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Title	Taxonomic Studies on the Genus <i>Lasius</i> in Hokkaido, with Ethological and Ecological Notes (Formicidae, Hymenoptera). : II. The Subgenus <i>Lasius</i> (With 7 Text-figures and 5 Tables)
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**Taxonomic Studies on the Genus *Lasius* in Hokkaido,  
with Ethological and Ecological Notes (Formicidae,  
Hymenoptera). II. The Subgenus *Lasius*<sup>1)</sup>**

By

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(With 7 Text-figures and 5 Tables)

As a part of their myrmecological studies in Hokkaido, the writers have attempted to clarify the taxonomy, ethology and ecology of the ant genus *Lasius* in Hokkaido since 1966, for the lack of reliable revision in Japan. Following the previous paper (1968) on the subgenus *Dendrolasius* or jet black ants, the present paper deals with *Lasius* s. str., the most predominant and troublesome subgenus, in Hokkaido.

Before going further, the writers wish to express their cordial thanks to Prof. Mayumi Yamada and Dr. Shôichi F. Sakagami, Zoological Institute, Hokkaido University, for their kind guidance to the present study. Their sincere gratitudes are also expressed to Prof. Edward O. Wilson, Harvard University, for his valuable suggestions concerning the taxonomic characteristics studied.

**I. Taxonomic Part**

1.1. *Characters examined and measured*

Besides the examination of numerous morphological characters, the individual variations of some characters were studied quantitatively, mainly by using the workers of each species. For various measurements, as a rule five nests, obtained in Sapporo, were sampled at random for each species and 20 specimens were extracted from of these nest series. In addition to these standard series, three specimens were extracted from each nest series obtained from various locations in Hokkaido. The collection of sexuals was not so easy that information on some

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taxonomic characters and their individual variations were not sufficiently studied except for *L. niger*.

Definition of measurements, terms and symbols used according to Wilson (1955) are as follows:

1) *Cephalic index* (CI): Head width  $\times$  100/head length, 2) *Eye length* (EL): Maximum eye length, 3) *Eye width* (EW): Maximum eye width, 4) *Head length* (HL): Head length, held in perfect full face, measured from midpoint of anterior border of median clypeal lobe to midpoint of occipital border, 5) *Head width* (HW): Maximum head width, held in perfect full face, excluding eyes in worker and queen while including eyes in male, 6) *Maxillary palpal length* (ML): Maximum length of terminal segment of maxillary palp, measured from distalmost part of rim of penultimate segment to tip of terminal segment, 7) *Perfect full face*: Head as seen in frontal view when held so as to attain occipital border horizontally aligned, 8) *Regression zone*. Zone expressed by the distribution of individual plots as to two characters concerned, 9) *Scape index* (SI): Scape length  $\times$  100/head width, 10) *Scape length* (SL): Maximum scape length exclusive of basalmost "neck", 11) *Seta count* (SC): Number of standing hairs seen extending beyond outline of the following appendage surfaces; anterior scape surface viewed in line with plane of funicular flexion, and outer surface of fore tibia viewed in line with plane of tibial flexion, henceforth often abbreviated SC-plane, 12) *Standing hairs*: Hairs forming an angle with cuticular surface of 45° or more.

All measurements were made with an ocular micrometer fitted in a binocular dissecting microscope at a magnification of 60  $\times$ .

### 1.2. Notes on the Japanese species of the subgenus *Lasius*

Although the species belonging to *Lasius* s. str. have frequently been cited in the previous papers dealing with the Japanese ant fauna, they represent indubitably one of the most confused group among Japanese ants. Wilson (1955) recorded three species from Japan; that is *Lasius niger*, *alienus* and *productus*. Thereafter, studying the ecological distribution of ants in Sapporo and its vicinity, one of the writer (K.H.) (1960) distinguished four species; *niger*, *alienus*, *emarginatus* and *brunneus*. On the other hand, another writer (K.Y.) (1968) regarded *niger*+*alienus*, *emarginatus* and *brunneus* reported by K.H., as *alienus*, *niger* and *L. sp.* respectively. These confusions were brought on by the difficulty in identification, due to the close similarity for each other and remarkable geographical variations which have not yet sufficiently be clarified. In the present study, the writers distinguished at least three forms in Hokkaido, each of which regarded distinct species. One of them is certainly identical with *L. niger*. The other two species do not coincide in some characters with descriptions of any *Lasius* species so far published.

It would be likely that one of them or both are identical with some other species already published under different names, with incomplete descriptions. After a little hesitation, however, the writers decided to describe them as new species by the following reasons:

1) The identification with the previous species described incompletely often causes a series confusion, especially in taxonomically difficult groups. In such case, the description sufficient for the check in future of any probably errors.

2) The species of *Lasius* s. str. are one of the most abundant and ubiquitous ant groups in Japan appearing in various ecological samples, so that the establishment of their accurate taxonomic characters symbolized by the names are urgently needed by ecologists of various fields.

### 1.3. Description of each species

#### *Lasius niger* Linné

According to Wilson (1955), the unique character found to be of consistent diagnostic value between *L. niger* and *L. alienus* is the quantity of appendage pilosity in all three castes. But he writes that in Eastern Asia *L. niger* tends to reduce standing hairs on scapes and tibiae, resulting in the difficulty of its separation from sympatric populations of *L. alienus*. In the present study too, this character of *L. niger-alienus* complex from Hokkaido varied in workers

