Faunal makeup of ground and carrion beetles in Kamiotoineppu, Hokkaido University Nakagawa Experiment Forest, Northern Japan, with some notes on related problems*

By

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北海道大学中川地方演習林における地表性甲虫類の調査

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From May to September 1972, we made monthly sampling of carrion and ground beetles using carrion and molasses pitfall traps. The aim of the survey was to clarify the faunal makeup of these beetles, certainly playing an important role for forest ecosystem economy, in the area studied, and to obtain some preliminary information for further ecological studies. In the present paper the beetles belonging to six families are reported: Carabidae, Harpalidae, Silphidae, Catopidae, Histeridae and Geotrupidae. Other beetles collected, including two important members of the carrion beetles assemblage, Staphylinidae and Hydrophilidae, are reported elsewhere.

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1. Area surveyed and methods.

1.1. *Area surveyed:* Kamiotoineppu is situated at the southern part of Hokkaido University Nakagawa Experiment Forest, Northern Japan (Fig. 1A), and is vegetationally belonging to the zone intermediate between the northern Asiatic Temperate- and Subarctic zones (cf. TATEWAKI and IGARASHI 1971). Climatic

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* Biofaunistic studies of ground and carrion beetles in Hokkaido. I.

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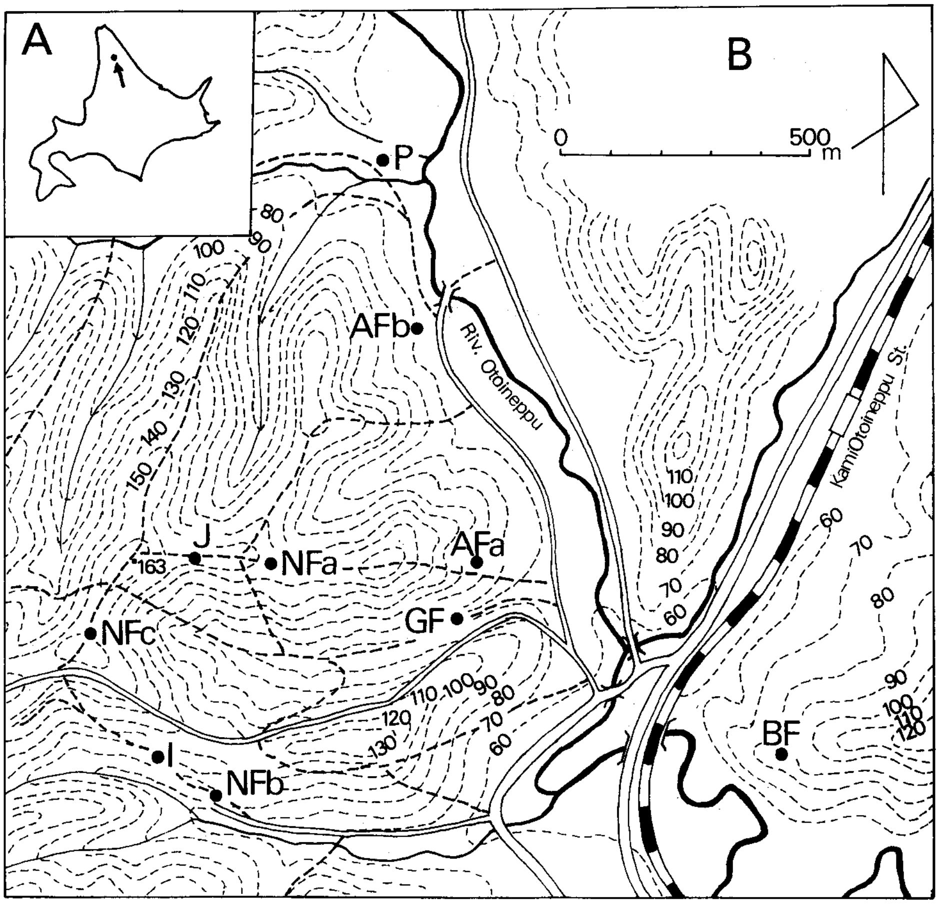

Fig. 1. Location (A) and topography (B) of the area surveyed. Trap stations are shown by black circles. Abbreviations for trap stations see in the text.

conditions of the area from May to September in 1972 are given in Fig. 2*. In total eight trap stations were set in five different vegetations as follows (abbreviations for trap stations in parentheses and topography of each trap station given in Fig. 1B):

Natural mixed forest (NFa, b, c): Mainly composed of *Abies sachalinensis* and *Picea glehnii*, with some broad-leaved trees. Conifers predominant in NFa, while broad-leaved trees in NFb. Undergrowth mostly *Sasa kurilensis* with some other vine plants.

Natural gallery forest (GF): Mainly composed of *Fraxinus mandshurica* with sparse admixture of other broad-leaved trees. Undergrowth mainly *Cirsium kamtschaticum*, *Cacalia hastata* and some other hygrophilous plants.

Secondary birch forest (BF): Mostly composed of *Betula platyphylla* grown after forest fire. Undergrowth mostly *Sasa kurilensis*.

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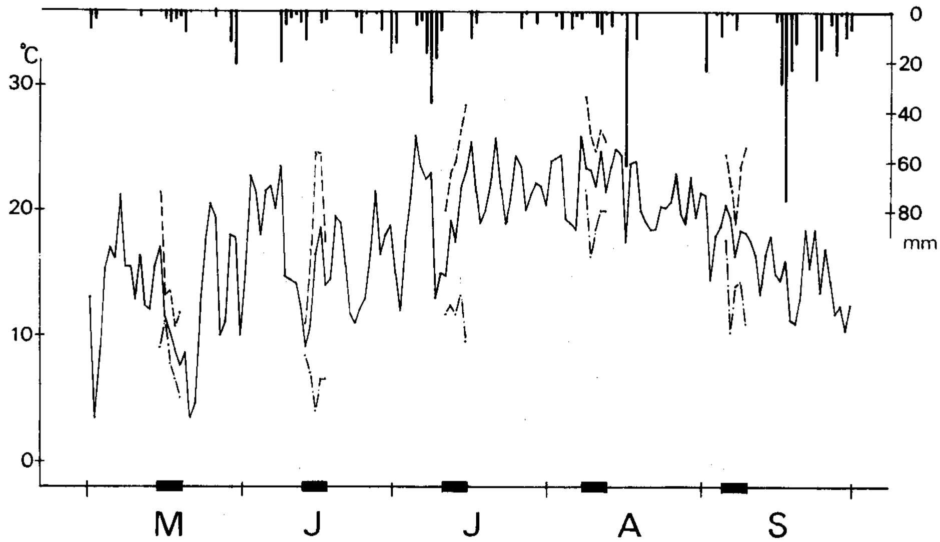

Fig. 2. Climatic conditions of the area surveyed from May to September, 1972. Above, precipitations. Below, air temperatures obtained at 9:00 each day (solid line). Maximum (broken) and minimum (chain) temperatures are added to the surveyed periods (black bars given below).

