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Faunal Makeup and Distribution of Ground Beetles in a Dairy Area Bekkai, Northern Japan[1)]

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酪農地帯・別海町の地表歩行性甲虫類とその分布

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Introduction

In recent years ground beetles have been accepted as one of the indicator insects to assess human impact: first, most of them consume dead organic matter in the food chain and sensitively react to the environmental change; second, a lot of beetles can be collected with a simple method, pitfall trap; lastly, the classification of bettles has considerably been advanced since the 1960's to the 1970's (e. g. Nakane *et al.* 1964, Habu 1978).

From May to September 1981, monthly sampling of ground beetles was made with pitfall traps at a dairy village in eastern Hokkaido, northern Japan. The purpose of this survey was to disclose the distributional pattern of the beetles in a farm area. The present paper takes up the seasonal change of faunal makeup, niche breadth and interspecific niche overlap of the ground beetles belonging to seven families: Carabidae, Harpalidae, Silphidae, Catopidae, Geotrupidae, Tenebrionidae, Meloidae.

Before going further, the authors wish to express their sincere thanks to Dr. Haruo Katakura, Faculty of Science, Hokkaido Univeristy, and to Mr. Toshinobu Matsumoto, Tokyo Agricultural University, for their useful advices on the identification of the ground beetles.

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Area Surveyed and Method

Bekkai lies on the eastern part of Hokkaido, northen Japan, facing the Nemuro strait (Fig. 1). According to Kojima (1979), this area vegetationally belongs to the nemoral *Acer mono* zone dominated by *Acer mono, Betula platyphylla* var. *japonica, Kalopanax septenlobus, Quercus mongolica* var. *grosseserrata, Tilia japonica, Ulmus davifiana* var. *japonica* and so on. The annual mean temperature and the annual precipitation in 1981 were 4.3°C and 1,493 mm respectively. Climatic conditions from May to September in 1981 are given in Fig. 2.

In total 34 trap sites were selected in Honbekkai, Furen, Nishibetsu and Kitayausubetsu (Fig. 1). The beetles were captured with pitfall trap of 210 cc volume, 6.5 cm caliver and 9 cm depth, using no bait. At each site five traps were linearly arranged at 1 m interval. The beetles were collected three days after the trap setting. The sampling was made on May 19 to 22, June 24 to 27, July 22 to 25, August 27 to 30 and September 19 to 22, 1981.

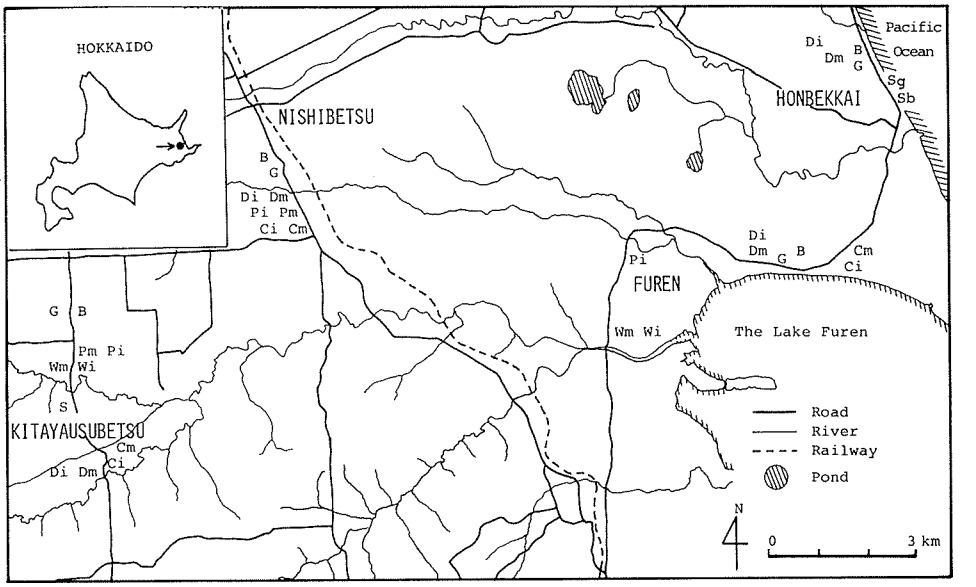


Fig. 1. Location and topography of Bekkai. B, bareland; G, grassland; Di, deciduous broad-leaved forest dominated by *Betula platyphylla*; Dm, its margin; Ci, coniferous forest of *Larix leptolepis*; Cm, its margin; Pi, plantation of *L. leptolepis* saplings; Pm, its margin; Wi, alder thicket in wetlands; Wm, its margin; Sg, coastal grassland covered with sweet briers; Sb, shore bare land; S, *Sasa nipponica* bush left in a pasture.