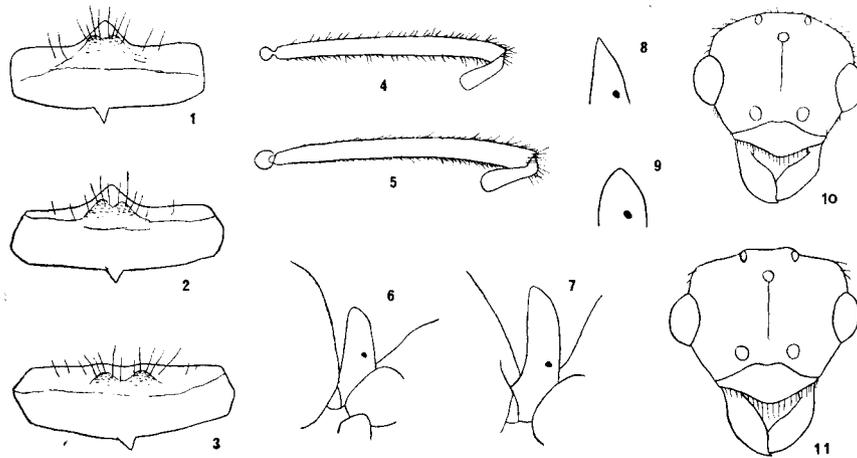


Fig. 1. 1, subgenital plate of *L. hayashi* ♂; 2, subgenital plate of *L. niger* ♂; 3, subgenital plate of *L. sakagamii* ♂; 4, scape of *L. sakagamii* ♀; 5, scape of *L. hayashi* ♀; 6, petiole in profile of *L. sakagamii* ♀; 7, petiole in profile of *L. hayashi* ♀; 8, petiole in profile of *L. hayashi* ♂; 9, petiole in profile of *L. sakagamii* ♂; 10, head of *L. sakagamii* ♂; 11, head of *L. hayashi* ♂.

considerably as shown by SC range covering 0–50 (Fig. 2) making the separation of *L. niger* and *L. alienus* impossible. Consequently, the writers would like to regard all populations of this complex in Hokkaido as *L. niger*. Another reason to strengthen this assumption is given as follows: The large sized workers with higher SC value can be identified with certainly *L. niger*. As mentioned by Wilson, these workers have smaller SC value than those of the European populations of *L. niger*. Their scapes have standing hairs tending to concentrate on the distal third to half

on the SC-plane as *L. hayashi* (cf. Fig. 1), although numerous standing hairs on scapes and tibiae contrast to the possession of few or no standing hairs in *L. alienus*.

Besides, it was concluded that the small workers with low SC value were always to be recognized as those of incipient colonies of *L. niger* by the following items of evidence:

1) All colonies of these small workers are very small as shown in Table 1. 2) Their queens have no characters definitely different from those of *L. niger*. 3) Their habitat and nest site preferences are not different from those of *L. niger* (cf. Tables 1 and 3). 4) EL-HW and SL-HW regression zones of these workers coincide with those of *L. niger*.

Table 1. Some records on the habitat and nest site of *L. niger* in incipient colonies.

Nest No.	Date of excavation	Habitat	Nest site	No. of queen	No. of worker
1	17-V-1966	<i>Salix</i> wood	Subterranean several cm in depth	1	20
2	16-VII-1966	Bare ground	In an abandoned nest of <i>Andrena valeriana</i>	1	20
3	22-VIII-1966	Herb ground	Around herbaceous root system	1	22
4	3-VI-1969	<i>Abies</i> wood	Under litter	1	49

However, these workers may hardly be distinguished from *L. alienus*. The name "*alienus*" is often found in the papers dealing with Japanese ants (Teranishi 1915, 1930, Morisita 1945, Kogure 1955). Morisita (personal communication) observed some specimens without standing hairs on scapes and tibiae and regarded them *L. alienus*. Further studies are required to clarify on the presence or not of *L. alienus* in Hokkaido.

In all queens examined, standing hairs on scapes and tibiae tend to diminish and concentrate on the distal third to half on SC-plane as in workers. Other measurements are given in Table 2.

In males examined, standing hairs are very sparse on scapes and tibiae, SC usually nearly 0. Other measurements are given in Table 2.

*Lasius sakagami* sp. nov.

*Worker.*

*Size:* Body length 2.5–3.5 mm; other measurements in Table 2.

*Color:* Body bicolourous, thorax and petiole medium brown, contrasting with slightly darker head and dark brown gaster; appendages light to medium brown; hairs whitish or light yellowish brown.

Table 2. Some morphological characters measured in each species of *Lasius* s. str. Values are given as modes and, in parentheses, minima and maxima.

Caste	Species	SL	HL	HW	EL	EW
worker	<i>hayashi</i>	1.01 (0.91-1.13)	1.06 (0.96-1.21)	1.08 (0.94-1.02)	0.24 (0.22-0.28)	0.19 (0.17-0.22)
	<i>niger</i>	1.03 (0.89-1.15)	1.03 (0.90-1.20)	0.98 (0.84-1.20)	0.26 (0.23-0.31)	0.22 (0.15-0.24)
	<i>sakagami</i>	0.94 (0.82-1.01)	0.94 (0.84-1.09)	0.86 (0.75-1.00)	0.24 (0.21-0.26)	0.19 (0.17-0.21)
queen	<i>hayashi</i>	(1.23-1.25)	(1.51-1.58)	(1.66-1.82)	(0.42-0.46)	(0.28-0.30)
	<i>niger</i>	(1.23-1.30)	(1.55-1.60)	(1.65-1.78)	(0.43-0.47)	(0.30-0.33)
	<i>sakagami</i>	(1.30-1.37)	(1.49-1.58)	(1.66-1.75)	(0.44-0.46)	(0.30-0.33)
male	<i>hayashi</i>	(0.74-0.76)	(0.87-0.92)	(1.03-1.09)	(0.29-0.33)	(0.24-0.26)
	<i>niger</i>	(0.63-0.68)	(0.78-0.84)	(0.85-1.00)	(0.30-0.34)	(0.24-0.26)
	<i>sakagami</i>	(0.63-0.66)	(0.70-0.81)	(0.85-0.93)	(0.29-0.32)	(0.24-0.26)