Fir afforestation (AFa, b): *Abies sachalinensis*, about 15 m high in AFa and 1~2 m high in AFb. Undergrowth, sparse *Sasa kurilensis* and vines in AFa, *Sasa kurilensis* and *Cirsium kamtschaticum* in AFb.

Pasture (P): White clover (*Triforium repens*) and *Phleum pratense*.

1. 2. *Methods:* The beetles were collected by polyethylen pitfall trap, 250 cc volume, 3.5 cm caliber and 12 cm deep, by using fish meat and molasses as baits. Five sets of traps, each consisting of one fish meat (F) and one molasses (M) traps set at 30 cm interval for each other, were arranged linearly in each station at an interval 2 m. In July, extra molasses traps were added to at natural forest (Fig. 1B, I and J). The survey was carried out on May 15~19, June 13~17, July 11~15, August 8~12 and September 5~9 with the following schedules: Traps set at 9:00~10:00 of the first day. From the second to fourth day, the trapped beetles were picked up twice per day, 9:00~10:00 and 17:00~18:00. Traps were removed after the collection in the morning of the fifth day. Some small sized beetles intermingled with meat would possibly be overlooked at the sampling on the second to fourth day.

2. Results

2. 1. *Faunal makeup:* The list of the species belonging to Carabidae, Harpalidae, Silphidae, Catopidae, Histeridae and Geotrupidae collected by the survey is presented for each species as follows:

Scientific name, total number (Total = ♂ + ♀), monthly number given male and female separately. Monthly number is omitted when only one specimen was collected.

Family CARABIDAE

1. *Carabus conciliator hokkaidensis* Lapouge. 2=1+1. ♂ VI; ♀ VII.
2. *C. granulatus yezoensis* Bates. 1=0+1. VI.
3. *C. opaculus* Putzeys. 21=9+12. ♂ VIII 2, IX 7; ♀ VI 1, VII 3, VIII 1, IX 7.
4. *Damaster blaptoides rugipennis* Motschulsky. 2=0+2. VI.
5. *D. gehini* Fairmaire. 4=3+1. ♂ VI 2, VII 1; ♀ VII.

Family HARPALIDAE

6. *Poecilus* (*Macropoecilus*) *fortipes* Chaudoir. 4=2+2. ♂ VI 1, VIII 1; ♀ VIII.
7. *P. caerulescens* Linné. 40=25+15. ♂ VI 3, VII 13, VIII 7, IX 2; ♀ V 1, VI 3, VII 8, VIII 3.
8. *Pterostichus haptoderoides* Tschitschérine. 22=12+10. ♂ V 7, VII 1, VIII 4; ♀ V 2, VII 3, VIII 5.
9. *Pt. thunbergi* Morawitz. 140=67+73. ♂ V 9, VI 14, VII 36, VIII 6, IX 2; ♀ V 12, VI 22, VII 27, VIII 6, IX 6.
10. *Pt. orientalis* Motschulsky. 8=4+4. ♂ VI 1, VII 1, VIII 1, IX 1; ♀ VII.
11. *Pt. nigritus* ssp. 1=1+0. VI.
12. *Synuchus melantho* Bates. 148=65+83. ♂ VII 4, VIII 50, IX 11; ♀ VII 3, VIII 73, IX 7.
13. *S. cycloderus* Bates. 2=1+1. ♂ VII; ♀ IX.
14. *Agonum impressum* Panzer. 61=43+18. ♂ VI 11, VII 12, VIII 20; ♀ V 1, VI 2, VII 2, VIII 13.
15. *Colpodes buchanani* Hope. 1=1+0. VII.

*16. *C. daisetsuzanus* Nakane. 1=0+1. VII.

17. *Amara chalcites* Dejean. 1=0+1. VI.
18. *Anisodactylus signatus* Panzer. 1=1+0. IX.
19. *Chlaenius pallipes* Gebler. 5=1+4. ♂ VI; ♀ VI 2, VII 2.

Family SILPHIDAE

20. *Nicrophorus tenuipes* Lewis. 64=12+52. ♂ VII 3, VIII 8, IX 1; ♀ VI 1, VII 23, VIII 24, IX 4.
21. *N. maculifrons* Kraatz. 560=267+293. ♂ VI 98, VII 40, VIII 50, IX 79; ♀ VI 79, VII 50, VIII 79, IX 85.
22. *N. quadripunctatus* Kraatz. 493=245+248. ♂ VI 36, VII 78, VIII 73, IX 58; ♀ VI 30, VII 34, VIII 65, IX 119.
23. *N. investigator* Zetterstedt. 329=173+156. ♂ VII 1, VIII 121, IX 51; ♀ VII 5, VIII 135, IX 16.
24. *N. vespilloides* Herbst. 360=224+136. ♂ VI 35, VII 28, VIII 116, IX 45; ♀ VI 18, VII 23, VIII 63, IX 32.

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* Collected only in extra sampling made in July.

25. *Necrodes asiaticus* Portevin. 7=3+4. ♂ VIII ; ♀ VIII 2, IX 2.
26. *Silpha perforata venatoria* Harold. 21=16+5. ♂ VI 4, VII 10, IX 2 ; ♀ VI 3, VII 1, IX 1.
27. *Phosphuga atrata* Linné. 2=2+0. VII 1, VIII 1.
28. *Oiceoptoma thoracica* Linné. 64=27+37. ♂ VI 3, VII 1, VIII 23 ; ♀ VI 9, VIII 28.
29. *O. subrufa* Lewis. 5=4+1. ♂ VIII ; ♀ VIII.
30. *Thanatophilus auripilosus* Portevin. 22=10+12. ♂ VI 2, VII 3, VIII 2, IX 3 ; ♀ VI 5, VII 2, VIII 2, IX 3.