Results and Discussion

Faunal makeup: In total 1891 individuals (45 species, 27 genera) were obtained. In the following list, scientific name, full total, monthly total and, in parentheses, the number of individuals captured at each sampling site are given for each

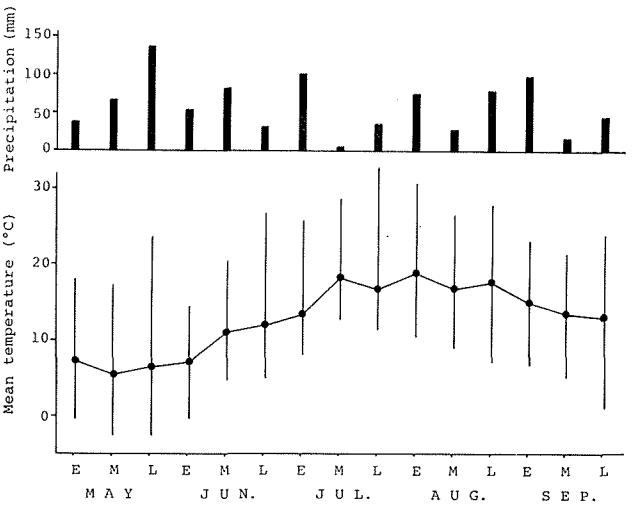


Fig. 2. Mean temperature with range and precipitation in the area surveyed from May to September, 1981 (based on Monthly Weather Report from Hokkaido Meteorological Observatory). E, the first third of each month; M, the second third; L, the last third.

species. Symbols of sampling areas and habitats are as follows: H, Honbekkai; F, Furen; N, Nishibetsu; K, Kitayausubetsu; B, bare land; G, grassland; Di, deciduous broad-leaved forest dominated by *Betula platyphylla*; Dm, its margin; Ci, coniferous forest of *Larix leptolepis*; Cm, its margin; Pi, plantation of *L. leptolepis* saplings; Pm, its margin; Wi, alder thicket in wetlands; Wm, its margin; Sg, coastal grassland covered with sweet briers; Sb, shore bare land; S, *Sasa nipponica* bush left in a pasture.

Family CARABIDAE

1. *Carabus conciliator hokkaidensis* Lapouge 69: V 23 (H-Dm 2, H-Di 1, F-Dm 1, N-G 4, N-Dm 6, N-Pi 1, N-Cm 1, K-Pi 1, K-Pm 1, K-Dm 3, K-Di 2), VI 23 (F-Dm 2, F-Di 4, F-Pi 3, F-Wm 3, N-Di 2, N-Pm 6, K-S 2, K-Dm 1), VII 11 (H-G 5, F-Pi 4, N-B 1, N-Pm 1), VIII 11 (N-G 1, N-Dm 1, F-Pi 2, N-Dm 2, N-Pi 1, K-Di 4), IX 1 (K-Cm).
2. *C. maeander paludis* Géhin 16: V 5 (F-G 1, F-Dm 1, N-Cm 2, N-Ci 1), VI 6 (H-Sb 3, F-B 2, N-B 1), VII 2 (F-Cm 1, F-B 1), VIII 3 (K-Cm 3).
3. *C. granulatus yezoensis* Bates 88: V 12 (H-Dm 3, H-Di 5, F-Wi 1, K-Wm 2, K-Wi 1), VI 48 (H-B 2, H-Dm 7, H-Di 5, F-G 5, F-Dm 1, F-Di 26, K-Wm 2), VII 16 (H-Dm 1, H-Di 3, F-G 1, F-Dm 3, F-Di 5, K-Dm 1, K-Di 2), VIII 9 (H-Di 6, F-Di 2, F-Pi 1), IX 3 (H-Dm 3).
4. *C. opaculus* Putzeys 85: VII 7 (F-Cm 2, N-Pm 1, K-Cm 2, K-Ci 2), VIII 17 (F-Ci 7, F-Pi 4, N-Pi 1, N-Ci 1, K-Dm 3, K-Di 1), IX 61 (H-Dm 2, H-Di 2, F-Cm 1, F-Ci 8, F-Dm 3, F-Di 6, F-Pi 1, N-Pm 5, N-Pi 9, N-Cm 2, N-Ci 8, K-S 1, K-Dm 7, K-Di 1, K-Cm 4, K-Ci 1).

5. *Hemicarabus tuberculosus* Dejean et Boisduval 10 : VI 3 (K-B 3), VIII 7 (H-G 1, F-B 1, K-G 4, K-S 1).
6. *Calosoma inquisitor cyanescens* Motschulsky 1 : VI 1 (H-Dm).
7. *Procrustes aino* Rost 1 : IX 1 (K-G).
8. *Cychrus morawitzi* Géhin 1 : VII 1 (K-Pi).