Caste	Species	ML	PW	CI	SI	SC
worker	<i>hayashi</i>	0.21 (0.18-0.23)	0.69 (0.60-0.80)	100 (95-109)	95 (86-100)	13 (4-25)
	<i>niger</i>	0.20 (0.18-0.23)	0.65 (0.56-0.80)	98 (93-105)	100 (90-108)	17 (6-30)
	<i>sakagami</i>	0.19 (0.17-0.22)	0.61 (0.52/0.72)	93 (89-97)	106 (99-110)	40 (30-53)
queen	<i>hayashi</i>	(0.23-0.25)	(1.88-1.93)	(110-118)	(69-70)	(2-8)
	<i>niger</i>	(0.21-0.25)	(1.90-2.03)	(104-111)	(70-79)	(8-18)
	<i>sakagami</i>	(0.21-0.23)	(2.00-2.12)	(110-112)	(77-80)	(45-56)
male	<i>hayashi</i>	(0.14-0.16)	(1.04-1.10)	(114-121)	(70-72)	(0-2)
	<i>niger</i>	(0.14-0.16)	(0.90-1.02)	(110-121)	(69-74)	(0-3)
	<i>sakagami</i>	(0.14-0.16)	(0.90-0.96)	(115-121)	(69-74)	(4-15)

*Hairs*: Head viewed in perfect full face with numerous standing hairs all over outline; scapes and tibiae with numerous standing hairs; SC more than 30 (Fig. 2); standing hairs on SC-plane of scape mostly erect to suberect, distributed uniformly from base to tip (Fig. 1).

*Head*: Narrower than other Japanese species of *Lasius* s. str. except *L. productus*; CI ranging 89-97, with mode at 93; occipital border viewed in full face feebly concave; frontal groove indistinct; clypeus feebly keeled or not, with broadly rounded anterior border; mandible with 7-9 denticules, the basal teeth 2-4 in number, about same for each other in size and shape; SI ranging 99-110 within workers with PW 0.52-0.72 mm, falling on same SL-HW regression zone of *L. niger* (cf. Fig. 3); ML as same as EW or smaller, rarely slightly larger.

*Thorax*: Thoracic dorsum to level same to that of propodeum, when seen in

Table 3. Habitat preference of each species expressed by the number

Species Habitat type	<i>L. niger</i>							
	BS	BA	SH	PT	HG	WM	WD	WC
Sapporo (Hayashida 1960)	33	48	46	—	10	51	30	
Sapporo (Yamauchi 1967)	5	8	1	1	7	34	44	9
Hidaka-Monbetsu (Yamauchi 1969)					4	22	2	3
Kutchan (Hayashida 1964)		2	1		16	46	13	
Akkeshi (Hayashida & Maeda 1960)	31	36			52	30		5
Nokanan (Yamauchi 1968)	15	23						7
Hama-Koshimizu			12					7
Nayoro		5						18
Rumoi		4			11			23

profile from a base line drawn from lowest point of prosternum to lowest point of the mesosternum.

*Petiole*: Thicker in profile and narrower in frontal view as compared with those of other Japanese species of *Lasius* s. str. (Fig. 1); posterior surface flat and brilliant at center, rounded at both sides; dorsal border in frontal view slightly convex to shallowly emarginate.

*Queen*.

*Size*: Body length 7–8 mm; other measurements in Table 2.

*Color*: Body concolous, dark brown; appendage medium brown; hairs whitish or light yellowish brown; wings hyaline.

*Hairs*: Head viewed in full face with many standing hairs at occipital border and corners, less at genal borders; scapes and tibiae with numerous standing hairs; SC more than 45; standing hairs on SC-plane of scapes mostly erect to suberect, distributed uniformly from base to tip as in worker.

*Head*: CI ranging 110–112; occipital border feebly concave; frontal groove distinct; clypeus feebly keeled, with broadly rounded anterior border; mandible with 7–9 denticules, basal teeth 2–4 in number, often varying in size and shape not as in worker; SI ranging 77–80, ML slightly larger than 2/3 of EW.

*Thorax*: Sectum in dorsal view broader than long, in profile sloped at anterior 1/4 to 1/3.

*Petiole*: Thin in profile, with sharp dorsal crest.

*Male*.

*Size*: Body about 3.5 mm; other measurements in Table 2.

*Color*: Body medium to dark brown, (uncertain because only juvenile specimens were observed); appendages light to medium brown; hairs whitish or light yellowish brown.

*Hairs*: Viewed in perfect full face with numerous standing hairs over outline; scapes and tibiae with numerous standing hairs, but remarkably less than those in worker and queen; SC mostly several.

of colonies discovered. (—: Species not discovered).

<i>L. sakagami</i>								<i>L. hayashi</i>							
BS	BA	SH	PT	HG	WM	WD	WC	BS	BA	SH	PT	HG	WM	WD	WC
29	—	—	—	—	—	—	—	—	—	—	—	—	11	—	24
4	—	—	—	—	—	—	—	—	—	—	—	—	1	4	—
—	—	—	—	—	—	—	—	—	—	—	—	—	—	2	—
—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
30	7	—	—	—	—	—	—	—	—	—	—	—	—	11	—
—	9	—	—	—	—	—	—	—	—	—	—	—	—	—	—
—	7	—	—	2	—	—	—	—	—	—	—	—	—	—	—

*Head*: Occipital border rounded, occipital corner curving gradually into occipital border (Fig. 1); clypeus not keeled, with broadly rounded anterior border; mandible lacking subapical cleft, the basal angle broadly rounded, the masticatory broader curving gradually into basal border; denticles lacking on masticatory border; ML about 3/5 of EW.

*Thorax*: Slightly broader than head; scutum broader than long; parapsidal furrows almost straight, broader at anterior.

*Petiole*: Thicker in profile than in other species of *Lasius* s. str., tapering roundly to tip (Fig. 1); in frontal view dorsal border concave.