Family CATOPIDAE

31. *Micronemadus pusillimus* Kraatz. 1=1+0. VI.
32. *Prionochaeta harmandi* Portevin. 22=14+8. ♂ VII 9, VIII 5 ; ♀ VI 1, VII 4, VIII 3.
33. *Sciodrepoides japonicus* Jeannel. 154=90+64. ♂ VI 24, VII 23, VIII 28, IX 15 ; ♀ VI 23, VII 16, VIII 17, IX 8.
34. *S. watsoni* Spence. 163=83+80. ♂ VI 46, VII 21, VIII 15, IX 1 ; ♀ VI 44, VII 20, VIII 13, IX 3.
35. *S. fumatus* Spence. 167=104+63. ♂ VI 10, VII 69, VIII 24, IX 1 ; ♀ VI 6, VII 50, VIII 6, IX 1.
36. *Catops sparsepunctatus* Jeannel. 56=28+28. ♂ VII 2, VIII 4, IX 22 ; ♀ VII 2, VIII 6, IX 20.
37. *C. angustipes apicalis* Portevin. 2=2+0. VI 1, VII 1.
38. *C. angustitarsis lewisi* Jeannel. 11=6+5. ♂ V 2, VI 2, VII 2 ; ♀ V 2, VI 1, VII 2.
39. *C.* sp. 1 (*hilleri* group*). 1=1+0. VII.
40. *C.* sp. 2 (*hilleri* group*). 12=12+0. IX.
41. *C.* sp. 3 (*hilleri* group*). 2=2+0. VII 1, IX 1.
* *C.* sp. 1~3 (*hilleri* group). 10=0+10. IX.
42. *Catopodes fuscifrons* Kraatz. 176=82+94. ♂ VII 16, VIII 7, IX 59 ; ♀ VII 27, VIII 7, IX 60.

Family HISTERIDAE

43. *Saprinus niponicus* Dahlgren. 199=112+87. ♂ VII 89, VIII 23 ; ♀ VII 68, VIII 19.
44. *S. cuspidatus* Ihssen. 3=3+0. VII 2, VIII 1.
45. *Margarinotus niponicus* Lewis. 156=96+60. ♂ VII ; ♀ VI 1, VII 59.
46. *M. weymarni* Wenzel. 7=4+3. ♂ VII 1, VIII 3 ; ♀ VII 1, VIII 1, IX 1.
47. *Hister concolor* Lewis. 8=5+3. ♂ VII 2, VIII 1, IX 2 ; ♀ VII.

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* Three species were recognized in *C. hilleri* group by the morphology of male genitalia, while in female clear separation could not be done. Therefore, females are shown in combination of three species.

Family GEOTRUPIDAE

48. *Geotrupes laevistriatus* Motschulsky. 85=51+34. ♂ V 2, VI 9, VII 15, VIII 10, IX 15; ♀ VI 6, VII 7, VIII 5, IX 16.

The relatively abundant species, represented by more than 20 individuals in total, are given in the descending order of individuals as follows (family names abbreviated: Carabidae=Car, Harpalidae=Har, Silphidae=Sil, Catopidae=Cat, Histeridae=His, Geotrupidae=Geo): 1) *Nicrophorus maculifrons* (Sil); 2) *N. quadripunctatus* (Sil); 3) *N. vespilloides* (Sil); 4) *N. investigator* (Sil); 5) *Saprinus niponicus* (His); 6) *Catopodes fuscifrons* (Cat); 7) *Sciodrepoides fumatus* (Cat); 8) *S. watsoni* (Cat); 9) *Margarinotus niponicus* (His); 10) *Sciodrepoides japonicus* (Cat); 11) *Synuchus melantho* (Har); 12) *Pterostichus thunbergi* (Har); 13) *Geotrupes laevistriatus* (Geo); 14) *Nicrophorus tenuipes* (Sil), *Oiceoptoma thoracica* (Sil); 16) *Agonum impressum* (Har); 17) *Catops sparsepunctatus* (Cat); 18) *Poecilus caerulescens* (Har); 19) *Thanatophilus auripilosus* (Sil), *Pterostichus haptoderoides* (Har), *Prionochaeta harmandi* (Cat); 22) *Silpha perforata venatoria* (Sil), *Carabus opaculus* (Car).

KAMIMURA *et al.* (1962, '64) studied seasonal and altitudinal distributions of carrion and ground beetles in Mt. Jônen, central Japan, using carrion pitfall traps. The following items could be pointed out from the comparison of the results in Kamiotoineppu and Mt. Jônen (cf. Table 1).

Table 1. Comparison of carrion and ground beetle fauna between Mt. Jônen (calculated from KAMIMURA *et al.*, 1962, '64) and Kamiotoineppu, indicating the number of species, relative frequency of individuals and the number of species common to both areas in each family. Number of individuals collected by molasses trap are omitted from the data in Kamiotoineppu.

Family	Jônen		Kamiotoineppu		Number of species common to both localities
	Number of species	% RF	Number of species	% RF	
Carabidae	12	1.0	3	0.1	1
Harpalidae	46	18.2	12	8.4	3
Silphidae	20	58.2	11	56.1	7
Catopidae	15	13.0	12	22.6	8
Histeridae	8	8.6	5	11.0	2
Geotrupidae	1	1.0	1	1.8	1

1) Ground beetles (Carabidae and Harpalidae) are far more abundant in Jônen in the numbers of both species and individuals. As these beetles are generally stenotopic (cf. 2. 4), the difference is probably due to the different habitat ranges covered in these two surveys. In Jônen, 51 trap stations were set at various environments such as natural forest, grassland, gallery forest, etc. ranging 700 to 2,800 m alt., while in the present study only 8 trap stations at nearly

same altitudes (70 to 150 m alt., cf. Fig. 1B).

2) Obvious abundance of Catopidae in Kamiotoineppu may partly depend on the sampling procedure. The beetles were collected twice every day in monthly sampling in Kamiotoineppu while once a week in Jônen. Considering the active and fragile nature of these beetles, it is inferred that escaped or destroyed individuals were more numerous in Jônen than in Kamiotoineppu.

3) The species common to both areas is mostly represented by Silphidae and Catopidae while few by Harpalidae and Carabidae. The scarcity of the common species in the ground beetles is probably explained by their stenotopic nature mentioned in 1). On the other hand, the faunal resemblance in Silphidae and Catopidae indicates their strong dispersal ability, probably related with the distribution of their food sources being widely scattered.

2. 2. *Bait preference*: Some differences in food habits have been observed in the species listed above. It is well known that larger carabids are mainly carnivorous, feeding land snails, earthworms, lepidopteran larvae, etc., while Harpalidae and many small carabids are omnivorous at least in adult stage (cf. LUFF 1974). Necrophagy is common in Silphidae but some species also attack living insects or feed plant detritus. Among silphids, *Nicrophorus* spp. are apparently necrophagous, both larvae and adults feed on carrion, though adults sometimes attack other insects (PUKOWSKI 1933). Catopidae may also mainly be necrophagous, Histeridae is carnivorous (NAKANE 1972) and Geotrupidae includes many coprophagous species though necrophagy are also observed (PUKOWSKI 1933).