Family HARPALIDAE

9. *Poecilus caerulescens* L. 336 : V 91 (H-B 1, H-G 3, H-Dm 5, H-Di 4, F-Cm 1, F-B 2, F-G 2, N-G 4, N-Dm 15, N-Di 3, N-Pm 9, N-Pi 1, N-Cm 2, K-B 3, K-G 12, K-Pm 6, K-Di 18), VI 156 (H-B 1, H-Dm 4, H-Di 1, F-B 26, F-G 25, F-Dm 1, F-Pi 1, N-B 1, N-G 4, N-Dm 2, N-Pm 5, N-Cm 5, K-B 2, K-G 46, K-Pm 2, K-S 2, K-Dm 15, K-Di 11, K-Cm 2), VII 43 (H-B 11, H-G 4, F-B 5, F-G 4, N-B 3, N-G 3, K-B 3, K-G 7, K-S 1, K-Dm 2), VIII 34 (H-B 2, H-G 7, H-Dm 1, F-B 4, F-G 3, N-B 1, N-G 6, N-Pm 2, K-B 2, K-G 5, K-Dm 1), IX 12 (N-B 2, N-G 2, K-B 4, K-Dm 4).
10. *P. fortipes* Chaudoir 2 : VII 1 (H-Sb), IX 1 (H-Sg).
11. *Agonum impressum* Panzer 96 : V 50 (H-B 6, H-G 10, H-Dm 4, H-Di 3, F-B 11, F-G 4, N-G 1, N-Dm 1, N-Pm 1, N-Pi 2, K-G 6, K-S 1), VI 33 (H-B 2, H-G 2, H-Dm 4, H-Sb 2, F-B 7, F-G 4, K-G 9, K-S 3), VII 4 (H-B 3, H-Sb 1), VIII 7 (H-B 5, F-G 1, K-G 1), IX 2 (H-B 1, H-Dm 1).
12. *A. charillum yezoanum* Nakane 2 : V 1 (K-Wi), VI 1 (F-Di).
13. *A. chalcomum* Bates 4 : VI 2 (F-Di 1, K-Wi 1), VIII 2 (K-Wi 2).
14. *Amara chalcites* Dejean 39 : V 21 (H-B 2, H-G 3, F-B 4, F-G 1, F-Dm 2, K-B 1, K-G 6, K-Pi 2), VI 15 (H-B 3, F-B 5, F-G 3, K-B 1, K-G 3), VII 1 (K-G), VIII 2 (K-G 2).
15. *Am. communis* Panzer 105 : V 79 (H-G 7, H-Dm 2, F-Ci 2, F-B 4, F-G 39, F-Pi 3, N-B 2, N-G 6, N-Pm 5, K-B 1, K-Pi 2, K-S 2, K-Di 3, K-Cm 1), VI 17 (H-B 1, H-Sg 2, F-B 2, N-B 1, N-G 1, N-Pm 3, K-Pm 1, K-Wi 1, K-S 3, K-Cm 2), VII 7 (F-G 3, N-G 2, K-B 1, K-G 1), VIII 2 (F-G 2).
16. *Am. erratica* Duftschmid 2 : VIII 2 (H-B 2).
17. *Pterostichus haptoderoides japanensis* Lutshnik 90 : V 27 (H-B 2, H-G 6, F-B 1, F-Pi 2, N-B 1, N-G 1, N-Cm 3, K-G 11), VI 40 (H-B 1, F-B 12, F-G 2, F-Pi 7, N-B 3, N-G 1, K-G 14), VII 10 (H-B 2, H-G 1, F-B 1, N-B 4, N-G 1), VIII 12 (H-B 1, F-B 1, F-G 3, K-B 5, K-G 2), IX 1 (H-G).
18. *Pt. neglectus* Morawitz 37 : V 21 (H-Dm 2, F-B 2, F-Dm 3, N-Pi 1, N-Ci 4, K-B 2, K-Wm 2, K-Wi 3, K-S 2), VI 8 (F-Pi 3, N-Pi 1, K-Pm 1, K-Wi 1, K-Cm 2), VII 8 (H-Dm 1, H-Di 3, F-Dm 1, F-Pi 2, N-Pi 1).
19. *Pt thunbergi* Morawitz 28 : V 14 (H-Dm 3, H-Di 2, K-Dm 2, K-Di 4, K-Cm 3), VI 2 (H-Di 1, K-Di 1), VII 4 (H-Di 2, F-Di 1, K-Di 1), IX 8 (H-Di 8).
20. *Pt. adstrictus* Eschscholtz 115 : V 21 (H-B 1, H-G 2, H-Dm 7, H-Di 5, F-Dm 1, N-Pi 1, K-Wi 2, K-Dm 1, K-Cm 1), VI 20 (H-Dm 2, H-Di 3, F-Dm 2, F-Di 1, N-Di 1, N-Pi 2, K-Pm 1, K-Dm 2, K-Di 4, K-Cm 1,

K-Ci 1), VII 27 (H-Dm 6, H-Di 4, F-Cm 1, F-Dm 4, F-Di 2, N-Dm 1, K-Pi 1, K-Dm 5, K-Di 3), VIII 44 (H-Dm 7, H-Di 4, F-Dm 11, F-Di 6, F-Pi 2, N-Dm 1, N-Di 2, K-Pm 1, K-Dm 6, K-Di 4), IX 3 (H-Di 1, K-Ci 2).

