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A preliminary Report of Wild Bee Fauna on Mt. Usu^{1),2)}

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Abstract

The bee fauna was surveyed on and around Mt. Usu in 1984, six years after the 1977-78 eruptions of this volcano which had caused faunal and vegetational damage especially around the mountaintop area. In total 46 species of 6 families were obtained, out of which Halictidae was most dominant as in other areas in Hokkaido. These species were grouped into four types from their nest site preference and into four types from their flower preference. The distribution of the bees seemed to be notably influenced by the availability of their favorite nest sites, because the bare-ground nesters were predominant on the deforested mountaintop area and the stalk nesters and the forest nesters were dominant in the mountain foot area which did not suffer the serious vegetational damage. As for the flower preference, legume visitors prevailed in the grass lands of mountaintop area where *Trifolium repens* had artificially been sown soon after the eruption to protect the soil from erosion. For the distribution of bees, however, the richness of their favorite flowers was not so critical as that of their favorite nest sites, because the bare-ground nesters Halictidae were predominant in the deforested area where their favorite open flowers were poor.

Key Words: Bee fauna, Mt. Usu, the 1977-78 Eruption, Distribution of bees.

1. Introduction

In the intervals of the 1977-78 eruption, Sakagami et al. (1980) surveyed the insects of Mt. Usu and reported their serious defaunation. To follow the recovery process of the insect community, a further comprehensive entomological survey was made on and around Mt. Usu in 1984, i. e. six years after the last eruption. The results on the moths, ants and drosophilid flies were reported elsewhere (Sato et al., 1985; Higashi et al., 1985; Toda and Fukuda, 1985), of which the winged insects, moths and drosophilid flies were frequently immigrating from the surrounding forests to the deforested area. However, the immigration of a social insect, ant, which is wingless except for males and virgin queens, was not so intensive as that of the winged insects. The present paper reports the results of the bees which

1) Entomological and ecological surveys on Mt. Usu in 1984. IV

2) Wild bee biofaunistics and biocoenotics in Hokkaido. XVII

are winged as the moths and the drosophilid flies but frequently social as the ants. Furthermore, this paper provides the first information on the bee fauna of Iburi Province, being open for the surveys of the bee fauna in Hokkaido to date.