*Type designation*: Holotype: Worker: Sapporo, Hokkaido, 30-VII-1966, K. Yamauchi leg. HW 0.95, HL 1.03, EW 0.19, EL 0.26, SL 1.00, ML 0.19, PW 0.67, SC 36, CI 108, SI 105. Paranidotypes: 20♂♂, 8♀♀, 8♂♂. Paratypes: Numerous ♂♂, 3♀♀ from Hokkaido (Sapporo, Shiraoi, Kutchan, Asahikawa, Nokanan, Rumoi, Nayoro), Honshu (Tokyo). The holotype, paranidotypes and some paratypes are provisionally deposited in the private collection of K.Y. Other paratypes are deposited in the Zoological Institute, Faculty of Science, Hokkaido University.

*Remarks*: This species can easily be separated from other Japanese species of *Lasius* s. str. by numerous standing hairs on worker and queen scapes and tibiae, shape of male and worker petioles, and shape of male subgenital plate. Besides, the coloration of workers is a good character to separate it from the other species. However, the proportions in some body parts of this species are almost same to those of *L. niger*. The mode of life of this species is, as mentioned later, very similar to that of *L. emarginatus*. Moreover, these two species are closely related for each other in some characters such as SI range, shape of subgenital plate, etc., but different in the following points: 1) the coloration of workers in this species is not reddish as in *L. emarginatus*; 2) the worker thoracic dorsum in almost same level relative to the propodeum in this species, contrasting with the lower level of thoracic dorsum in those of *L. emarginatus*; 3) the queen scutum in

profile is sloped at the anterior 1/4 to 1/3 as compared with *L. emarginatus* in which the scutum is sloped at anterior 1/6, and the rest is perfectly flattened. The species was dedicated to Dr. Sh. F. Sakagami.

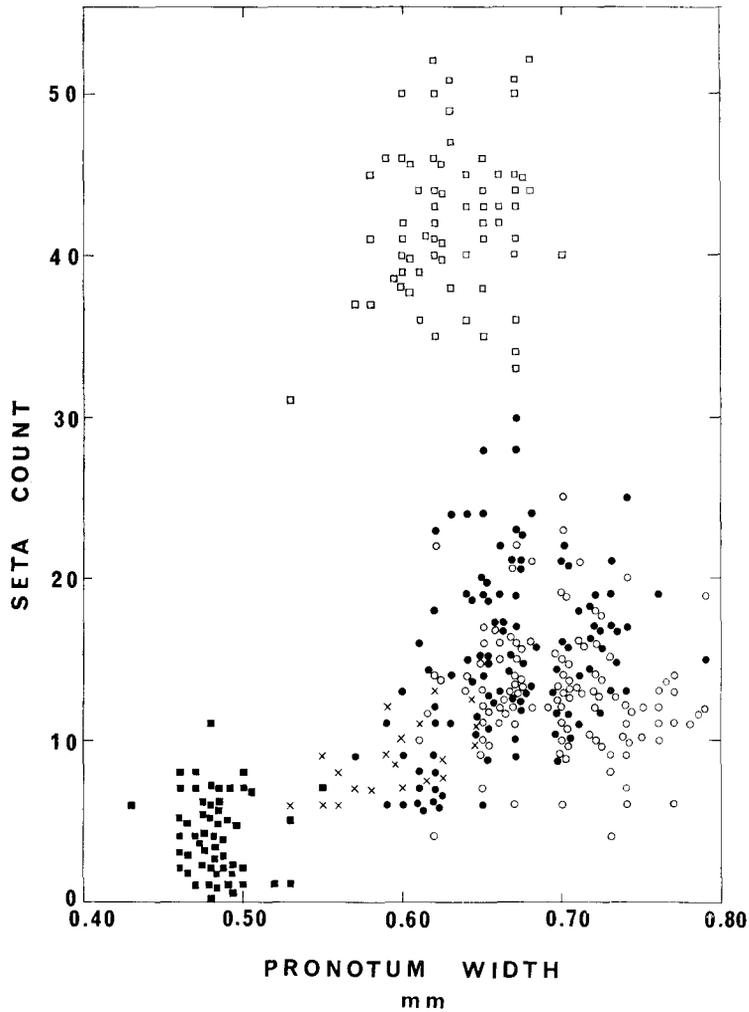


Fig. 2. Seta count-pronotum width relationships in workers of *L. niger*, *L. sakagami* and *L. hayashi*. ●: *niger* in mature colonies, ×: *niger* in small colonies, ■: *niger* in incipient colonies, ○: *hayashi*, □: *sakagami*.

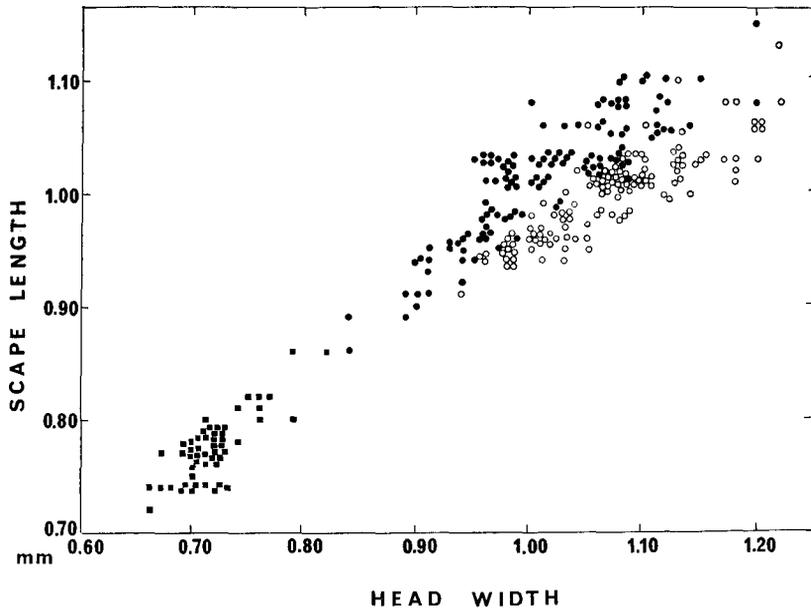


Fig. 3. Scape length-head width relationships in workers of *L. niger* and *L. hayashi*. ●: *niger*, ■: *niger* in incipient colonies, ○: *hayashi*.