21. *Pt. microcephalus* Motschulsky 34 : V 10 (F-B 1, F-G 1, F-Pi 1, N-Dm 1, N-Pm 4, K-Wi 2), VI 19 (F-B 3, F-G 4, F-Pi 2, N-G 1, N-Dm 1, N-Pm 7, K-Di 1), VII 3 (H-G 3), VIII 1 (F-G), IX 3 (N-G 1, N-Dm 1, K-B 1).
22. *Pt. orientalis* Motschulsky 33 : V 1 (N-Pm), VI 17 (F-Cm 2, F-Ci 1, F-Dm 2, F-Di 2, N-G 3, N-Pm 3, K-Pi 1, K-Dm 2, K-Cm 1), VII 15 (H-Dm 4, H-Di 3, F-Dm 1, F-Di 2, N-Di 1, N-Pm 1, N-Cm 1, K-Di 2), VIII 12 (F-Dm 3, F-Di 4, N-Dm 2, N-Pm 2, K-B 1), IX 3 (N-Dm 1, K-B 1, K-Ci 1).
23. *Pt. sulcitarsis* Morawitz 14 : V 2 (N-Ci 1, K-Wi 1), VI 7 (H-B 3, H-Sg 1, F-B 2, K-B 1), VII 4 (H-B 1, H-Sg 1, F-B 1, K-G 1), IX 1 (K-G).
24. *Pt. rotundangulus* Morawitz 6 : VI 1 (F-Wi), VII 5 (H-Di 2, F-Wm 1, N-Di 1, K-Dm 1).
25. *Pt. subovatus* Motschulsky 8 : VI 2 (F-Di 1, K-B 1), VII 6 (H-Dm 3, K-Wi 3).
26. *Pt. prolongatus* Morawitz 1 : VIII 1 (N-G).
27. *Bembidion poppii captivorum* Netolitzky 26 : V 1 (K-G), VI 17 (F-B 2, F-Pi 1, K-B 2, K-G 1, K-Wm 8, K-Cm 3), VII 8 (F-Wm 1, F-Wi 1, K-Wm 4, K-Wi 2).
28. *B. morawitzi* Csiki 3 : V 1 (H-Sb), VI 1 (H-Sb), IX 1 (K-Wm).
29. *Chlaenius pallipes* Gebler 113 : V 13 (H-B 1, F-B 1, F-G 1, N-B 3, N-Pm 1, K-B 3, K-Wi 1, K-Dm 2), VI 46 (H-B 4, F-B 5, F-G 5, F-Dm 1, N-B 1, N-Pm 4, N-Pi 1, K-B 15, K-Pi 1, K-Wm 1, K-Wi 8), VII 17 (H-B 1, H-G 4, F-B 1, F-G 1, N-B 3, N-Pm 1, K-B 5, K-G 1), VIII 29 (H-B 2, H-G 4, F-Cm 1, F-B 6, F-G 1, N-G 1, K-B 7, K-G 5, K-S 2), IX 8 (H-Dm 1, N-B 2, N-G 2, K-B 2, K-Dm 1).
30. *Platynus subovatus* Putzeys 7 : V 2 (K-Wm 1, K-Wi 1), VI 5 (F-Di 1, K-Wm 1, K-Wi 3).
31. *Anisodactylus signatus* Panzer 8 : V 1 (H-B), VI 3 (N-Pm 3), VII 1 (F-G), VIII 3 (N-B 1, N-G 2).
32. *Harpalus quadripunctatus ainus* Habu et Baba 5 : V 1 (F-B), VI 3 (F-Cm 1, F-B 1, K-Pm 1), VIII 1 (K-B).
33. *Panagaeus robustus* Morawitz 7 : V 1 (F-Wm), VI 4 (F-Wm 1, F-Wi 3), VII 1 (H-Sg), VIII 1 (H-Sg).
34. *Stenolophus propinguus* Morawitz 2 : VI 1 (N-Pi), VIII 1 (H-Sg).
35. *Synuchus melantho* Bates 57 : VII 2 (N-Pm 2), VIII 40 (H-Di 3, F-Dm 8, N-Dm 15, N-Pm 5, N-Cm 1, K-G 1, K-Dm 6, K-Di 1), IX 15 (H-Di 2, F-Ci 3, N-Pm 1, N-Pi 1, K-B 4, K-Dm 3, K-Di 1).
36. *Craspedonotus tibialis* Schaum 1 : VIII 1 (H-Sg).
37. *Ophonus sinicus* Hope 1 : VIII 1 (H-Sg).
38. *Bradytus simplicidens* Morawitz 1 : IX 1 (H-B).

Family SILPHIDAE

39. *Silpha perforata venatoria* Harold 170 · V 34 (H-Dm 1, H-Di 3, H-Sg 2, F-Cm 3, F-Ci 4, F-B 1, F-G 1, F-Di 2, F-Wm 2, F-Wi 1, N-G 1, N-Dm 1, N-Pm 3, N-Pi 4, N-Ci 1, K-Pi 1, K-Wm 1, K-Di 1, K-Cm 1), VI 44 (H-G 1, H-Dm 1, H-Sg 4, F-G 7, F-Dm 1, F-Di 5, F-Wm 3, N-Dm 1, N-Di 2, N-Pm 1, N-Pi 4, N-Cm 2, K-B 3, K-G 6, K-Dm 1, K-Cm 1, K-Ci 1), VII 51 (H-G 2, H-Dm 4, H-Di 5, H-Sg 1, F-Ci 1, F-B 1, F-G 2, F-Dm 3, F-Di 3, F-Pi 1, N-G 1, N-Dm 2, N-Di 4, N-Pm 3, N-Pi 6, N-Ci 1, K-B 1, K-Pi 1, K-Pm 2, K-Dm 2, K-Di 5), VIII 30 (H-B 1, H-Dm 2, H-Di 3, F-Cm 3, F-Ci 1, F-Dm 2, F-Di 4, N-G 1, N-Di 1, K-Pi 1, K-S 1, K-Dm 6, K-Di 4), IX 11 (F-Dm 1, F-Di 1, N-G 1, N-Pm 3, N-Cm 1, K-Dm 2, K-Di 1, K-Cm 1).
40. *Phosphuga atrata* L. 6 : VII 5 (F-Dm 2, K-B 1, K-Pi 1, K-Di 1), VIII 1 (H-Di).