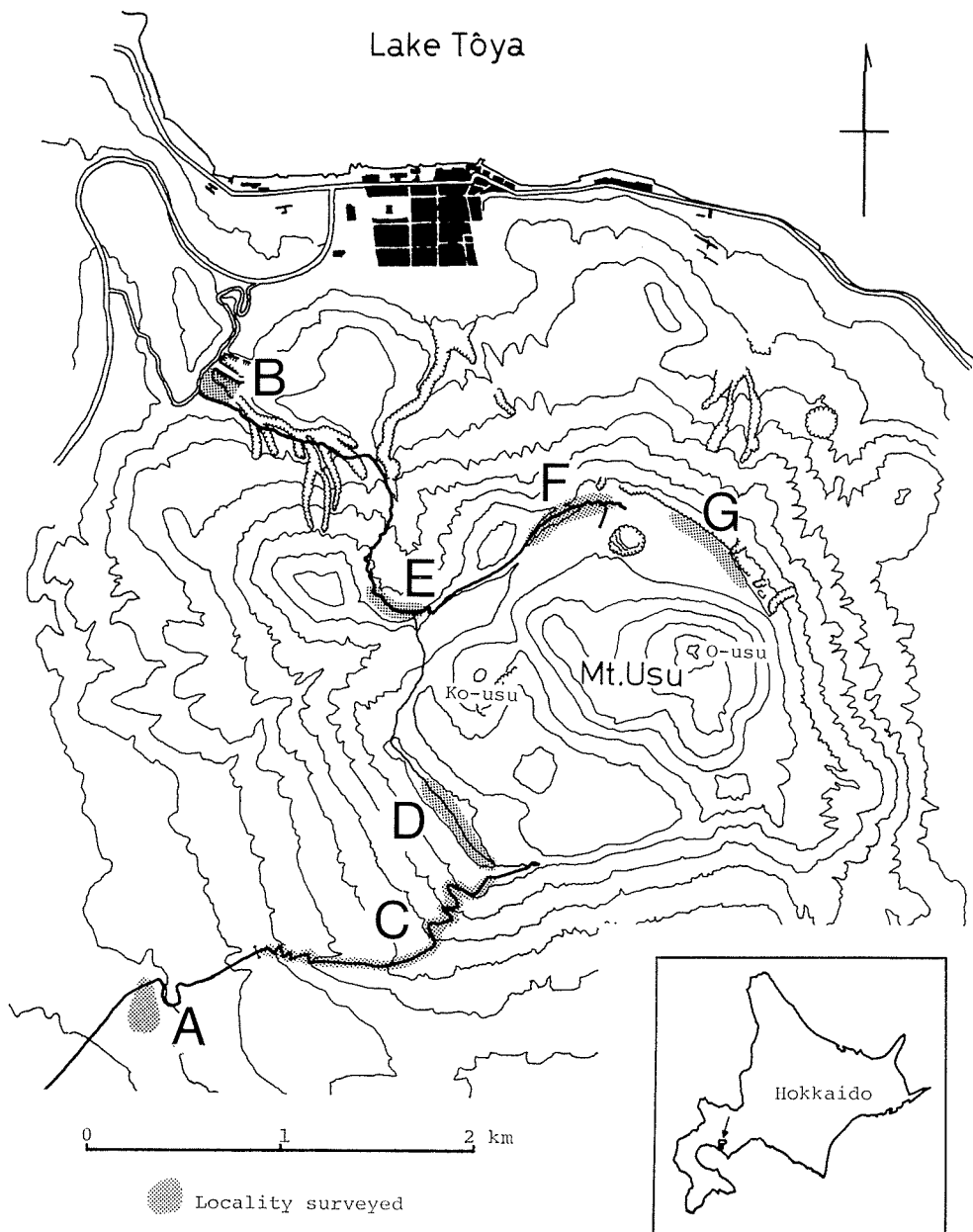


Figure 1. Topography, and the seven localities surveyed on and around Mt. Usu.

2. Sampling Area and Methods

Maruoka et al. (1978) grouped the areas on and around Mt. Usu into four damage classes based on the vegetational damage by the 1977-78 eruption: 0, no damage; I, trees were alive but some twigs and branches were broken by volcanic ashes and lapilli; II, most trees died of the thick accumulation of the ashes; III, completely deforested. The bee sampling was made three times, i. e. June 15 to 16, July 30 to August 1, and September 8 to 9. In accordance with procedures of Sakagami et al. (1974), the sampling was conducted for one hour in each of the following seven localities belonging to different classes of the vegetational damage (Fig. 1): A: An open grassland close to a stand of *Quercus mongolica* var. *grosseserrata*, and to that of *Larix leptorepis* planted at the foot of southern slope (about 90 m in altitude and the damage class 0); B: A grassland around the Nishiyama sand control dam constructed on the foot of the northwest slope (about 150 m in alt., damage class I); C: Along a pathway through the forest of *Quercus dentata*, running on the southern slope (180 to 470 m in alt., damage class I); D: A grassland with shrubs, which remained bare grounds here and there, expanding on the southwest margin of the mountaintop area (about 520 m in alt., damage class III); E: A grassland along a pathway running on the west margin of the mountaintop area (400 to 450 m in alt., damage class III); F: Waysides and grasslands partially covered with clumps of *Polygonum sachalinense*, distributed on the foot of Ko-usu (about 450 m in alt., damage class III); G: Waysides and clumps of *Polygonum sachalinense* on the inner slope of the somma surrounding O-usu (about 460 m in alt., damage class II).

3. Results and Discussion

In total 571 individuals of 46 species were collected. These species are listed below, together with the number of individuals sampled (total=females+males, or, only in bumble bees, total=queens+workers+males), sampling season (Sp: June 15/16, Sm: July 30/Aug. 1, Au: Sept. 8/10), sampling locality and, in parentheses, the number of individuals samples in each season and at each locality. Abbreviations of generic names follow those in Sakagami and Fukuda (1973). Asterisks are given for dominant species which exceeded the average sample size ($571/46 = 12.4$) in the number of individuals obtained.

