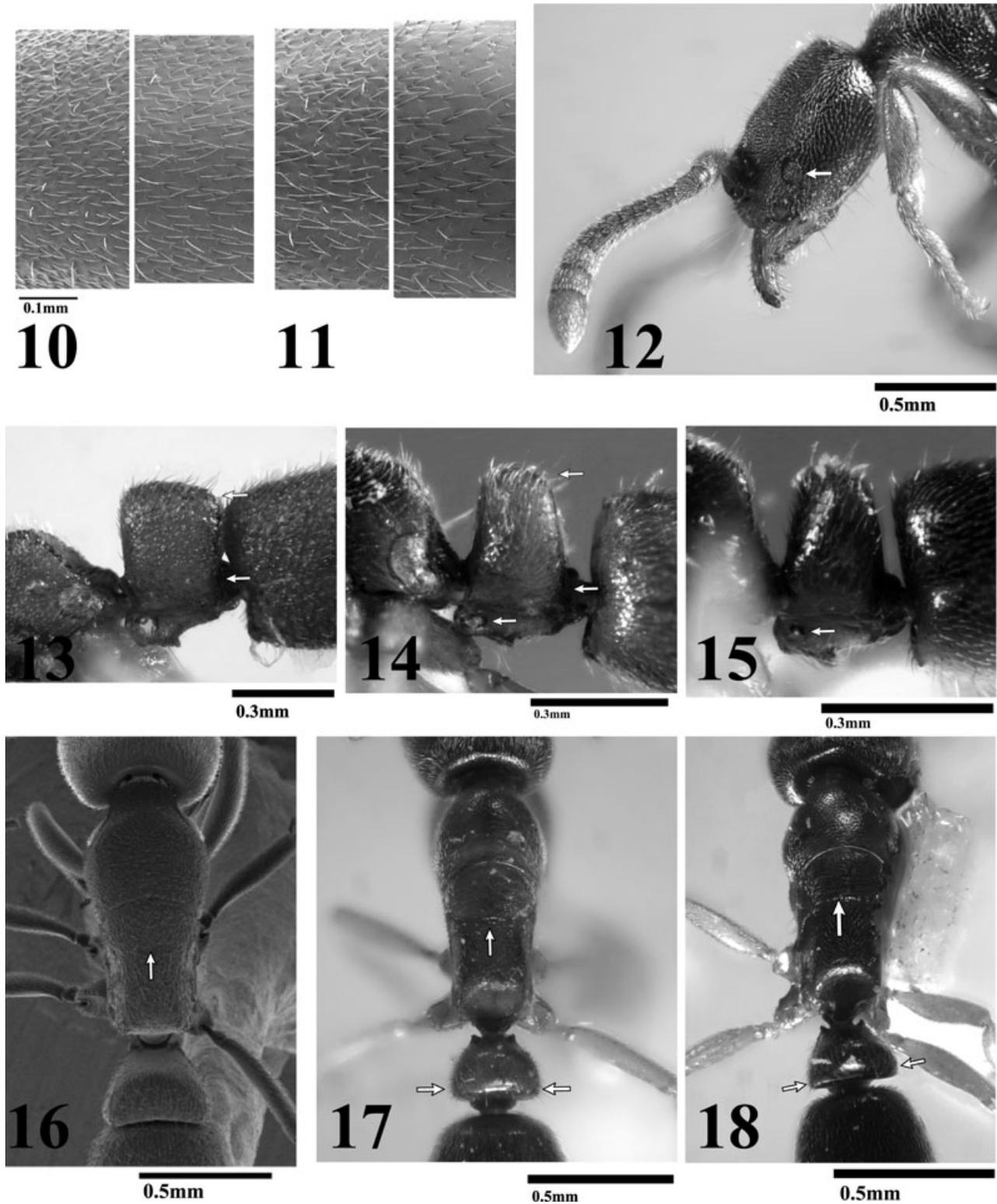
while some specimens from Yakushima exhibited the alternative condition, as seen in the holotype of *P. yakushimensis*. No other characters however supported the recognition of two separate species. The observed reduction of puncturation in specimens from Yakushima might represent geographical variation, especially at high altitudes.

These results indicated that the holotype of *P. yakushimensis* Tanaka (1974) falls within the range of intraspecific variation of *P. scabra*, so that the

former must be considered a junior synonym of the latter.

***Ponera alisana* Terayama, 1986 (Japanese name: Kodama-hari-ari [newly named]).**
(Figs 4–9)

Ponera alisana Terayama (1986): 591–593, figs 1–5 (holotype and a paratype examined).



Figures 10–18 Workers of the genus *Ponera* from Japan. 10, 11, 16 *Ponera scabra*; 12 *Ponera kohmoku*; 13 *Ponera takaminei*; 14, 17 *Ponera japonica*; 15, 18 *Ponera tamon*. 10, 11 sculpture on abdominal tergites III and IV (left: AIII, right: AIV); 12 head in lateral view; 13–15 petiole in lateral view; 16–18 mesosoma and petiole in dorsal view.

Ponera yakushimensis: Hosoishi *et al.* (2007) (misidentification).