Family CATOPIDAE

41. *Catops angustitarsis lewisi* Jeannel 8 : V 6 (F-Ci 6), VI 2 (K-Cm 1, K-Ci 1).

Family GEOTRUPIDAE

42. *Geotrupes laevistriatus* Motschulsky 126 : VI 11 (H-G 3, H-Di 2, N-Di 1, K-G 3, K-Pm 2), VII 58 (H-G 1, H-Dm 9, H-Di 11, F-Dm 3, F-Di 5, F-Pi 1, N-Pi 3, N-Ci 1, K-G 1, K-Pi 1, K-Pm 2, K-Dm 8, K-Di 12), VIII 31 (H-G 2, H-Dm 5, H-Di 4, F-Dm 1, F-Di 2, N-Dm 1, N-Cm 1, K-G 1, K-Pi 3, K-Dm 4, K-Di 7), IX 26 (H-Dm 5, H-Di 6, F-Ci 1, F-Di 1, N-Dm 1, N-Pm 1, N-Pi 3, N-Cm 1, K-Di 5, K-Cm 2).

Family TENEBRIONIDAE

43. *Phaleromela subhumeralis* Marseul 104 : V 16 (H-Sb 16), VI 20 (H-Sb 20), VII 11 (H-Sb 11), VIII 15 (H-Sb 15), IX 42 (H-Sb 42).
44. *Genocephalum recticolle* Motschulsky 4 : VII 3 (H-Sb 3), VIII 1 (H-Sb).

Family MELOIDAE

45. *Meloë proscalabaeus sapporensis* Kôno 2 : VI 2 (H-B 1, F-B 1).

Dominant species exceeding the average in number of individuals obtained are given in the descending order as follows : In May, *Poecilus caerulescens, Amara communis, Agonum impressum, Silpha perforata venatoria, Pterostichus haptoderoides japanensis, Carabus conciliator hokkaidensis, Amara chalcites, Pterostichus neglectus, Pterostichus adstrictus* ; in June, *Poecilus caerulescens, Carabus granulatus yezoensis, Chlaenius pallipes, Silpha perforata venatoria, Pterostichus haptoderoides japanensis, Agonum impressum, Carabus conciliator hokkaidensis, Pterostichus adstrictus, Phaleromela subhumeralis, Pterostichus microcephalus* ; in July, *Geotrupes*

laevistriatus, Silpha perforata venatoria, Poecilus caerulescens, Pterostichus microcephalus, Chlaenius pallipes, Carabus granulatus yezoensis, Pterostichus orientalis; in August, *Pterostichus adstrictus, Synuchus melantho, Poecilus caerulescens, Geotrupes laevistriatus, Silpha perforata venatoria, Chlaenius pallipes, Carabus opaculus, Phaleromela subhumeralis, Pterostichus haptoderoides japanensis, P. orientalis*; in September, *Carabus opaculus, Phaleromela subhumeralis, Geotrupes laevistriatus, Synuchus melantho, Poecilus aerulescens, Silpha perforata venatoria.*

Katakura and Fukuda (1975) made monthly sampling of carrion and ground beetles in Kamiotoineppu, northern Japan, with carrion and molasses pitfall traps. Table 1 gives the faunal comparison between Kamiotoineppu and Bekkai. The number of species obtained in Bekkai was larger in Carabidae and Harpalidae but smaller in Silphidae and Catopidae than that in Kamiotoineppu. This may be partially due to the difference of sampling procedures. Fish meat which was used in Kamiotoineppu but not in Bekkai should attract mostly Silphidae and Catopidae (Pukowski 1933, Katakura and Fukuda 1975). On the other hand, the abundance of sampling sites in Bekkai (34, in Kamiotoineppu 10) should be effective to get more species of Carabidae and Harpalidae which are generally stenotopic (cf. Kamimura *et al.* 1962, Katakura and Fukuda 1975). The species common to both areas were *Carabus conciliator hokkaidensis, C. granulatus yezoensis, C. opaculus* (Carabidae), *Poecilus caerulescens, P. fortipes, Pterostichus haptoderoides japanensis, P. thunbergi, P. orientalis, Synuchus melantho, Agonum impressum, Amara chalcites, Anisodactylus signatus, Chlaenius pallipes* (Harpalidae), *Silpha perforata venatoria, Phosphuga atrata* (Silphidae), *Catops angustitarsis lewisi* (Catopidae), *Geotrupes laevistriatus* (Geotrupidae).

Seasonal fluctuation of niche breadth (Fig. 3): The niche breadth of six species (*Silpha perforata venatoria, Geotrupes laevistriatus, Poecilus caerulescens, Pterostichus adstrictus, Carabus granulatus yezoensis, Chlaenius pallipes*) which were relatively dominant in all seasons was calculated with following formula of Simpson (1949):

$$N.\,B. = N^2 / \sum_i n_i^2$$

where n_i and N are the number of individuals at sampling site i and the total number respectively.

Table 1. Faunal comparison of ground beetles between Kamiotoineppu (Katakura and Fukuda 1975) and Bekkai, giving the number of species obtained.