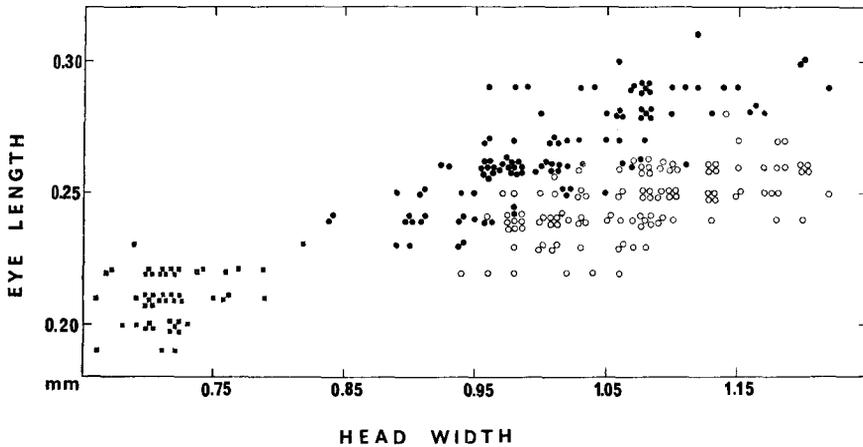


Fig. 4. Eye length-head width relationships in workers of *L. niger* and *L. hayashi*. ●: *niger* in mature colonies, ■: *niger* in incipient colonies, ○: *hayashi*.

*Lasius hayashi* sp. nov.*Worker.*

*Size:* Body length 2–4 mm; other measurements in Table 2.

*Color:* Body bicolorous, contrasting with dark reddish brown gaster and light yellowish brown to medium reddish brown thorax and petiole, head as same as thorax and petiole or slightly darker; appendages yellowish brown; hairs whitish or light yellowish brown.

*Hair:* Head viewed in full face with less standing hairs than *L. sakagami*, the genal margins with few or no standing hairs at eye level; scapes and tibiae with numerous standing hairs, but tending to be less than *L. niger* as shown by SC value (Fig. 2); scape with a few or several standing hairs on SC plane, tending to concentrate on the distal third or half as *L. niger* (Fig. 1).

*Head:* Head relatively to thorax more massive than other Japanese species of *Lasius* s. str.; CI ranging 95–109, the mode at 100; occipital border viewed in full face feebly concave; frontal groove indistinct; clypeus feebly keeled or not, with broadly rounded anterior border; mandible with 7–9 denticules, basal teeth almost same for each other in size and shape; ML about same as EW, mostly slightly larger; SI smallest among Japanese species of *Lasius* s. str., but overlapping partly with *L. niger* and *L. sakagami* as in Fig. 3.

*Thorax:* Thoracic dorsum as same level as propodeum as in *L. sakagami*.

*Petiole:* Petiole in profile thin (Fig. 1), broad in frontal view; posterior surface flat to slightly concave, strongly brilliant; dorsal border in frontal view slightly convex to slightly emarginate, mostly flat.

*Queen.*

*Size:* Body length 7–8 mm; other measurements in Table 2.

*Color:* Body color varying from concolorous dark reddish brown to bicolorous with reddish brown thorax and petiole contrasting with dark reddish brown head and gaster; appendages light to medium brown; hairs whitish or light yellowish brown; wings hyaline.

*Hair:* Head with a few standing hairs all over the outline; standing hairs on scapes and tibiae as in worker, although much sparser; SC less than 10.

*Head:* CI ranging 110–118; occipital border feebly concave; frontal groove distinct; clypeus feebly keeled, with broadly rounded anterior border; mandible with 7–9 denticules, basal teeth 2–4 in number, often varying in size and shape not as in worker; SI ranging 69–70; ML/EW ratio larger than *L. sakagami*.

*Thorax:* Scutum in dorsal view broader than, in profile sloped at anterior 1/4 to 1/3.

*Petiole:* Petiole in profile thin, with sharp dorsal crest.

*Male.*

*Size:* Body length about 4 mm; other measurements in Table 2.

*Color:* In juvenile specimens, body bicolorous, thorax and petiole medium brown contrasting with dark brown head and gaster; appendages light to medium brown, wings hyaline.

*Hairs:* Head with few or no standing hairs all over the outline; scape and tibiae with sparse standing hairs; SC usually 0.

*Head:* Head viewed in full face with broad occipital border as shown in Fig. 1. CI ranging 114–121; SI 70–72; clypeus not keeled, with broadly rounded anterior border; mandible lacking subapical cleft, basal angle broadly rounded, masticatory border curving gradually into basal border; denticules lacking on masticatory border; ML about 3/5 of EW.

*Thorax:* Slightly broader than head; scutum broader than long; parapsidal furrows almost straight, broader at anterior.

*Petiole:* Petiole in profile thin, tapering to tip almost straight, forming sharp dorsal crest (Fig. 1); in frontal view dorsal border usually concave, waving in one specimen.

*Type designation:* Holotype: Worker: Sapporo, Hokkaido, 27-VII-1967, K. Yamauchi leg. HW 1.10, HL 1.09, EW 0.19, EL 0.25, SL 1.01, ML 0.21, PW 0.71, SC 13, CI 101, SI 92. Paranidotypes: 20♂♂, 20♀♀, 3♂♂. Paratypes: Numerous ♂♂ from Hokkaido (Sapporo, Abashiri, Esashi, Hakodate, Utashinai, Wakkanai, Hama-Koshimizu, Hidaka-Monbetsu, Obihiro, Rishiri Isl.), Honshu (Kinkazan), Shikoku (Kochi). The holotype, paranidotypes and some paratypes are provisionally deposited in the private collection of K.Y. Other paratypes are deposited in the Zoological Institute, Hokkaido University.