Bait preference of the predominant species collected in the present study is given in Table 2, together with those of each family (cf. also Fig. 6). Carabids, especially *Carabus opaculus*, being presumed as carnivorous, were abundantly collected by molasses than by fish meat. While other groups showed the opposite trend of bait preference, divided into two types by the bait preference:

A) Collected both by fish meat and molasses though more abundantly by the former ($0.1<F-M/F+M<0.70$). All harpalid species, *Silpha perforata venatoria* and *Geotrupes laevistriatus*. Judging from the previous information, the species enumerated here are likely omni- or saprophagous.

B) Collected virtually only by fish meat ($0.70<F-M/F+M<1$). Silphids except for *Silpha perforata venatoria*, Catopidae and Histeridae. Silphids and catopids are necrophagous while histerids are carnivorous, feeding on other insects gathering on carrion.

2. 3. *Daily activity*: Fig. 3 shows the number of individuals of some predominant species (with more than 50 individuals) collected in the morning (9:00 ~10:00, black) and the evening (17:00~18:00, hatching) in each month. Individuals collected on the last day of each monthly sampling were omitted because the sampling often ranged from 9:00 to 13:00. In the figure, black bar shows the individuals being active in dusk, night and twilight (called here 'nocturnal') while hatching shows the diurnal individuals. Diurnal tendency is distinct in two histerids (*Saprinus niponicus* and *Margarinotus niponicus*) and, though less

Table 2. Bait preference in each family and predominant species.

Family and species	M	F	Total	F−M/F+M
Carabidae	**26**	**4**	**30**	**−0.733**
Carabus opaculus	20	1	21	−0.904
Others combined	6	3	9	−0.333
Harpalidae	**150**	**284**	**434**	**0.308**
Poecilus caerulescens	11	29	40	0.450
Pterostichus thunbergi	58	82	140	0.171
Pte. haptoderoides	4	18	22	0.636
Synuchus melantho	46	102	148	0.378
Agonum impressum	22	39	61	0.278
Others	9	14	23	0.217
Silphidae	**47**	**1,890**	**1,937**	**0.952**
Nicrophorus tenuipes	2	62	64	0.937
N. maculifrons	13	547	560	0.953
N. quadripunctatus	7	486	493	0.971
N. investigator	0	329	329	1.00
N. vespilloides	12	348	360	0.933
Silpha perforata venatoria	7	14	21	0.333
Oiceoptoma thoracica	4	60	64	0.875
Thanatophilus auripilosus	0	22	22	1.00
Others	2	12	14	0.714
Catopidae	**16**	**761**	**777**	**0.958**
Prionochaeta harmandi	0	22	22	1.00
Sciodrepoides japonicus	6	148	154	0.922
S. watsoni	3	160	163	0.963
S. fumatus	2	165	167	0.970
Catops sparsepunctatus	1	55	56	0.964
Catopodes fuscifrons	3	173	176	0.965
Others	1	38	39	0.948
Histeridae	**3**	**370**	**373**	**0.983**
Saprinus niponicus	0	199	199	1.00
Margarinotus niponicus	3	153	156	0.961
Others	0	18	18	1.00
Geotrupidae	**26**	**59**	**85**	**0.388**
Geotrupes laevistriatus	26	59	85	0.388

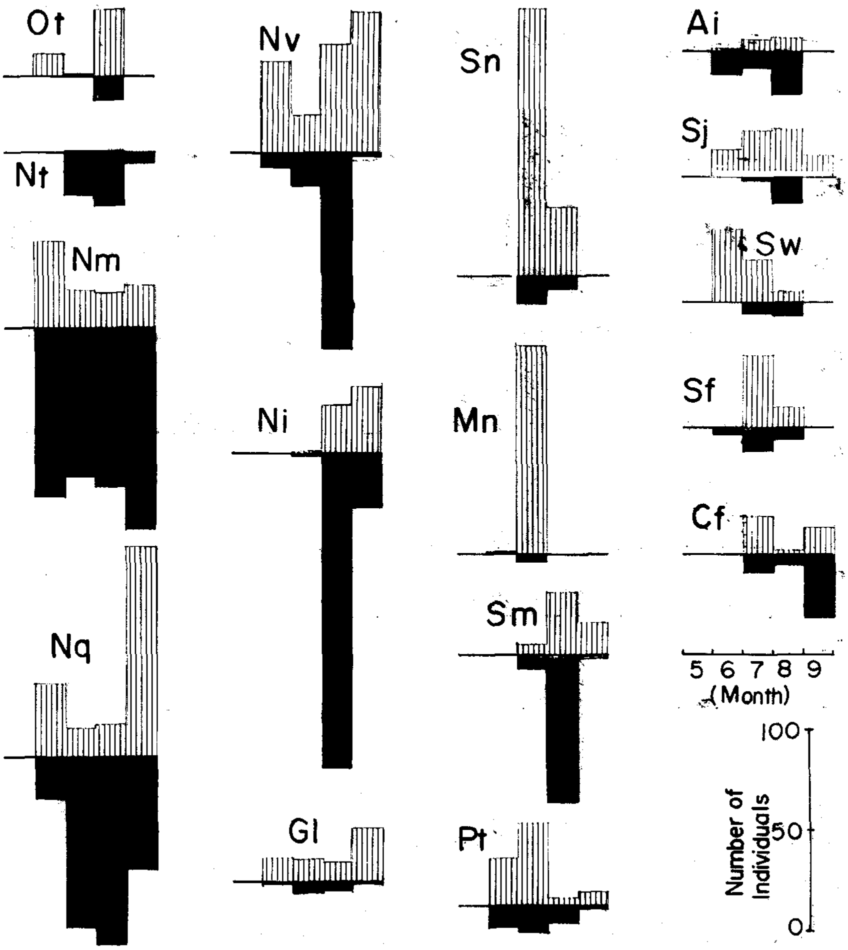

Fig. 3. Daily activity of some predominant species (those with more than 50 individuals) in each month: Black, collected at 9:00~10:00; hatched, at 17:00~18:00 (cf. also text). Ot = *Oiceoptoma thoracica*, Nt = *Nicrophorus tenuipes*, Nm = *N. maculifrons*, Nq = *N. quadripunctatus*, Nv = *N. vespilloides*, Ni = *N. investigator*, Gl = *Geotrupes laevistriatus*, Sn = *Saprinus niponicus*, Mn = *Margarinotus niponicus*, Sm = *Synuchus melantho*, Pt = *Pterostichus thunbergi* Ai = *Agonum impressum*, Sj = *Sciodrepoides japonicus*, Sw = *S. watsoni*, Sf = *S. fumatus*, Cf = *Catopodes fuscifrons*.