Family	Kamiotoineppu	Bekkai	Common to both areas
Carabidae	5	8	3
Harpalidae	14	30	10
Silphidae	11	2	2
Catopidae	12	1	1
Geotrupidae	1	1	1

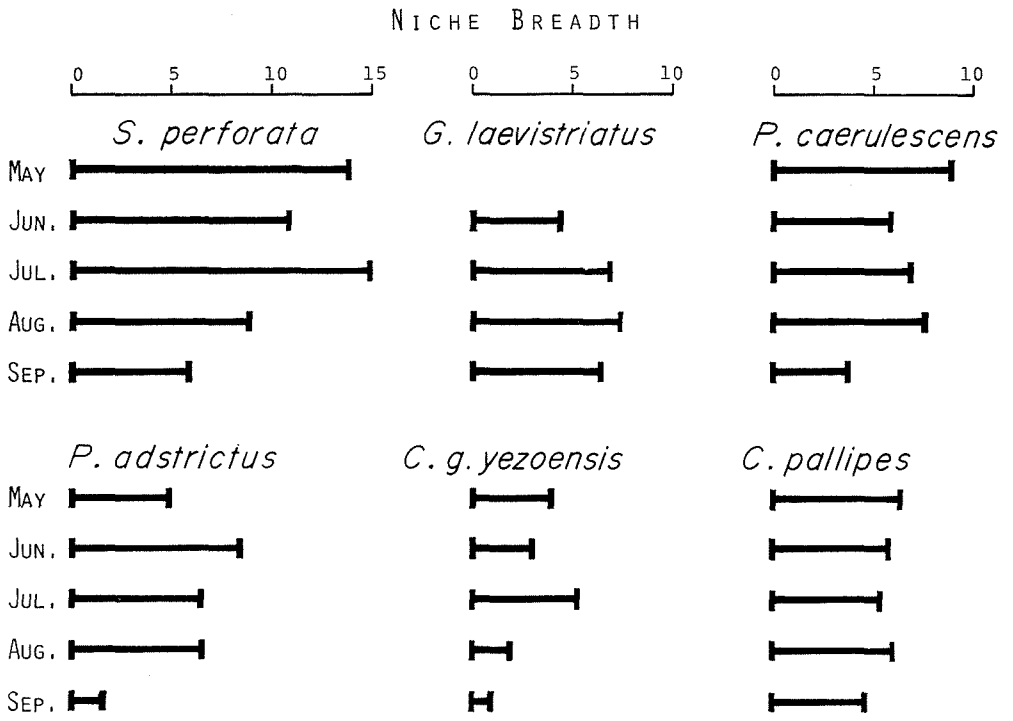


Fig. 3. Seasonal fluctuation of niche breadth.

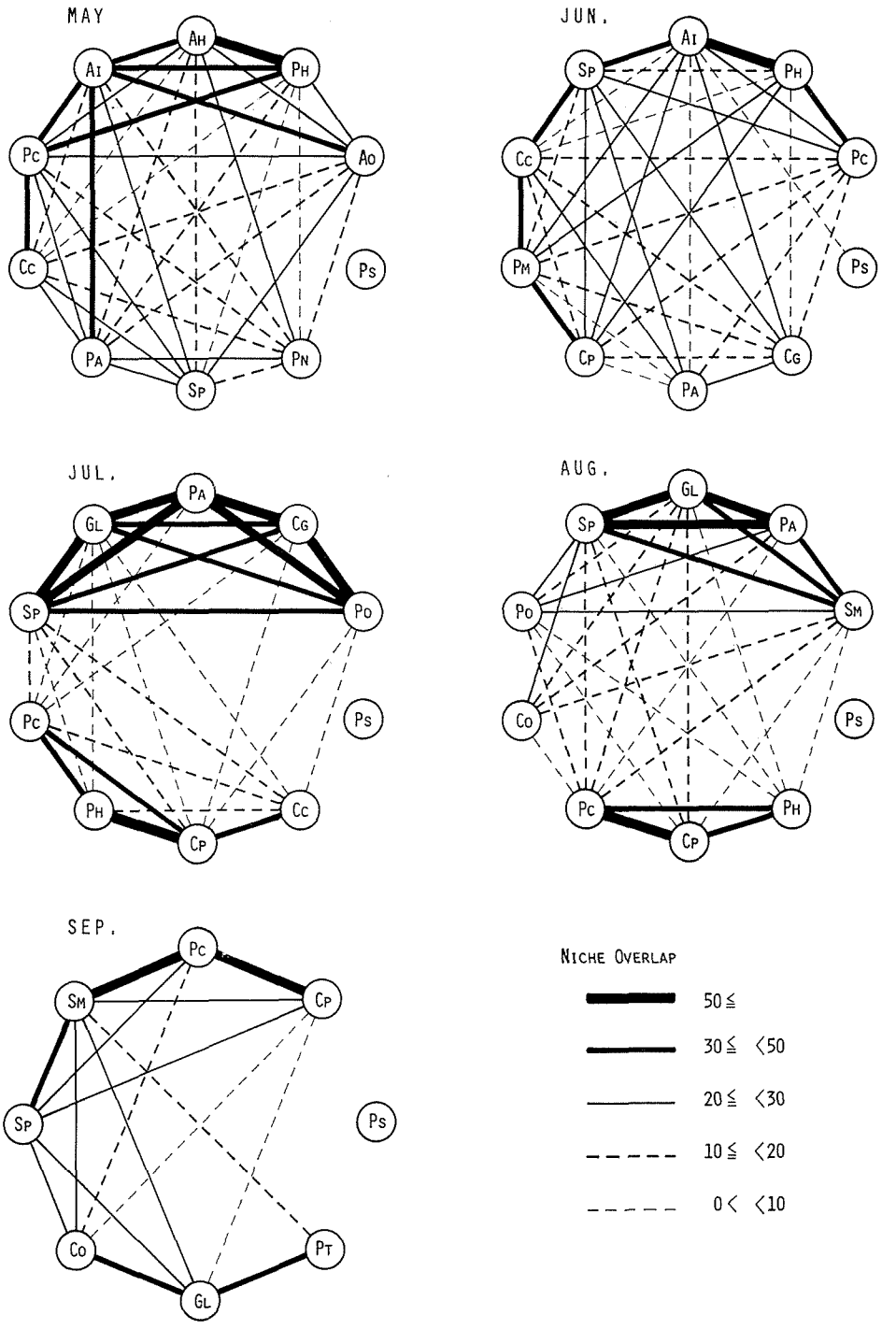
The niche breadth of *Pterostichus adstrictus* and *Geotrupes laevistriatus* fluctuated unimodally, having a peak in summer when the beetles were most active and new adults in addition emerged. In other species, however, the fluctuation was bimodal, having another peak in May. Since trees were not nearly leaf-opening in May, the difference of abiotic conditions between the forest and the open habitats was to be less in this season than in late June when the trees were completely leafy. This is a reason for the great breadth in May. Actually, *Poecilus caerulescens* preferring grasslands and bare lands in the summer was abundant even in the forest in May.