Family Colletidae 27=8+19

1. *Colletes collaris* Dours. 1=0+1. Au-C(0+1).
- 2.* *Co. yasumatsui* Hirashima. 13=0+13. Sm-E(0+11), F(0+2).
3. *Co. sp. near jankowsky* Noskiewitz. 8=4+4. Sm-C(0+1), D(3+3).
Au-G(1+0).
4. *Co. pateratus* Pérez. 1=1+0. Sm-E(1+0).
5. *Hylaeus floralis* Smith. 1=1+0. Sp-F(1+0).
6. *Hy. niger* Bridwell. 1=1+0. Sm-C(1+0).

7. *Hy. nipponicus* Bridwell. 1=1+0. Sm-A(1+0).
8. *Hy. sp. 1.* 1=1+0. Au-C(1+0).

Family Halictidae 142=108+34.

9. *Halictus (Halictus) tsingtouensis* Strand. 1=1+0. Sm-A(1+0).
10. *Ha. (Seladonia) tumurorum higashi* Sakagami et Ebmer. 4=4+0. Sp-B(2+0), Sm-B(1+0), C(1+0).
11. *Lasioglossum (Lasioglossum) extliceps* (Vachal). 3=3+0. Sp-F(2+0), G(1+0).
12. *Lg. (Lg.) proximatum* (Smith). 1=1+0. Sp-F(1+0).
- 13.* *Lg. (Lg.) laeviventre* (Pérez). 20=19+1. Sp-A(1+0), D(17+1), E(1+0).
- 14.* *Lg. (Lg.) sp. 3.* 13=4+9. Sp-C(2+0), Sm-A(1+0), C(0+1), F(1+0), G(0+1), Au-C(0+4), D(0+1), F(0+2).
15. *Lg. (Dialictus) problematicum* (Blüthgen). 1=1+0. Sm-G(1+0).
16. *Lg. (Carinate-Evylaeus) sibiriacum* (Blüthgen). 1=1+0. Sp-A(1+0).
- 17.* *Lg. (Et.) baleicum* (Cockerell). 20=11+9. Sp-D(1+0), Sm-F(1+0), Au-B(0+1), D(1+0), F(0+8), G(8+0).
18. *Lg. (Et.) duplex* (Dalla Torre). 3=0+3. Au-A(0+3).
19. *Lg. (Et.) vulsum* (Vachal). 1=1+0. Sm-F(1+0).
- 20.* *Lg. (Carinaless-Evylaeus) transpositum* Sakagami. 15=13+2. Sp-E(1+0), F(10+0), G(2+0), Sm-B(0+1), C(0+1).
21. *Lg. (EL.) villosulum trichopse* (Strand). 5=2+3. Sp-B(1+0), G(1+0), Sm-B(0+3).
- 22.* *Lg. (EL.) allodalum* Ebmer et Sakagami. 25=21+4, Sp-D(9+0), E(5+0), F(3+0), G(3+0). Sm-F(1+3), G(0+1).
23. *Lg. (EL.) sp. 4* 4=1+3. Sp-D(1+0), Sm-A(0+1), B(0+2).
24. *Lg. (EL.) sp. 5* 3=3+0. Sp-C(1+0), Sm-C(1+0), F(1+0).
25. *Lg. (EL.) sp. 10* 7=7+0. Sp-D(1+0), F(3+0), G(1+0), Sm-A(2+0).
26. *Lg. (EL.) sp. 17* 7=7+0. Sp-B(7+0).
27. *Lg. (EL.) sp. 18* 8=8+0. Sp-B(7+0), G(1+0).

Family Andrenidae 51=22+29

- 28.* *Andrena (Taeniandrena) ezoensis* Hirashima. 50=22+28. Sp-B(4+13), C(0+1), D(4+10), E(7+4), F(1+0), Sm-A(2+0), D(1+0), E(3+0).
29. *Ad. (Micrandrena) brassicae* Hirashima. 1=0+1. Sm-C(0+1).