clear, also observed in *Oiceoptoma thoracica*, *Sciodrepoides* spp. (*japonicus*, *watsoni*, *fumatus*), *Pterostichus thunbergi* and *Geotrupes laevistriatus*. On the other hand, *Nicrophorus* spp. except for *vespilloides* and, to some degree, *Synuchus melantho* and *Agonum impressum* show 'nocturnal' pattern. Interestingly some 'nocturnal' species behaved as if diurnal in the cooler season such as June and September (cf. Fig. 2). This tendency was most prominant in *N. quadripunctatus* but also recognized in *N. maculifrons*, *N. investigator*, *Sciodrepoides watsoni* and *Synuchus melantho*.

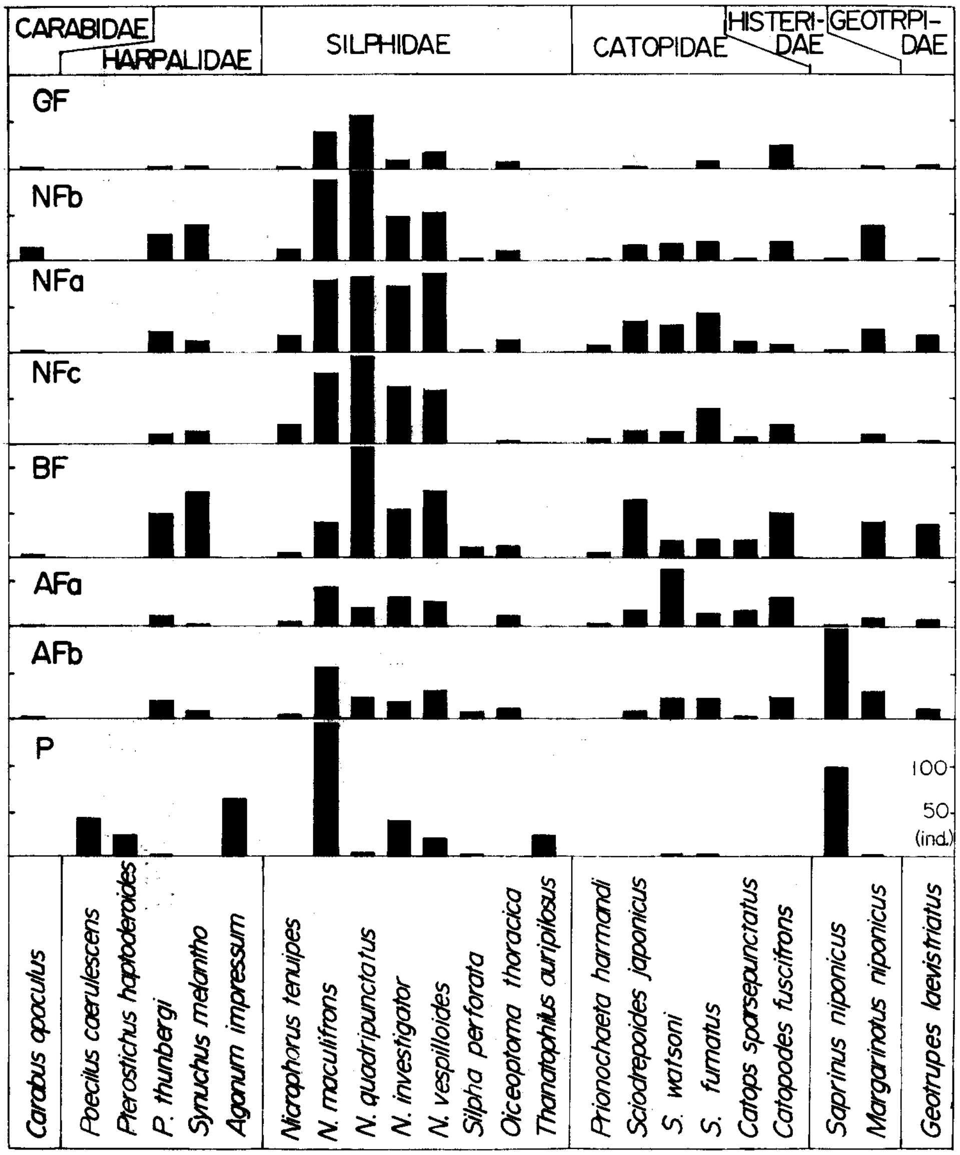

Fig. 4. Distribution of the predominant species in each habitat.

2. 4. *Habitat preference:* Fig. 4 shows the distribution in each trap station of the predominant species (with more than 20 individuals) and Table 3 the relative frequency of predominant species in each trap station.

The species composition was quite different between openland and other trap stations. AFb (young *Abies* afforestation) could be regarded in vegetation as transitional between P and AFa, but the species composition was similar to other forest trap stations except for *Saprinus niponicus*, a typical openland species. Table 4 shows different species compositions between openland (P) and forest. In Harpalidae and Histeridae the segregation of openland and forest species is

Table 3. Relative frequency of predominant species among trap stations, the most preferred stations shown in Gothic.

	Total individual number	GF	NF			BF	AF		P
			a	b	c		a	b	
Carabidae									
Carabus opaculus	21	4.8	4.8	**66.7**		14.3	4.8	4.8	
Harpalidae									
Poecilus caerulescens	40								**100.0**
Pterostichus thunbergi	140	1.4	15.7	20.0	7.1	**33.6**	7.9	13.6	0.7
Pte. haptoderoides	22								**100.0**
Synuchcs melantho	148	2.0	8.2	26.4	8.8	**48.6**	0.7	5.4	
Agonum impressum	61								**100.0**
Silphidae									
Nicrophorus tenuipes	64	1.6	28.1	17.2	**31.3**	7.8	7.8	6.3	
N. maculifrons	560	7.0	13.9	15.4	13.8	6.8	7.7	9.7	**25.7**
N. quadripunctatus	493	11.4	16.4	19.5	19.3	**24.1**	4.1	4.5	0.8
N. investigator	329	2.7	**21.6**	14.3	18.8	15.8	9.4	5.5	11.9
N. vespilloides	360	4.7	**23.6**	14.2	16.4	20.3	7.2	8.3	5.3
Silpha perforata venatoria	21		4.8	4.8		**52.4**		33.3	4.8
Oiceoptoma thoracica	64	9.4	**20.3**	15.6	3.1	18.8	17.2	15.6	
Thanatophilus auripilosus	22								**100.0**
Catopidae									
Prionochaeta harmandi	22		**31.8**	4.5	22.7	22.7	18.2		
Sciodrepoides japonicus	154	1.3	22.1	10.4	9.1	**40.9**	11.0	5.2	
S. watsoni	163		17.8	11.0	8.0	11.7	**37.4**	12.9	1.2
S. fumatus	167	5.4	**25.7**	12.0	22.8	12.0	8.4	12.6	1.2
Catops sparsepunctatus	56		19.6	1.8	10.7	**33.9**	30.4	3.6	
Catopodes fuscifrons	176	14.2	4.5	11.4	11.4	**27.8**	17.6	13.1	
Histeridae									
Saprinus niponicus	199		1.0	0.5			1.0	**49.2**	**48.2**
Margarinotus niponicus	156	1.9	16.0	**25.0**	6.4	**25.0**	5.8	19.2	0.6
Geotrupidae									
Geotrupes laevistriatus	85	4.7	21.2	4.7	3.5	**43.5**	10.6	12.9	