*Remarks:* This species closely similar to *L. niger*. Worker coloration may be a good character for the separation of these two species, although the overlap is exceptionally seen. Besides, slight differences are seen in some proportions measured such as SL-HW and EW-HW between them. In spite of morphological similarities, this species is different in mode of life from *L. niger* as shown later, and rather similar to *L. brunneus*, from which *L. hayashi* is, however, easily separated by its hyaline wings and numerous standing hairs on scapes and tibiae. The specific name “hayashi” means the forest or wood in Japanese.

1.4. *Provisional Key to the Japanese species of Lasius s. str.*

The discovery of further “forms” of *Lasius* s. str. from Japan, is not always improbable, because no systematic survey has so far been made except for Hokkaido. Here is given a provisional key to four species so far recorded from Japan.

As mentioned in the description of *L. niger*, *L. alienus* is seemingly not distributed in Hokkaido. Wilson (1955) and Morisita recorded *L. alienus* from Honshu, but the writers have so far not examined the specimens identified with this species, so that it must be excluded from the following key until further researches are undertaken.

*Worker*

1. Fore tibiae with few or no standing hairs; HW 0.80–1.12 mm, SI exceeding 112 ..... *productus*

- Fore tibiae with numerous standing hairs; HW range same, but SI less than 111 ..... 2
- 2. SC more than 30 (cf. Fig. 2); scape with numerous standing hairs mostly erect or suberect, uniformly from base to tip on SC plane (Fig. 1); petiole thicker and lower than in other species as shown in Fig. 1, posterior surface flat and brilliant centrally whereas rounded at both sides ..... *sakagami*
- SC less than 30 (cf. Fig. 2); scape with standing hairs at the distal third to half on SC plane (Fig. 1); petiole thinner and higher than in *sakagami* (Fig. 1), posterior surface flat throughout or slightly concave, strongly brilliant ..... 3
- 3. Body concolorous blackish brown, rarely thorax and petiole dark reddish brown ..... *niger*
- Body bicolorous, thorax and petiole light to medium yellowish brown, contrasting with somewhat darker head and dark brown gaster, but rarely nearly concolorous dark brown, making the separation from *niger* by this character difficult..... *hayashi*

#### *Queen*

- 1. Length of terminal segment of maxillary palp more than 0.30 mm; SI more than 81 ..... *productus*
- Length of terminal segment of maxillary palp less than 0.28 mm; SI less than 80 ..... 2
- 2. Scape with numerous standing hairs, more than 20 on SC plane, mostly erect or suberect, uniformly base to tip as in worker; SC more than 45..... *sakagami*
- Scape with standing hairs less than 10 on SC plane concentrated at distal third or half; SC less than 10 ..... *niger, hayashi*

#### *Male*

- 1. SI exceeding 100 ..... *productus*
- SI less than 80 ..... 2
- 2. Petiole in profile lower and thicker, tapering to tip roundly (Fig. 1); subgenital plate with almost straight posterior border (Fig. 1); head with rounded occipital border as shown in Fig. 1..... *sakagami*
- Petiole in profile high and thin, tapering to tip almost straightly (Fig. 1); subgenital plate with convex posterior border (Fig. 1); head with broad occipital border as shown in Fig. 1. .... *niger, hayashi*

## II. Etho-Ecological Part

The etho-ecological observations by the writers on this subgenus are still so incomplete that here is given only some preliminary remarks.

### 2.1. *Habitats and nest sites*

In the previous papers concerning the ecological distribution of ants in

Hokkaido (Hayashida, 1957, 1960, 1964; Hayashida and Maeda 1960; Yamauchi 1968), the specific names belonging to *Lasius* s. str. were not always appropriately used, because they were mainly identified based upon the characters adopted in classic studies alone. The materials so far accumulated were thoroughly re-examined, their names were clarified in the present study, and the previous data on habitat and nest site preference were used after these corrections, in addition to those obtained from some other localities.

Since the publication of the previous papers, habitat and nest site types adopted by the writers are as follows:

*Habitat types:* BS: Bare sandy area or lands with sparse vegetations found in such places as river-banks and dry river-beds; BA: Bare area or lands with sparse vegetations such as crop-fields, road sides, etc.; SH: Grassy or herbaceous lands on mainly sand dunes near the seashore; PT: Peat bogs; HG: Grassy or herbaceous lands such as meadows and abandoned farms; WM: Woodmargins; WD: Deciduous woods; WC: Coniferous woods.

*Nest site types:* s: In exposed sandy surface;  $\bar{s}$ : In shaded sandy surface; l: In exposed loam or clay surface;  $\bar{l}$ : In shaded loam or clay surface; u: Under stones; m: Under accumulations of humus and other debris; r: Around rootsystems of grasses and herbs; p: In peat; n: Around rootsystems of living trees; w: In trunks of living trees; d: In decayed stumps or fallen logs.

As shown in Table 3, *L. niger* is discovered from almost all localities and habitat types surveyed. This species is the most dominant in *Lasius* s. str. in Hokkaido, and eurytopic though relatively abundant in wood margins. Nests are also seen in almost all nest site types, excluding peats and living tree trunks, and especially frequently used sites are m, r and d. The central cores of their nests are seen rather shallowly in most cases in various situations, so that the immatures are easily extracted from the upper layers, for instance immediately below stones or debris. In the woodlands, without *L. hayashi*, *L. niger* tends to occupy the living trees more frequently than the areas distributed with *L. hayashi*. But in such case, too, the nests are made shallowly as in other situations, not so deeply as in *L. hayashi*. The habitat and nest site preferences of the populations in Hokkaido seem to agree with those of European and North American populations (cf. Wilson 1955, Bernard 1968).

According to the surveys by Gösswald (1932) in Germany, *L. niger* occurs in both deciduous and coniferous forests as well in mixed ones, along forest borders, in hedgerows, in open meadows, and also on cultivated lands. In exposed situations with sparse vegetation cover, the nests are mostly found under stones. Such preferences of nest site well accord with those of the populations in Hokkaido.

