INFLUENCE OF A SUPERCOLONIAL ANT FORMICA (FORMICA) YESSSENSIS FOREL ON THE DISTRIBUTION OF OTHER ANTS IN ISHIKARI COAST

Seigo Higashi, The Institute of Low Temperature Science, Hokkaido University, Sapporo 060
and
Katsusuke Yamauchi, Biological Institute, Faculty of Education, Gifu University, Gifu 502

Synopsis


The grasslands of the Ishikari coast are occupied by a huge supercolony of Formica yessensis, consisting of about 45,000 nests. This supercolony skews the habitat preferences of some ants. Thus, some ants are rare or absent in the grasslands (probably as a consequence of avoiding F. yessensis), though they inhabit the forest where F. yessensis is scarce.

Introduction

Until now about 50 ant species (20 genera, 4 subfamilies) have been identified in Hokkaido (Hayashida 1960, 1964, Hayashida & Maeda 1960, Yamauchi 1968, etc.). In Sapporo and the vicinity, Hayashida (1960) and Yamauchi (1968) enumerated 32 species (17 genera, 4 subfamilies) and analyzed their habitat preferences, nest sites, interspecific coexistence, etc.

The Ishikari Coast near Sapporo is inhabited by a huge supercolony of F. yessensis Forel, probably one of the biggest supercolonies of Formica in the world. Unfortunately, this megalopolis is destined for extinction due to the construction of a big seaport in the heart of its domain, which encompasses the majority of the supercolony. Although Yamauchi (1968) briefly touched upon the ant fauna of the area, no detailed survey has so far been carried out. Therefore, the purpose of the present paper is to provide a detailed report on the ant fauna and to clarify the role of the supercolony in the ant fauna of the Ishikari Coast.

Census area and Methods

1. Census of Formica ants (Census I)

From late June to early September 1973, a census of nests of Formica (Formica) yessensis, F. (Coptoformica) fukaiui Wheeler and F. (Serviformica) japonica Motschulsky was taken. The area surveyed extended between beach and oak forest, a belt averaging 200 m wide, along shore from Ishikari Route 5 to Zenibako for a distance of about 11 km (Fig. 1). Thus, the area inspected with the belt transect method amounted to about 2.2 km²: 1. In total, the census of 218 parallel courses about 50 m distant from each other and running perpendicularly to the shore line were taken. 2. Along each course, an investigator walked from the beach to the edge of the oak forest facing the sea. 3. Whenever a nest was found within a distance of 50 cm either to the left or the right from the investigator (hence the width of each course was 1 m), the number of steps from the beach (70 steps ±50 m) was noted along with the microvegetation classified into six degrees each of which roughly corresponded to the gradual increase in the plant density. These are S, aphylal sandy ground exposed...
2. Census of ant fauna at Ishikari Route 5
(Census II)

From 12 to 18 June, 1966, census of the local ant fauna was taken at Ishikari Route 5 (Fig. 1). In accordance with the zonation (cf. Iro 1971) of vegetation extending from the beach to the oak forest, the coastal vegetation was divided into eleven zones: Zone I, exposed sand beach; II-IX, covered with various plants (Fig. 2) with a gradual increase of density to IX; X, sea-side edge of the oak forest; and XI, inside the oak forest. The census of each zone was taken using the following procedures: Five quadrats, each 2 m × 5 m, were established and all ants found within five minutes in each quadrant were counted; Next, the number of all nests in each quadrat was determined by digging 5 cm into the ground to find the nests with no external indication of their presence.

Results and Discussion

Census I

Number of nests and individuals

By Census I, 785 Formica nests (704 yessensis, 59 japonica, 22 fukaii) from all courses were discovered in a total area of 46,474 m². From these figures, the total number of Formica nests in the census area of 2.2 km² is estimated as 39,250 (785 × 50): 35,200 F. yessensis, 2,950 F. japonica, 1,100 F. fukaii. Applying this figure to the probable number of other nests to be found in the unsurveyed northern part (about 0.5 km², cf. Fig. 1),

as in beach or roads; A, nearly monopolized by Elymus mollis which appeared first in all courses; B, an occasional admixture of Calystegia soldanella, Carex kobomugi, Poa pratensis, etc. in E. mollis stand; C, frequent appearance of Rosa rugosa, Ca. kobomugi, Equisetum hiemale, etc. with occasional admixture of Miscanthus sinensis; D, dominated by crowds of M. sinensis with the plant density higher than in C; and E, densely covered with M. sinensis, Celastrus orbiculatus, Vitis coignetiae, Lonicera morrowii, etc.
an estimate of about 45,000 nests of *F. yessensis* can be made for the entire coast. Since the mean numbers of workers and queens per one nest are about 6,800 and 24 respectively (Ito 1973), about 306,000,000 workers and 1,080,000 queens should inhabit this coast.