clear. Catopids are all confined to forest. Only silphids involve the species common to both habitats.

Among the forest vegetations including AFb, the species composition was closely similar with each other while the number of individuals in each species was variable among different trap stations:

Natural mixed forest (NFa, b, c): Characterized by the dominance of *Nicro-*

Table 4. Comparison of species composition between openland and forest by using predominant species.

Family	Forest	Common to both environments	Openland
Carabidae	*C. opaculus*		
Harpalidae	*Pterostichus thunbergi* *Synuchus melantho*		*Poecilus caerulescens* *Pterostichus haptoderoides* *Agonum impressum*
Silphidae	*Nicrophorus tenuipes* *N. quadripunctatus* *Oiceoptoma thoracica*	*N. maculifrons* *N. investigator* *N. vespilloides* *Silpha perforata venatoria*	*Thanatophilus auripilosus*
Catopidae	*Prionochaeta harmandi* *Sciodrepoides japonicus* *S. watsoni* *S. fumatus* *Catops sparsepunctatus* *Catopodes fuscifrons*		
Histeridae	*Margarinotus niponicus*		*Saprinus niponicus*
Geotrupidae	*Geotrupes laevistriatus*		

phorus spp.

Natural gallery forest (GF): Faunal makeup similar to natural mixed forest, but the number of individuals per species generally far inferior.

Secondary birch forest (BF): Individual number of *Nicrophorus* spp. similar to or less than in natural mixed forest while other species generally higher in individuals.

Fir afforestation (AF a, b): *Nicrophorus* spp. fewer while other species remained at the level similar to natural mixed forest. In spite of the difference of the vegetations, no significant difference was observed between two trap stations except for the abundance of *Saprinus niponicus* in AF b and of *Sciodrepoides watsoni* in AF a.

Consequently the abundance of faunal makeup among vegetations may be arranged as BF>NF>AF>GF.

As the number of trap stations in each vegetation were small, further confirmation would be necessary to determine whether the trend characteristic to each vegetation exists or not. However, above mentioned differences among trap stations may reflect the different environmental conditions such as microclimates and complexity of floral makeup in each trap station. On the other hand, the mircohabitat preference of each species affects the faunal makeup at each trap station. Discarding openland species which were mainly collected by only one trap station (P), the microhabitat preference of the predominant species are described as follows:

Carabidae: *Carabus opaculus*, a silvophilous species, collected especially at NFb (66.7%).

Harpalidae: *Pterostichus thunbergi* and *Synuchus melantho* with a similar microhabitat preference, both collected especially at BF (33.6% and 48.6%, respectively) and NFb (20.0% and 26.4%).

Silphidae: *Nicrophorus tenuipes* and *N. quadripunctatus* confined to forest. *N. investigator* and *N. vespilloides* likely forest species, but less strictly. *N. maculifrons*, a unique eurytopic species collected abundantly both in forest and openland (most collected at P, 25.7%), though with an interesting seasonal change as referred to the next section. The most preferred habitat of each *Nicrophorus* species except *N. maculifrons* are slightly different: *N. tenuipes* NFc (31.3%), NFa (28.1%); *N. quadripunctatus* BF (24.1%), NFb (19.5%), NFc (19.3%); *N. investigator* NFa (21.6%), NFc (18.8%); *N. vespilloides* NFa (23.6%), BF (20.3%).

Such differences may partly depend on the sampling error but must also reflect microhabitat preference of each species. After PUKOWSKI (1933), *N. vespilloides* is silvophilous, especially confined to coniferous forest in Europe, too. On the other hand, one of us (KATAKURA unpubl.) observed that this species was restricted in openland in Ishikari, central Hokkaido, hardly entering the broad-leaved forest occupied by *N. quadripunctatus*. Such case suggests, together with the seasonal change of habitat-preference of *N. maculifrons*, the plasticity of habitat preference in *Nicrophorus* species mediated by interspecific relations.

Concerning other silphids, *Oiceoptoma thoracica* was confined to forest but relatively poor in GF and NFc. *Silpha perforata venatoria* was seemingly more strongly connected with forest than openland, collected especially at BF.

Catopidae: All species silvophilous, but microhabitat preference as in *Nicrophorus* spp. was recognized as follows: *Proinochaeta harmandi* NFa (31.8%); *Sciodrepoides japonicus* BF (40.9%), NFa (22.1%); *S. watsoni* AFa (37.4%), NFa (17.8%); *S. fumatus* NFa (25.7%), NFc (22.8%); *Catops sparsepunctatus* BF (33.9%), AFa (30.4%); *Catopodes fuscifrons* BF (27.8%), AFa (17.6%).

Histeridae: *Margarinotus niponicus* was sporadically collected in forest, especially in NFb and BF (both 25.0%).

Geotrupidae: *Geotrupes laevistriatus* typically silvophilous, especially in BF (43.5%).