The writers observed occasionally earthen mounds which were built around the vegetation, with the result that such earthen cylindrical cover may exceed 30 cm in height, as to examples in Germany (Gösswald 1932).

*L. sakagami*, less abundant than *L. niger*, prefers more sunny places in open lands such as BS or BA (Table 3), nesting mainly under stones or in exposed sandy area (Table 4). This species is often observed to occur with *L. niger* in the same places. In the river-sides in Sapporo and Nokanan, they made their nests under

stones in the place with sparse or no vegetation while *L. niger* around the root-systems of herbs or in and under drift woods. The habitat and nest site preferences of this species are rather similar to those of European *L. alienus* (cf. Wilson 1955, Bernard 1968).

*L. hayashi*, also less abundant than *L. niger*, is discovered mostly from well shaded deciduous woods consisting of large trees. This species is also frequently recorded from woodmargins, but from no other habitats (Table 3). Their nests are established mostly either within the root-systems of large deciduous trees or in the tree trunks. Therefore, it is very difficult to examine the structure of central core of the nests. Their habitat and nest site preferences closely similar to those of *L. brunneus* in Europe (Donisthorpe 1927, Forsslund 1947, Bernard 1968).

Table 4. Nest site preferences of three species of *Lasius* s. str. expressed by the number of colonies discovered.

Species	Nest site type										
	s	$\bar{s}$	l	$\bar{l}$	p	u	m	r	n	w	d
<i>L. niger</i>	10	5	4	5		54	149	148	61	9	135
<i>L. sakagami</i>	13					15	1	4			
<i>L. hayashi</i>							2		34		3

## 2.2 Foraging activity and production of sexual forms

General observations were carried out to detect the nature of foraging paths and behavior upon them. The period of extranidal activities of workers observed in Sapporo in 1966 continues from early April to late October in *L. niger* and *L. sakagami*. While, in *L. hayashi*, the cessation of extranidal activity delays till middle November. The diurnal rhythms of foraging activities were observed about only one colony of *L. niger* in the forest in Sapporo on May 19 and June 16 (Figs. 5 and 6). On May 19, the temperature was still low at night and tree canopies were still sparse to allow the occasional penetration of sunshine on the ground. The activities of workers were remarkably high during daytime and early night, although frequent drops were observed during daytime, which may be explained by the high temperature caused by the occasional penetration of sunshine. But the activities dropped at mid-night when the temperature decreased less than 10°C. On June 16, when the canopies were dense and the temperature was relatively stable, the activities were also stable without significant difference between day and night. These patterns of diurnal rhythms were about as same as those of *L. fuliginosus* or *L. crispus* (Yamauchi and Hayashida 1968).

Some behavior differences were observed with respect to the foraging activities among *L. niger*, *L. sakagami* and *L. hayashi*. *L. hayashi* covered their foraging paths nearly completely by macerated plant material and humus both on the tree

trunks and on the ground nearby the tree, where homopterous insects were kept as the important food suppliers. In this species the dependence on the arboreal hemipterous is more conspicuous than in the other two species. *L. niger* seems to cover the foraging paths less completely even when the nest were made in tree trunks like *L. hayashi*. Most workers foraged on more or less covered ground or on

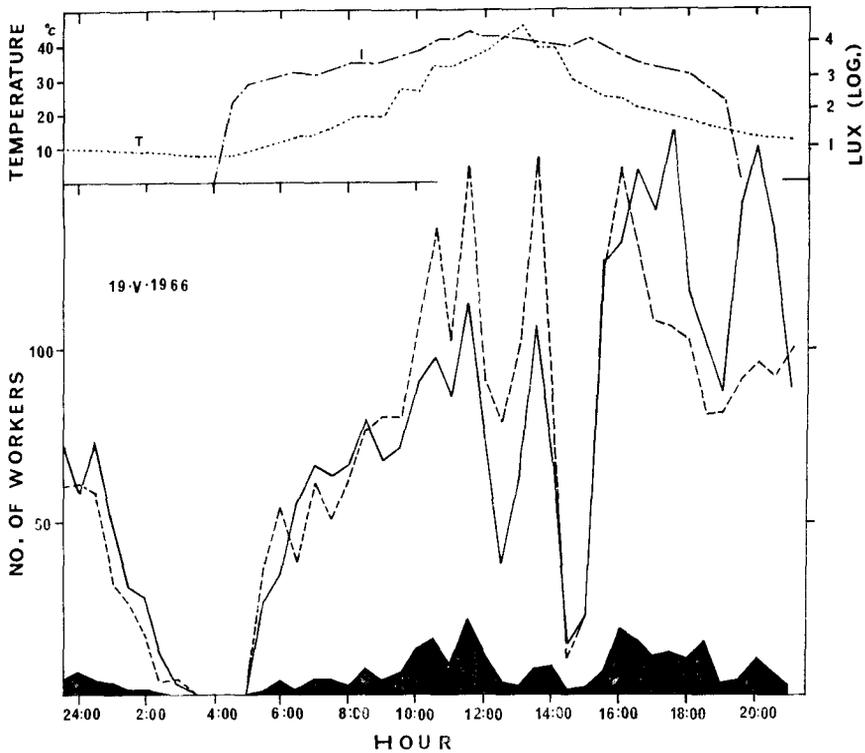


Fig. 5. Diurnal rhythm of foraging activity of a colony of *Lasius niger*, on May 19. Number of workers passing a path was counted during five minutes at every 30 minutes at 50 cm distant from one nest entrance. Solid line, total number of returning workers; broken line, total number of starting workers; striped area, number of returning workers carrying honeydew; black area, number of returning workers carrying animal food; T, surface temperature; I, intensity of illumination.

herbs and small trees. Besides honeydew of homopterous insects and small animal remains, this species gathers floral nectar. *L. sakagami* is different from the other species by their foraging in more sunny places. The visits to tree trunks were occasionally observed in three colonies found in BA.