**Preference of microvegetations (Table 1)**

Most nests (91.6%) of *F. yessensis* were found between 100 m and 250 m from the beach (Table 2), an area corresponding to the microvegetations C and D. For *F. fukai*, 86.4% of nests were found

<table>
<thead>
<tr>
<th>Distance from beach (m)</th>
<th>Total</th>
<th>&lt;50</th>
<th>&lt;100</th>
<th>&lt;150</th>
<th>&lt;200</th>
<th>&lt;250</th>
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</thead>
<tbody>
<tr>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>27 (3.8)</td>
<td>243 (34.5)</td>
<td>277 (39.3)</td>
<td>125 (17.6)</td>
<td>32 (4.6)</td>
<td>704</td>
<td></td>
</tr>
<tr>
<td>2 (6.8)</td>
<td>4 (6.8)</td>
<td>23 (35.9)</td>
<td>16 (21.1)</td>
<td>4 (6.8)</td>
<td>59</td>
<td></td>
</tr>
</tbody>
</table>

Table 1. Nest abundance in each zone. Percentage in parentheses. S, aphral sandy ground exposed as in beach or roads. A, near monoposited by *F. mopsi*, *F. mopsi*, *C. aedoeides*. B, aphral sandy ground exposed as in beach or roads. C, frequent appearance of *R. nipponia*, *C. medoidea*. D, dominated by *M. sinensis* with the density higher than in C. E, density covered with *M. sinensis*, *C. medoidea*, etc.

Table 2. Relationship between the distance from beach and the nest abundance of 3 species of *Formica*. Percentage in parentheses.
between 100 m and 250 m. These two species preferred similar microvegetations consisting of *Poa pratensis*, *Equisetum hiemale*, *Lathyrus maritimus*, *Miscanthus sinensis*, etc. This habitat was plentiful in sun-light and the honey dews of aphids proliferating on *M. sinensis* and saplings of *Quercus dentata* which were sometimes found at D. On the other hand, many nests (45.8%) of *F. japonica* were found within the area 100 m from the beach, which the other two species rarely invaded. Actually, *F. japonica* was the only ant species found in the area nearest to the beach which contained sparse vegetation and loose sandy substratum. One may assume on the extremely wide foraging area (cf. Tsuneki & Adachi 1957), strong tolerance to the sun, and an excellent digging ability in loose sand for this ant.

Comparison of various sections of the shore

In order to compare the faunal composition of various portions of the shore, the census area was divided into 11 sections (a to k in Fig. 1), each of which included 20 courses (except 18 in k). Thus, the area of each section was about 200×1,000 m². As shown in Fig. 3A, nests of *F. yessensis* were more abundant in most sections than those of the other two species. But the number of nests of *F. yessensis* varied greatly among sections with the maximum in a (131) and the minimum in h (14). The difference was probably caused mainly by the difference in the microvegetational compositions because the number of nests of *F. yessensis* corresponded to the frequency of microvegetations C+D (Fig. 3A), except for sections g and h. Section h includes the estuary of the river Shinkawa (Fig. 1), therefore, most of that area is damp, a fact which probably accounts for the sparsity of *F. yessensis*. However, *F. japonica* was relatively abundant in h, seven nests being found even at points more than 150 m distant from the beach. This may mean that *F. japonica* can establish nests even at such inland areas if *F. yessensis* is scarce. Some authors (Tsuneki & Adachi 1957, Tsuneki & Okuno 1967, Yasuno 1963, 1964a, b, 1965) have also observed that *F. japonica* can easily occupy open spaces which other species have never colonized. In section g, the scarcity of *F. yessensis* is probably brought about not by physical factors but by the abundance of *F. fukaii*. Yasuno (1965) reported that *F. fukaii* established territories (in average 28 m², in maximum 94.5 m² for each nest) where *F. yessensis* could invade only with difficulty. The same situation is expected for the Ishikari Coast, too, though why *F. fukaii* was more abundant in g is unknown.