Family Megachilidae 55=23+32

30. *Megachile (Megachile) ligniseca* Kirby. 33=7+26. Sp-D(6+10), E(1+3), Sm-C(0+1), D(0+5), E(0+3), F(0+2), G(0+2).
31. *Mg. (M.) centuncularis ainu* Hirashima et Maeta. 4=3+1. Sm-B(1+0), E(0+1), F(2+0).
32. *Mg. (Eutricharaea) remota sakagamii* Hirahima et Maeta. 2=1+1. Sm-A(0+1), E(1+0).
33. *Mg. (E.) kyotensis* Alfken. 1=1+0. Au-B(1+0).
34. *Osmia (Osmia) taurus* Smith. 2=1+1. Sp-C(1+1).
- 35.* *Coelioxys yanonis* Matsumura. 13=10+3. Sp-E(1+0), Sm-B(2+0), C(0+1),

D(6+2), E(1+0).

Family Anthophoridae 138=105+33

- 36*. *Ceratina (Ceratinidia) japonica* Cockerell. 35=33+2. Sp-A(6+0), B(1+0), Sm-A(7+0), C(2+1), D(1+0), F(0+1), G(1+0), Au-A(6+0), B(1+0), C(6+0), F(1+0), G(1+0).
- 37.* *Ct. (Ceratinidia) flavipes* Smith. 59=48+11. Sp-A(13+0), B(1+0), E(1+0), Sm-A(21+5), Au-A(11+6), C(1+0).
38. *Ct. (Ceratina) megastigmata* Yasumatsu et Hirashima. 5=5+0. Sm-C(4+0), Au-C(1+0).
39. *Nomada* sp. A 1=1+0. Sp-B(1+0).
40. *Nomada* sp. B 1=1+0. Sp-E(1+0).
- 41.* *Epeolus melectiformis* Yasumatsu. 37=17+20. Sm-C(2+5), D(10+12), E(5+0), F(0+1), G(0+2).

Family Apidae 158=1+132+25

- 42.* *Bombus (Bombus) hypocrita sapporensis* Cockerell. 56=1+42+13. Sp-B(0+1+0), C(0+1+0), D(0+1+0), E(1+2+0), Sm-B(0+1+0), D(0+1+0), E(0+12+7), F(0+7+3), G(0+1+0), Au-B(0+2+1), D(0+3+0), E(0+4+0), F(0+5+2), G(0+1+0).
43. *Bo. (Diversobombus) diversus tersatus* Smith. 2=0+1+1. Sm-A(1+0), Sm-A(0+1+0), Au-C(0+0+1).
44. *Bo. (Pyrobombus) beaticola moshkarareppus* Sakagami et Ishikawa. 1=0+1+0. Sp-C(0+1+0).
- 45.* *Bo. (Thoracobombus) honshuensis tkalkui* Sakagami et Ishikawa. 16=0+16+0. Sm-A(0+3+0), B(0+9+0), C(0+1+0), Au-B(0+1+0), C(0+2+0).
- 46.* *Bo. (T.) deuteronymus deuteronymus* Shultz. 83=0+72+11. Sp-A(0+2+0), B(0+1+0), C(0+2+0), D(0+3+0), G(0+1+0), Sm-A(0+16+0), B(0+11+0), C(0+4+0), D(0+7+1), E(0+7+0), F(0+2+0), G(0+2+0), Au-A(0+1+0), B(0+6+9), C(0+5+0), E(0+2+0), G(0+0+1).

Out of six families obtained, Halictidae was the richest in species as in other areas of Hokkaido (Fig. 2). However, Andrenidae, which is another family being dominant in the temperate zone of northern hemisphere as well as Halictidae (Sakagami and Fukuda, 1973), was poor in the present survey probably due to the lack of the sampling in early to mid spring when Andrenidae almost monopolizes the bee fauna in Hokkaido (Sakagami and Fukuda, 1973).