2.5. *Seasonal fluctuation:* The seasonal fluctuation of individuals both in total number and in each family (except for Carabidae) are shown in Fig. 5, together with those of the predominant species represented by more than 50 individuals. Although the total number showed a unimodal curve with a peak in August, the high variability among various species is noticed:

Carabidae: Although the number collected was small, Carabidae was collected at family level throughout the sampling period except May. The dominant

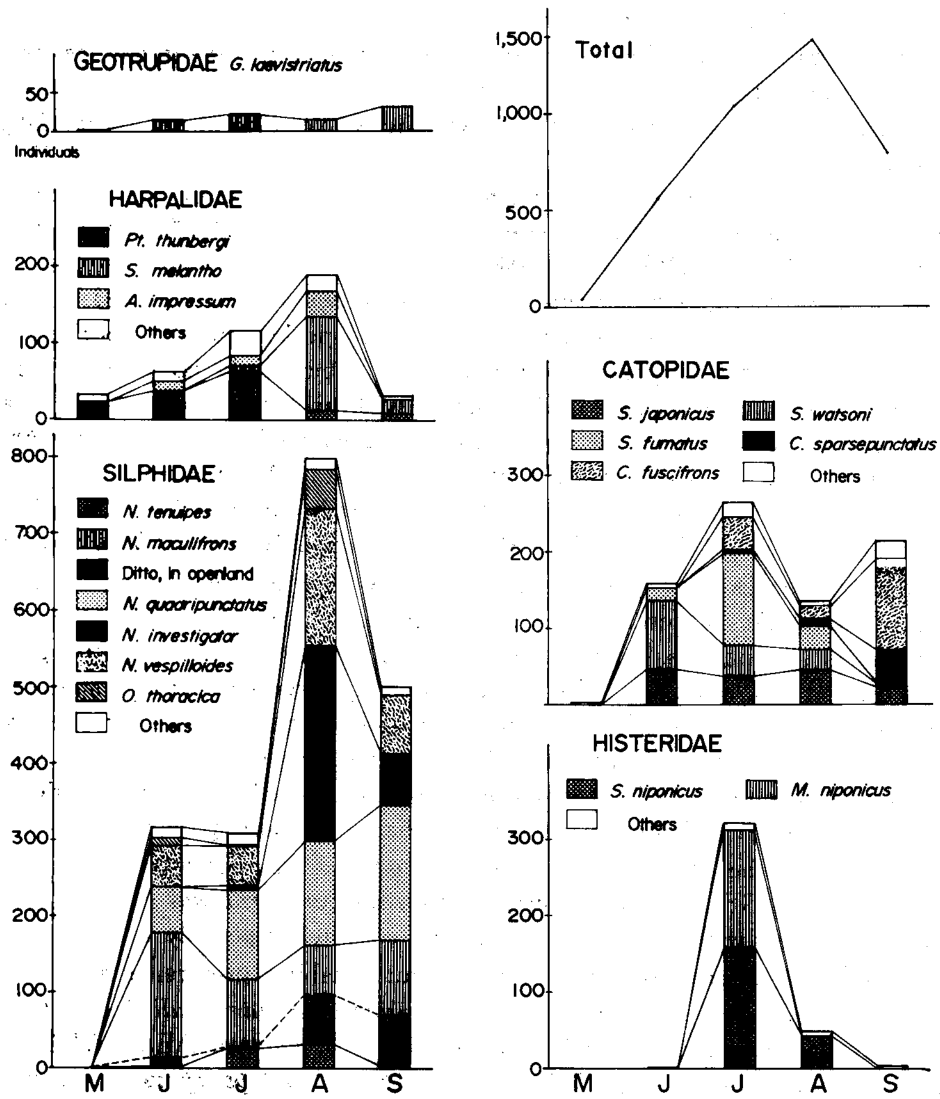

Fig. 5. Seasonal fluctuation of individuals at family level (excl. Carabidae), together with those of total species and predominant species.

species, *Carabus opaculus*, was collected from June to September with a peak in September (cf. the list in 2. 1).

Harpalidae: At family level, Harpalidae showed a unimodal distribution with a peak in August. However, two predominant forest species, *Pterostichus thunbergi* and *Synuchus melantho*, had different distributoin patterns; the former mainly collected in spring and early summer with a peak in July while the latter more abundant in autumn with a peak in September. According to KAMIMURA *et al.* (1962), this tendency is generic shown by numerous congeneric species. *Agonum impressum*, an openland species, was collected from June to August with a peak in August.

Silphidae : Among *Nicrophorus* spp., *N. maculifrons*, *N. quadripunctatus* and *N. vespilloides* were collected from June to September each with the peak in June, September and August. *N. tenuipes* was collected throughout the sampling period except May though poorer in June and September. *N. investigator* emerged in late summer and autumn with a peculiar peak in August. In Europe, *Nicrophorus* hibernated as adults (A) or as prepupae (final instar larvae, B) (PUKOWSKI 1933). Such difference of hibernation habit resulted in different seasonal distribution of adults of respective groups ; the adults of group A were active through all seasons except winter while group B were active in rather resticted season such as July, August and September (NOVÀK 1964). Concerning the species referred to in the present paper, *N. vespilloides* belongs to A and *N. investigator* to B (PUKOWSKI 1933). Probably *N. quadripunctatus* and *N. maculifrons* are also A species but precise life history study have not been made in Japan. As to *N. tenuipes*, no assumption could be done by the present result but the seasonal distribution in Jônen (KAMIMURA *et al.* 1964) suggested B type.

Interestingly *N. maculifrons* exhibited a distinct seasonal shift of habitat preference. In early summer it is confined to forest, while in late summer and autumn abundantly collected in openland. This may indicate the wider habitat preference of *N. maculifrons* in comparison with other congeneric species but the influence of the population increase of other species in late summer and autumn is also suspected. No other species showed such clear seasonal shift of habitat preference in the present study. *Oiceoptoma thoracica* showed a bimodal pattern with peaks in June and August.

Catopidae : *Sciodrepoides japonicus* was collected in every month except May without particular peak of activity. On the other hand, the other four predominant species showed different seasonal fluctuations : *S. watsoni*, with a peak in June ; *S. fumatus*, with a distinct peak in July ; *Catops sparsepunctatus* with a weak peak in September ; *Catopodes fuscifrons* with a weak peak in July and a distinct one in September.

Histeridae : Two predominant species, *Saprinus niponicus* and *Margarinotus niponicus*, possessed a quite similar seasonal trend, both mainly collected in July.

Geotrupidae : *Geotrupes laevistriatus* was collected in every sampling with a weak peak in September.

The marked sexual difference was not observed in the seasonal distribution except for *N. quadripunctatus* as given below :

Month	V	VI	VII	VIII	IX
♂	0	36	78	73	58
♀	0	30	34	65	119
♂/♀	—	1.2	2.29	1.12	0.49

The seasonal fluctuation in Kamiotoineppu is compared with that of Jônen (KAMIMURA *et al.* 1962, '64) on the species relatively abundant in both areas :

1) *Synuchus melantho*, *Nicrophorus tenuipes*, *N. investigator* and *Geotrupes*

laevistriatus, especially *S. melantho*, showed a similar trend in both areas.