Census II

Results of Census II are shown in Table 3. In addition to the 14 species identified by the census, two more species were collected from the area in an extra-routine survey: *Formica fukaii* in grassland and *Camponotus japonicus Mayr* at the edge of the oak forest. All these are included among the 32 ant species so far reported in Sapporo and the vicinity (Hayashida 1960, Yamauchi 1968). Near the tidal area (Zone I) no nests were found, perhaps because no grass covers provide protection.
Table 3. Abundance of the ants in various zones at Ishikari Coast. Numerals given are number of colonies and, in parentheses, of individuals by five minutes sampling.

<table>
<thead>
<tr>
<th>Ant species</th>
<th>I</th>
<th>II</th>
<th>III</th>
<th>IV</th>
<th>V</th>
<th>VI</th>
<th>VII</th>
<th>VIII</th>
<th>IX</th>
<th>X</th>
<th>XI</th>
<th>Total</th>
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<td><strong>Ponerinae</strong></td>
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</tr>
<tr>
<td><em>Ponera japonica</em> WHEELER</td>
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<td></td>
<td></td>
<td></td>
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<td>(6)</td>
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<td>0(7)</td>
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<tr>
<td><strong>Myrmicinae</strong></td>
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</tr>
<tr>
<td><em>Myrmica ruginodis</em> NYLANDER</td>
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<td></td>
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<td>(3)</td>
<td>5</td>
<td>5(10)</td>
</tr>
<tr>
<td><em>M. lobicorns var. jessensis</em> FOREL</td>
<td></td>
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</tr>
<tr>
<td><em>Aphaenogaster japonica</em> FOREL</td>
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<td></td>
<td></td>
<td></td>
<td>2</td>
<td>1</td>
<td>1(3)</td>
</tr>
<tr>
<td><em>Pheidole fervida</em> SMITH</td>
<td></td>
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<td></td>
<td></td>
<td>2</td>
<td>3</td>
<td>5(6)</td>
</tr>
<tr>
<td><em>Leptothorax spinosior</em> FOREL</td>
<td></td>
<td></td>
<td></td>
<td></td>
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<td></td>
<td>(4)</td>
<td>3</td>
<td>19</td>
<td>5</td>
<td>11(7)</td>
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<tr>
<td><em>Solenopsis fugax</em> LATREILLE</td>
<td></td>
<td></td>
<td></td>
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<td></td>
<td></td>
<td>5</td>
<td>1</td>
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<td>6</td>
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<tr>
<td><strong>Formicinae</strong></td>
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<tr>
<td><em>Paratrechina flavipes</em> SMITH</td>
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<td></td>
<td></td>
<td>2</td>
<td>2</td>
<td>36(60)</td>
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<tr>
<td><em>Lasius umbratus</em> NYLANDER</td>
<td></td>
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<td></td>
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<tr>
<td><em>L. flavus</em> FABRICIUS</td>
<td></td>
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<td>1</td>
<td></td>
<td>36(60)</td>
</tr>
<tr>
<td><em>L. niger</em> L.</td>
<td></td>
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<td></td>
<td></td>
<td>5</td>
<td>5</td>
<td>5(25)</td>
</tr>
<tr>
<td><em>Camponotus obscures</em> MAYR</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>1</td>
<td>1</td>
<td>5(25)</td>
</tr>
<tr>
<td><em>Formica japonica</em> Motschulsky</td>
<td>1(7)</td>
<td>2(15)</td>
<td>2(15)</td>
<td>1(16)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>6(53)</td>
</tr>
<tr>
<td><em>F. jessensis</em> FOREL</td>
<td></td>
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<td></td>
<td></td>
<td></td>
<td>2</td>
<td>2</td>
<td>12(120)</td>
</tr>
</tbody>
</table>

Number of species

| 0 | 0 | 1 | 2 | 2 | 2 | 3 | 3 | 7 | 9 | 7 | 14 |
against strong sea-winds and the sun. In Zones II and III only F. japonica was found which can thrive in various kinds of openlands, as mentioned in the preceding section. In IV to VIII F. yessensis predominated but the ant fauna was sparse. In Zones IX and X where F. yessensis was not predominant, the fauna was rich (10 species) compared with that in Zones I to VIII (4 species). In the forest (Zone XI) many nests of seven species were found. Summarizing these results, ant fauna of this coast became abundant not gradually from Zone I to XI but suddenly from Zone IX where F. yessensis represented the minor species.