Based on the studies hitherto made in Hokkaido (e.g. Sakagami and Matsumura, 1967; Matsumura and Munakata, 1969; Munakata, 1971; Sakagami and Fukuda, 1972), the nest site preference of the 15 dominant species can be grouped into four types. 1. Bare-ground nesters: *Ad. ezoensis*, *Mg. ligniseca*, *El. allodalum*, *Et. baleicum*, *Lg. laeviventre*, *El. transpositum* and *Co. yasumatsui* which nest by excavating bare grounds. 2. Grassy-ground nesters: *Bo. deuteronymus* which digs along the root system of grasslands. 3. Stalk nesters: *Ct. flavipes*

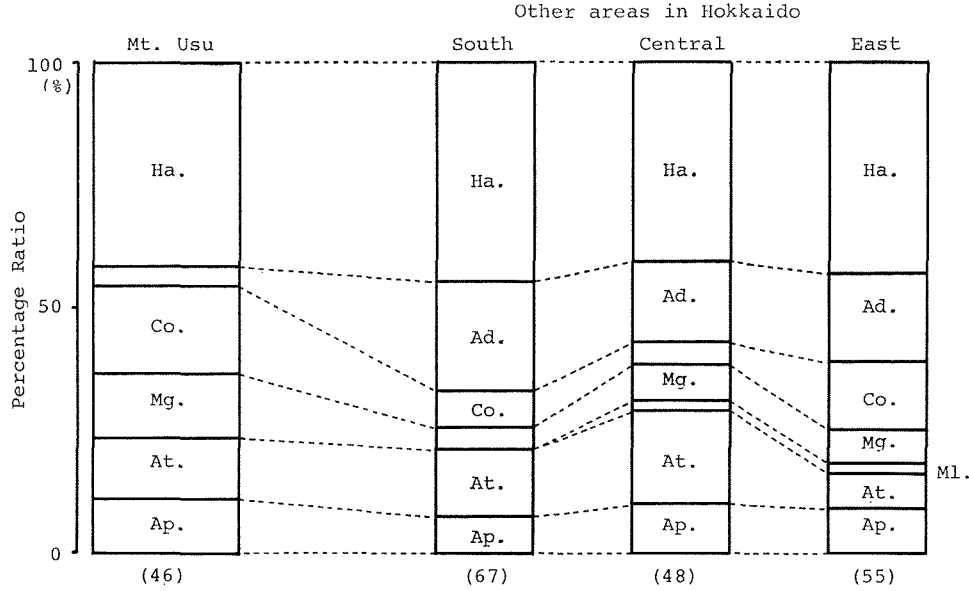


Figure 2. Percentage ratios of species richness at familial level on Mt. Usu and in other areas of Hokkaido. Ha: Halictidae, Ad: Andrenidae, Co: Colletidae, Mg: Megachilidae, Ml: Melittidae, At: Anthophoridae, Ap: Apidae. Total number of species sampled, given in parentheses. The results in each area of Hokkaido were cited from Munakata and Kobayashi (1983) for southern, Munakata and Kikuchi (1979) for central, and Fukuda et al. (1973) for eastern area.

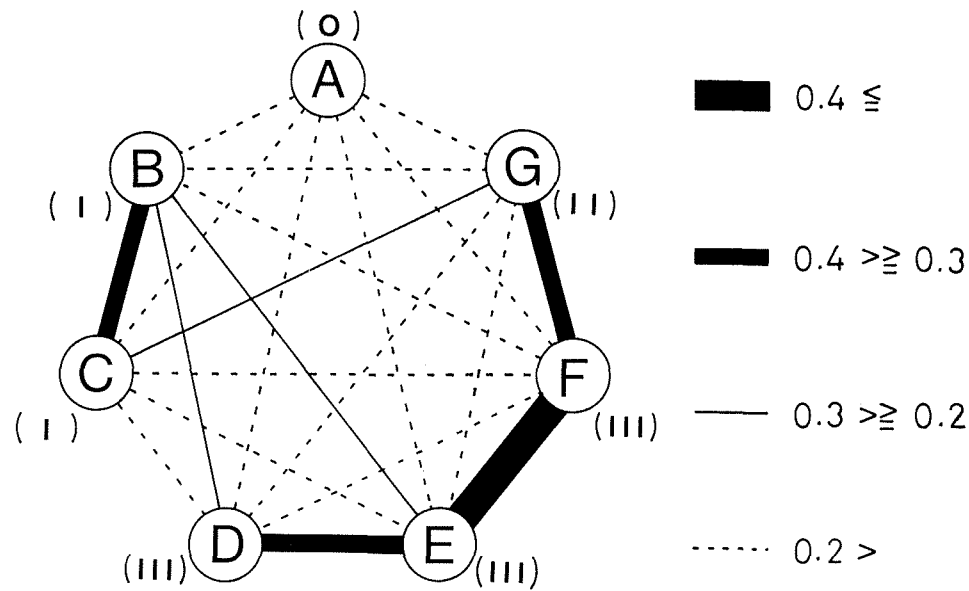


Figure 3. Faunal similarities among seven localities surveyed, by the index SR of Janssen (1975). The damage class of each locality is also given in parentheses.