2) *Sciodrepoides fumatus*, *Catops sparsepunctatus*, *Catopodes fuscifrons* and *Margarinotus niponicus* had a distinct peak in spring (May) in Jônen, but such peak was not recognized in the present study. A successive survey through years may solve either the scarcity of these species in spring is characteristic to Kamiotoineppu or not.

3) *Oiceoptoma thoracica*, *Nicrophorus maculifrons*, *N. quadripunctatus* and *N. vespilloides* showed remarkable variations in seasonal distribution at different altitudes in Jônen accompanied with a large fluctuation of individuals among samples. Our results were too gross to compare the seasonal trend of these species except for the approximate estimation of emergence period.

Summary

From May to September, 1972, ground and carrion beetles were collected by fish meat and molasses traps in Kamiotoineppu, belonging to Hokkaido University Nakagawa Experiment Forest, northern Japan. The total sample consisting of 48 species and 3,627 individuals belonging to the following six families were reported: Carabidae, Harpalidae, Silphidae, Catopidae, Histeridae and Geotrupidae. Further, bait preference, daily activity, habitat preference and seasonal activity of the predominant species were examined in order to get some basic information on the ecological survey of these beetles. Main results obtained were:

1) The faunal makeup was different between openland and forest. The species composition was similar among all stations except openland, but the number of individuals of each species was variable among different forest types.

2) Microhabitat preference of the predominant species was confirmed from the collection at four different forest vegetations; natural mixed forest, natural gallery forest, secondary birch forest and fir afforestation, except for the species characteristic to grassland.

3) The differences among some related species for microhabitat preference, seasonal activity and both were noticed.

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摘　　要

1972年5月～9月に，北海道大学中川地方演習林，上音威子府で行なわれた糖蜜と魚肉によるトラップ採集によって得られた甲虫類のうち，以下の6科に属する48種，3,627個体が報告された：オサムシ科 (Carabidae)，ゴミムシ科 (Harpalidae)，シデムシ科 (Silphidae)，チビシデムシ科 (Catopidae)，エンマムシ科 (Histeridae)，センチコガネ科 (Geotrupidae)。更に，優占種の誘引物に対する選好性，日周活動性，環境選好性，及び季節消長についての調査が行なわれた。主な結果は以下の3点に要約される。

1) 牧草地と森林では種類構成が異なる。一方，異なった植生の森林間では，種類構成は概ね共通だが，それぞれの種類の個体数に変異が認められた。

2) 天然混交林，ヤチダモ林，白樺林，及びトドマツ造林地での採集結果から，牧草地に特有な種を除く優占種の環境選好性が調べられた。

3) いくつかの近縁種間において，環境選好性，季節消長，又はその両方が異なることが認められた。

附　　記

最後に，今回報告した甲虫類が森林生態系で果す役割について手短かにふれておく。これらの甲虫は森林の地表部をその主な生活の場としており，他の森林性の種類とは生息場所のちがいによってある程度明確に区別できる“地表性の甲虫群”である。それ故に，摂食，繁殖あるいは休息場所としての森林地表部の生態学的な性質が，これらの甲虫の生活に極めて重要な意味をもっていると考えられる。広葉樹林では，落葉の分解は早く季節的な量の変動を伴うのに対して，針葉樹林では落葉の分解は遅く季節的な変動が少ないという点と，広葉樹林で林床植物がより豊富な点から，広葉樹林の地表部の方が，針葉樹林のそれよりも変化に富む環境であり，より多くの動物相を維持できると考えられる。すなわち，これらの甲虫相は，広葉樹林，混交林，針葉樹林の順に貧困になることが予想される。この傾向は，今回の調査でもある程度認められた (2.5参照)。

食物連鎖を考慮すると，今回報告した種類は全て残渣食物連鎖 (死んだ生物体を起点とするエネルギーの流れ) 上に位置する (Fig. 6 及び 2.2 参照)。すなわち，雑食性と考えられるゴ

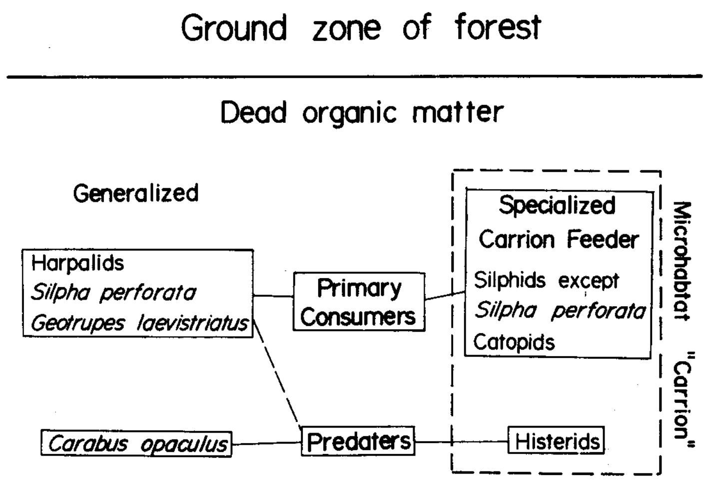

Fig. 6. Schematized diagram of position of the beetles collected in forest ecosystem.

ミムシ類，ヒラタシデムシ (*Silpha perforata venatoria*)，センチコガネ (*Geotrupes laevistriatus*) は，森林の残渣食物連鎖上で第一次，あるいは更に高次の消費者として，又，肉食と考えられるヒメクロオサムシ (*Carabus opaculus*) は同じく捕食者 (第二又は三次消費者) として位置づけられる。一方，ヒラタシデムシを除くシデムシ類とチビシデムシ類は，特に腐肉食に適応したグループで，中でもモンシデムシ類 (*Nicrophorus* 属) では腐肉食と結びついて甲虫類では最も発達した育児習性をもっている。又，エンマムシ類は，腐肉に集中する昆虫類の捕食者の位置にある。こういった腐肉と強く結びついた種類にとっては，量，分解・消費される速度，乾燥度等からみて，小型の脊椎動物の屍体が最も重要と考えられ，特にモンシデムシ類では，その発達した育児習性と関連して小型脊椎動物の屍体が必要となっている。これらの食屍性の甲虫類が，どの程度の効率で屍体を処理するかは現段階では不明だが，この面で森林生態系の物質循環に寄与していることは疑いがない。又，今回は殆んど採集されなかった食糞性の多くの種類 (特にコガネムシ科) があり，これも残渣食物連鎖中で重要な位置を占めると思われる。