YAMAUCHI (1968) distinguished eight habitats and clarified the habitat preference of each ant species, using nearly the same method as in the present study. Vegetational conditions in Zones I–IV nearly correspond to those in the habitat BS (bare sandy areas or lands with sparse vegetation found on river-banks and in dry river-beds) in his paper. V–VIII corresponded to HG (grassy or herbaceous lands such as meadows and abandoned farms). IX and X corresponded to WM (margins of deciduous woods). Finally, XI to WD (deciduous woods).

A comparison between YAMAUCHI's (1968) and the present results is schematically shown in Fig. 4. Many openland type or eurytopic type ants (L. niger, M. ruginodis, Ph. fervida, L. flavus, M. lob. yessensis, Para. flavipes) cannot colonize grassland and bareland in this coast. We can assume two kinds of causes, physical ones [such as high salinity, loose sandy ground and high temperature of the ground surface at daytime in mid summer] and biological one [such as the influence of an aggressive ant F. yessensis]. The authors feel the latter cause is more likely for the following reasons:

1. Out of 35 quadrats in Zones IV to X where F. yessensis was found, nine quadrats contained one (six quadrats) or two (three quadrats) nests of F. yessensis, but 26 quadrats did not. As shown in Table 4, no nests of other species were found in any quadrat with two nests of F. yessensis. Excluding S. fugax, a symbiont of F. yessensis, only 0.83 nests of other species were contained per quadrat with one nest of F. yessensis, while 1.19 per quadrat without F. yessensis. Thus even the coexisting ants tended to avoid colonizing near nests of F. yessensis.

2. In the oak forest of this coast we can see many nests of forest-type ants (L. umbratus, Aphae. japonica, C. obscribes) and eurytopic type ants (L. niger, M. ruginodis, Ph. fervida, Para. flavipes). This means that much salinity and loose ground do not inhibit ant colonizing.

3. Most openland type ants cannot colonize even the high grass-density area (Zones VII to IX) where the ground temperature is not so different from that in the oak forest.

4. The two species coexisting with F. yessensis seem to possess characteristics enabling them to avoid competition with F. yessensis: F. japonica is agile (Morisita 1939a, b, 1941, Tsuneki & Adachi 1957) and occupies open spots where F. yessensis cannot invade (Yasuno 1963, 1964a, b, 1965); S. fugax is somewhat of a symbiont of F. yessensis. It is unknown why the small ant Lept. spinosior can
coexist with *F. yessensis*.

In conclusion, the authors wish to express their sincere thanks to Prof. Dr. Shōichi F. SAKAGAMI for his pertinent guidance in the course of this study and to Prof. Dr. Koji Iro for his identification of various plants.

**Summary**

The census of ants were taken at Ishikari Coast and the following results were obtained: 1. 16 species (10 genera, 3 subfamilies) were discovered; 2. *F. yessensis* possesses a big supercolony in the grasslands: ca. 45,000 nests, 306,000,000 workers and 1,080,000 queens extending over an area of 2.7 km² (This is one of the biggest polycalic colonies in the world.); 3. Some eurytopic and openland type species were never found in the grassland and the bareland along this coast. They probably avoided the aggressive ant *F. yessensis*.

**References**


摘 要
石狩海岸にてアリ相調査を行ない、次のような結果を得た。
1. この海岸には、少なくとも16種（10属、3亜科）のアリが棲息している。
2. それらの種の中で最も優占的なエゾアカヤマアリ

は、約45,000巢からなるスーパーコロニーを形成している。これは、現在迄に発見されている多巣性コロニーの中でも世界最大級の規模である。

3. 本来、草地や裸地に棲息しやすい種でも、多くはカシワ林の林内や林縁部でしか発見し得ない。これは、彼等が攻撃性の強いエゾアカヤマアリを避けて営巣している為と思われる。

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