and *Ct. japonica* which always nest in a dead stalk of *Miscanthus sinensis*, *Weigela hortensis* and so on. 4. Forest nesters: *Bo. hypocrita* and *Bo. honshuensis* which often prefer the forest or its margin by nesting under leaf litter. Moreover, their flower preference is also grouped as follows: 1. Legume visitors: *Ad. ezoensis* and *Mg. ligniseca* feeding on the pollen and the nectar almost only of legumes. 2. Tubular-flower visitors: *Bo. honshuensis*, *Bo. diversus* which have long proboscides and are nearly specialized to such tubular flowers not only as legumes but also as *Weigela hortensis*, *Lilium cordatum* for collecting the pollen and the nectar. 3. Open-flower visitors: most species of Halictidae, Andrenidae and Colletidae which have too short proboscides to reach the nectary of the tubular flowers, and visit

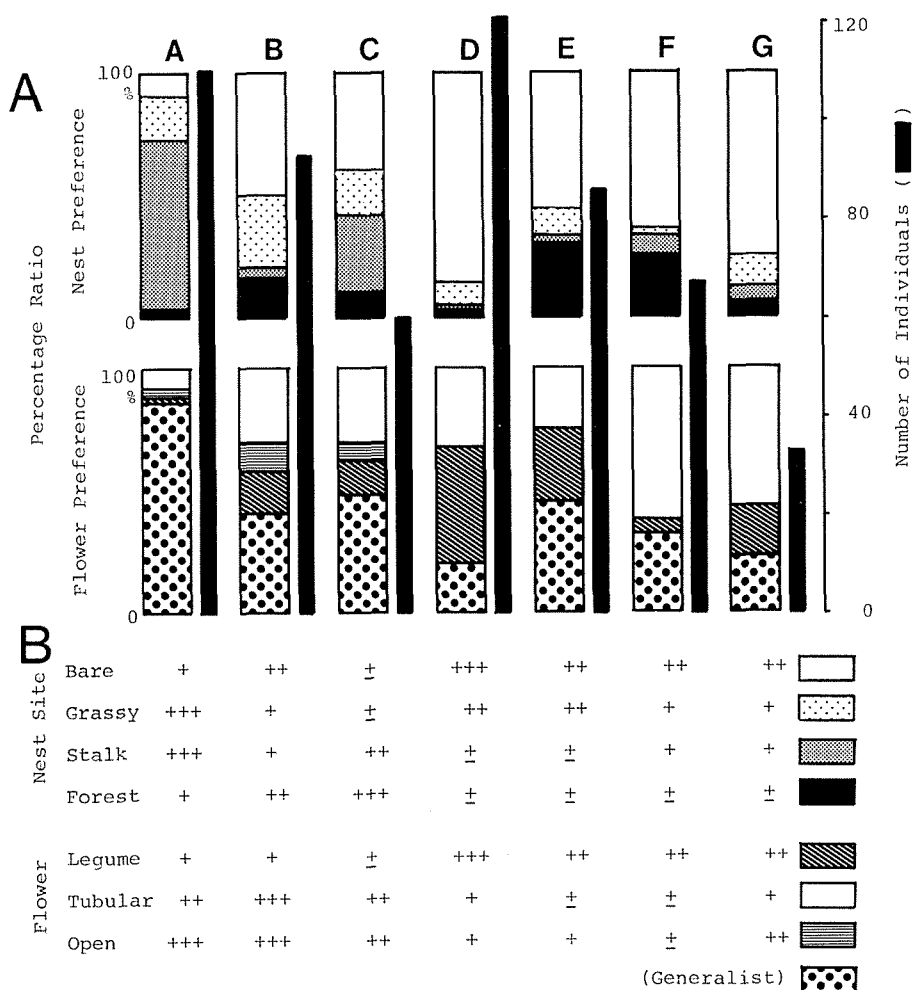


Figure 4. Inter-locality comparison of bees, from the viewpoint of nest site preference and flower preference (A), with the environmental conditions of each locality (B). In each category, # and ± are the highest and the lowest levels respectively and other marks mean the relative levels compared with those two extremes.