Niche overlap (Fig. 4): The index of Whittaker (1952) was used to represent the niche overlaps among dominant species in each month:

$$N.O. = \sum_i \min(P_{ai}, P_{bi}) \times 100$$

where P_{ai} and P_{bi} are relative frequencies of individuals obtained at sampling site i in the total numbers of species a and b respectively.

Fig. 4. Niche overlap among dominant species in each month. AH, *Amara chalcites*; AI, *Agonum impressum*; AO, *Amara communis*; CC, *Carabus conciliator hokkaidensis*; CG, *Carabus granulatus yezoensis*; CO, *Carabus opaculus*; CP, *Chlaenius pallipes*; GL, *Geotrupes laevistriatus*; PA, *Pterostichus adstrictus*; PC, *Poecilus caerulescens*; PH, *Pterostichus haptoderoides*; PM, *Pterostichus microcephalus*; PN, *Pterostichus neglectus*; PO, *Pterostichus orientalis*; PS, *Phaleromela subhumeralis*; PT, *Pterostschus thumbergi*; SM, *Synuchus melantho*; SP, *Silpha perforata venatoria.*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20≦ <30
10≦ <20
0< <10

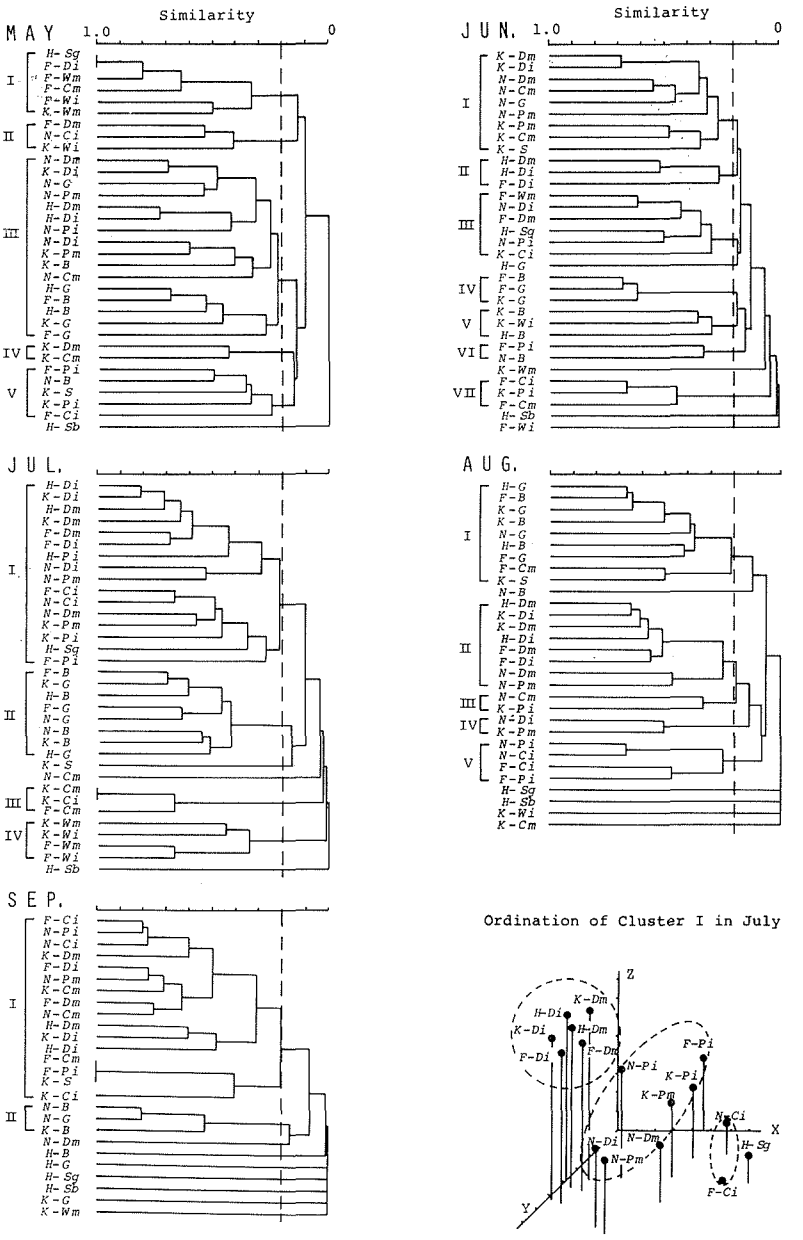

Fig. 5. Cluster analysis of sampling sites with the average-linkage method (Davis 1963) and ordination of Cluster I in July with the method of Bray and Curtis (1957). Similarity index of Whittaker (1952) was used.

The interspecific relationship seasonally changes (Fig. 4). In the spring and autumn, most of the niche overlaps among dominant species were less than 30%, each species showing nearly peculiar distribution. In July when the folliage stage culminates in trees the dominant species were divided into four groups : 1. *Geotrupes laevistriatus, Pterostichus adstrictus, P. orientalis, Carabus granulatus, Silpha*

perforata venatoria, which were plentiful in broad-leaved forests and on their margin. 2. *Poecilus caerulescens*, *Pterostichus haptoderoides*, *Chlaenius pallipes*, preferring bare lands and grasslands. 3. *Carabus conciliator hokkaidensis*. This species were found in the young-aged plantation of *Larix leptolepis* in Furen, but the grassland in Honbekkai. 4. *Phaleromela subhumeralis*, which was distributed only in the beach of Honbekkai. This pattern almost remained even in August.

Faunal similarities among sampling sites: No beetle was captured at following sites in each month: K-Ci/May; N-Ci/June; F-Wm, F-Wi, K-Wm, K-Ci/August; F-B, F-G, F-Wm, F-Wi, N-Di, K-Pi, K-Pm, K-Wi/September.

The similarities among sampling sites where beetles were obtained were calculated with the Whittaker's index (1952):

$$S.I. = \sum_{i} \min (P_{ai}, P_{bi})$$

where P_{ai} and P_{bi} are relative frequencies of species i at sampling sites a and b respectively. In Fig. 5 giving the cluster analysis of sampling sites with the average-linkage method (Davis 1963), the similarity limit is set at $S.I.=0.2$:

After the foliage opened in June, each culuster tended to contain exclusively either forest habitats (Di, Dm, Ci, Cm, Pi, Pm) or open habitats (B, G). The separation of the forest from open habitats was clearest in July, forming four clusters and three independent sampling sites. Culster I mostly consisted of forest habitats, which could be subdivided into three groups (cf. ordination in Fig. 5): Ia, containing broad-leaved forest and its margin (H-Di, Dm, K-Di, Dm, F-Di, Dm), commonly inhabited by *Carabus granulatus yezoensis*, *Geotrupes laevistriatus*, *Silpha perforata venatoria*, *Pterostichus adstrictus*; Ib, all plantations of *Larix leptolepis* and their margin (F-Pi, N-Pi, Pm, K-Pi, Pm), and a broad-leaved forest and its margin (N-Di, Dm), occupied by *Silpha perforata venatoria*; Ic, nearly defaunated coniferous plantations of *Larix leptolepis* (F-Ci, N-Ci). The coastal grassland covered with sweet briers also belonged to Cluster I. Cluster II exclusively contained open habitats commonly dominated by *Poecilus caerulescens* and *Chlaenius pallipes*. Cluster III was a group of *Larix leptolepis* plantation and its margin (K-Ci, Cm, F-Cm), occupied by *Carabus opaculus*. Cluster IV consisted of alder thicket and its margin (F-Wi, Wm, K-Wi, Wm), occupied by *Bembidion poppii*.

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Summary

Sampling of ground beetles was made monthly from May to September 1981, at 34 stations in a dairy area of Bekkai Village, Hokkaido, Northern Japan. The results are:

1) In total 1891 individuals of 45 species were obtained. The dominant species were *Carabus granulatus yezoensis, C. opaculus, Poecilus caerulescens, Agonum impressum, Amara communis, Pterostichus haptoderoides japanensis, P. adstricutus, Chlaenius pallipes, Silpha perforata venatoria, Geotrupes laevistriatus* and *Phaleromela subhumeralis.*

2) The seasonal fluctuation of niche breadth was unimodal in *G. laevistriatus* and *P. adstrictus*, but bimodal in *S. perforata venatoria, P. caerulescens, C. granulatus yezoensis* and *C. pallipes.*

3) The interspecific niche overlap seasonally changed. In the summer the beetles could be divided into two types, sylvan species (*C. granulatus yezoensis, P. adstrictus, P. orientalis, S. perforata venatoria,* and *G. laevistriatus*) and openland species (*P. caerulescens, P. haptoderoides japanensis* and *Chlaenius pallipes*).

4) According to the cluster analysis of sampling sites, the faunal difference between openland and forest habitats was remarkable after the foliage of forests developed well.