When foragers are attacked or distributed during their foraging activity on

their outside territory by other insects, *L. niger* and *L. sakagamii* usually run away timidly, but *L. hayashi* takes on a defensive posture, similar to that exhibited by *Formica truncorum*, though far less exaggerated.

To study the emergence of sexual forms, certain nests of *L. niger* were observed every ten days in the Campus of Hokkaido University and the University Botanical Garden in 1966. Other species could not be observed periodically, because of the difficulty to excavate their nests. The seasonal shift of the members of *L. niger* colonies is shown in Table 5. The sexual forms were observed in their nests from middle July to late September. Nuptial flights seem to take

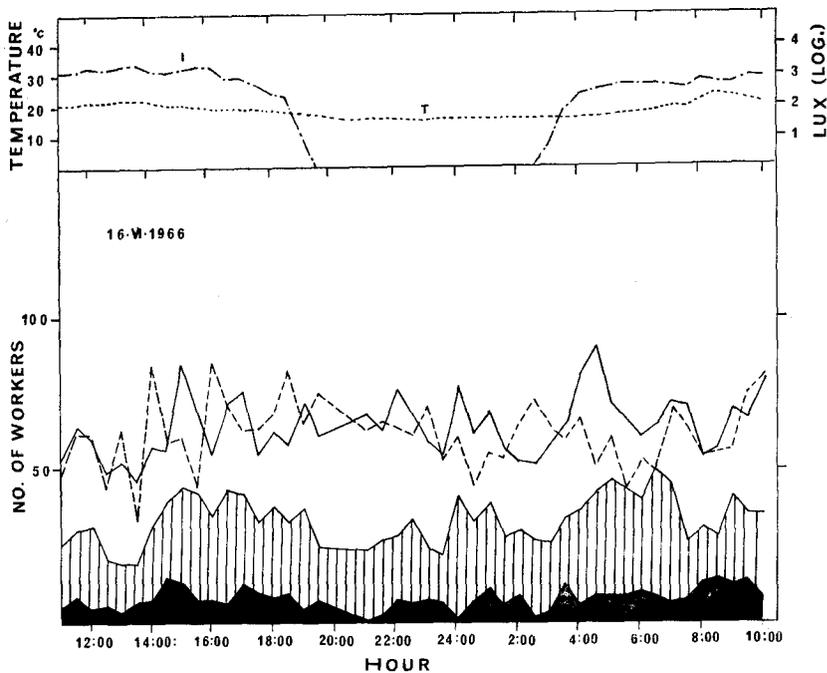


Fig. 6. Diurnal rhythm of foraging activity of a colony of *Lasius niger*, on June 16. Otherwise as in Fig. 5.

place after late July, judging from the appearance numerous wandering queens. From the nests of *L. hayashi*, in spite of frequent observations on the nests surfaces, no sexual forms were discovered, except those fortunately obtained on July 27, 1967 from one colony nesting in the tree trunk, which had been brought down by the wind. This fact may suggest that the period or time of nuptial flight is considerably limited. In *L. sakagamii* the sexual forms were obtained from only two nests, one in Sapporo on July 27, 1967 and another in Nokanan, Kamikawa Prov., Central Hokkaido, on July 21, 1967.



It is one of the most dominant ant species in Hokkaido, usually occupying the first and second rank. *L. hayashi* is also widely distributed from various localities, but less abundant in the Eastern Hokkaido and so far not recorded from Provinces Kushiro and Nemuro. *L. sakagami*, rather less abundant species, was only found from Central Hokkaido. The occurrence of all three species is so far confirmed only in Sapporo and Nokanan, within the limit of the present materials. Judging from the habitat and nest site preferences, *L. sakagami* will be expected to find in other localities, for instance in South Western Hokkaido, by further surveys. Further discussion on the geographical distribution of the *Lasius* s. str. throughout Japan is impossible at the present except *L. niger* which widely distributes from the Northern to Southern Japan.

As described above, *L. niger* is the most eurytopic species among *Lasius* s. str., and the vast number of records on the distribution of this species was reported by many authors throughout most of Europe, North Africa, Asia and Pacific Northwest of U.S.A. According to Wilson (1955), the distribution of *L. niger* in the Far Eastern Asia, was known from Japan (Hokkaido, Honshu, Shikoku and Kyushu), Formosa, Korea (entire Peninsula) and Southern Kuriles (Shikotan Isl.).

In the present study of re-examination of *Lasius* s. str. in Hokkaido, the writers could not recognize the presence of *L. alienus* and *L. productus*, of which Japanese species were reported by Wilson (1955) from Japan. Namely, *L. alienus* was recorded from Towada, Northern Honshu, and *L. productus* from Kyushu, Shikoku and Western Honshu. Therefore, these records may suggest the presence of, more or less, *L. alienus* in Hokkaido.

### Summary

Three species of the subgenus *Lasius* Fabricius of the genus *Lasius* Fabricius are found in Hokkaido, of which the two are new to science: *L. niger* Linné, *L. sakagami* sp. nov. and *L. hayashi* sp. nov. A critical taxonomic study of these species was made and key to the species was prepared based upon all three castes. The most reliable and distinctive characters are coloration and standing hairs on appendages in workers. In queens and males, *L. niger* and *L. hayashi* are very similar to each other. *L. sakagami* is distinct by the shape of petiole and subgenital plate in male and standing hairs in queen.

Some ethological and ecological remarks were briefly given as to habitat and nest site preference, foraging activities and production of sexual forms, together with notes on geographical distribution. *L. niger* is most dominant and eurytopic, although relatively abundant in woodmargins, nesting shallowly. *L. sakagami* inhabits more dry situations, such as dry river-beds, nesting in the tree trunks or in the tree root systems. The formation covers on the foraging paths is most distinct in *L. hayashi*, less distinct in *L. niger* and weak in *L. sakagami*. *L. niger* is distributed all over Hokkaido and anywhere most dominant, *L. hayashi* is also widely distributed but so far not recorded from Provinces Kushiro and Nemuro,

and *L. sakagami* is at the present found only from Central Hokkaido.

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