only open flowers such as Compositae species. 4. Generalistic visitors: *Bo. deuteronymus*, *Bo. hypocrita*, *Ct. japonica* and *Ct. flavipes* which can collect the pollen and the nectar from any of legumes, tubular flowers, and open flowers. Faunal similarities among the seven localities surveyed were examined by an index SR of Janssen (1975) (Fig. 3). They were clustered into three groups at the similarity level of $SR=0.29$: A, which suffered no vegetational damage from the 1977-78 eruption, (damage class 0), and predominantly inhabited by *Ct. flavipes*, *Ct. japonica* and *Bo. deuteronymus*; B-C, where the vegetation was less damaged (class I), and *Bo. honshuensis*, *Bo. deuteronymus* were commonly dominant; D-E-F-G, which were approximately or completely deforested by the eruptions (class II or III) and *Bo. deuteronymus*, *Ad. ezoensis* were commonly dominant. The good correlation between the faunal similarities and the damage classes suggests that the bee fauna notably depends on the habitat conditions of the localities surveyed, unlike the moth and drosophilid fly faunae in which lots of forestal species were found even in the deforested mountaintop area because of their long distance drift from the lowland forests (Sato et al., 1985; Toda and Fukuda, 1985). Actually, the locality A where a grassland expanded and many stalks of *Miscanthus sinensis* were distributed was dominated by some stalk nesters (*Ct. flavipes* and *Ct. japonica*) and a grassy-ground nester (*Bo. deuteronymus*), while the deforested localities D, E, F and G were dominated by bare-ground nesters of Halictidae such as *Et. baleicum* and *El. allodatum* (Fig. 4). However, the forest nesters were relatively abundant not only in the localities B and C closely surrounded with forests but also in the deforested localities D, E, F and G. The only forest nester being dominant in the deforested localities was *Bo. hypocrita* which was seemingly able to fly to these localities from the forests developed on the foot of the mountain.

The flora which provides the pollen and the nectar to the bees was also influential to the bee fauna (Fig. 4): In the localities D and E where the nectar and pollen resources were poor except for *Trifolium repens* and *Artemisia montana*, lots of legume visitors (*Ad. ezoensis*, *Mg. ligniseca*) were collected on the flowers of *Trifolium repens*. The tubular-flower visitors such as *Bo. honshuensis* and *Bo. diversus* having extremely long proboscides were obtained mainly in the mountain foot area but rarely in the mountaintop area where their favorite flowers were scarce. However, such open-flower visitors as *Et. baleicum* and *El. allodatum* were relatively rich in the mountaintop area which was rather poor in their favorite flowers. The distribution of the open-flower visitors seems to depend more critically on the availability of their nest sites than that of their favorite flowers. It was also interesting that the locality A where the flora was most diverse among the seven localities surveyed was dominated by generalists (*Bo. deuteronymus*, *Ct. flavipes* and *Ct. japonica*), while the mountaintop areas where the flora was poor in flower species were inhabited by many specialists such as legume visitors and open-flower visitors.

4. Conclusion

Unlike moths (Sato et al., 1985) and drosophilid flies (Toda and Fukuda, 1985), the bee fauna of the mountaintop area reflected the deforested habitat, since this area was dominated by the bare-ground nesters of Halictidae and Colletidae. However, a forest nester *Bo. hypocrita* was collected even in the deforested area, probably because this species has a wide foraging range. Although the legume visitors and the tubular-flower visitors were rich in the localities where their favorite flowers were abundant, the bare-ground nesters of a predominant family Halictidae were abundant in the deforested area where their favorite open flowers were scarcely discovered. This suggests that the flower makeup was not so influential to the bee fauna as the richness of their favorite nest sites.

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