Specimens examined. Holotype worker and a paratype dealate female (same colony) (NSMT), Fenchifu (*ca.* 1400 m a.s.l.), Chiayi Hsien, Taiwan, 3. viii. 1980, M. Terayama.

Non-type specimens examined (KUEC): Japan. Island Yakushima, Kumage, Kagoshima. 1 w (worker), Seibu forest path (180 m a.s.l.), 24. viii. 2004, K. Ogata *et al.*; 5 w, 1 alate female, Nagata (280 m a.s.l.), 21. viii. 2006, Y. Kuboki *et al.*

Measurements. Measurement criteria here follow Taylor (1967).

Holotype. Head length (HL) 0.77 mm, head width (HW) 0.59 mm, cephalic index (CI) 77, scape length (SL) 0.59 mm, scape index (SI) 100, Weber's length of mesosoma (WL) 1.01 mm.

A paratype worker. HL 0.80 mm, HW 0.59 mm, CI 75, SL 0.62 mm, SI 105, WL 1.04 mm.

Non-type specimens. HL 0.76–0.82 mm, HW 0.58–0.63 mm, CI 75–81, SL 0.55–0.59 mm, SI 91–100, WL 0.99–1.08 mm (eight workers measured).

Remarks. This is the first record of *P. alisana* from Japan. These specimens were misidentified as *P. yakushimensis* in the faunal report of Hosoishi *et al.* (2007). All were collected from litter and humus collected from laurel forests in the western part of Yakushima during surveys carried out 2004–2006.

Ponera alisana can be distinguished from other Japanese *Ponera* species by the following characteristics: (i) the body size is relatively large (HW: 0.58–0.62 mm in worker, 0.62 mm in female); (ii) the compound eyes are small, consisting of less than five facets; (iii) the mesopleuron is clearly separated from the mesonotum by an oblique suture; (iv) the metanotal groove is clearly and deeply impressed; (v) the anterior and posterior margins of the petiole in lateral view are nearly parallel; (vi) the petiole in lateral view is rectangular, and the posterior margin of the petiolar node is almost straight; (vii) the subpetiolar process in lateral view is long, distinctly more than twice as long as its height; and (viii) abdominal segment III in dorsal view is nearly as wide as long, or slightly wider than long.

Ponera alisana was originally described from Taiwan, and no other distribution records had been reported. Worker specimens of this species from Yakushima differ from the type specimens in having relatively short antennal scapes (SI 91–100), which fail slightly to reach the posterior margin of the head (Figs 7,8), as opposed to distinctly exceeding this boundary in the types. Length

of the antennal scape is generally considered a stable character serving to distinguish species in Ponerinae (e.g. in the genera *Hypoponera* and *Pachycondyla*). However, no other consistent differences between the types and the Yakushima specimens can be found. Taylor (1967) also mentioned geographical variation in length of the scape in *Ponera japonica* Wheeler (1928). In addition, some morphological variation in other characters was found among the Yakushima specimens (e.g. size of the metapleural gland bulla, depth of the metanotal groove, width of the petiole), and Yakushima is geographically remote from the Taiwan type locality, with the diverse Nansei Islands chain, separating the two (Terayama & Yamane 1999). We consider this difference in only one quantitative character insufficient to warrant recognition of specimens from these two islands as separate species, and regard the observed differences in relative length of the antennal scape as intraspecific variation.

The following revised key is based largely on that of the Japanese Ant Database Group (1998).

Key to the Japanese species of *Ponera*

1. The third abdominal tergite distinctly longer than wide in dorsal view*P. bishamon*
– The third abdominal tergite nearly as long as wide in dorsal view (Figs 2,6)2
2. Dorsal margin of petiolar node in lateral view extending posteriorly over a vertical line extended from its lower part (Fig. 13)*P. takaminei*
– Dorsal margin of petiolar node in lateral view not extending posteriorly over a vertical extension of its lower part (Figs 1,4,14,15)3
3. Eyes large, each consisting of 20 or more facets (Fig. 12)*P. kohmoku*
– Eyes small, each consisting of 10 or fewer facets (Fig. 4)4
4. Suture between mesonotum and mesopleuron absent*P. swezeyi*
– Suture between mesonotum and mesopleuron distinct (Fig. 4)5
5. Metanotal groove vestigial or indistinct (Fig. 16)*P. scabra*
– Metanotal groove deeply impressed (Figs 6,17,18)6
6. Petiolar dorsum wholly covered with sculpture. Posterior margin of petiolar node almost straight in lateral view (Fig. 4)*P. alisana*
– Petiolar dorsum partially unsculptured and shining. Posterior margin of petiolar node weakly convex in lateral view (Figs 14,15)7
7. Petiolar node less than twice as wide as thick (Fig. 17). The fenestra on the subpetiolar process

large in lateral view, its vertical diameter as long as or longer than the length between the ventral margin of the fenestra and that of the subpetiolar process (Fig. 14)*P. japonica*
 – Petiolar node at least twice as wide as thick (Fig. 15). Fenestra on the subpetiolar process small in lateral view, its vertical diameter shorter than the length between the ventral margin of the fenestra and that of the subpetiolar process (Fig. 15)*P. tamon*

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