琉球列島に於ける白蟻相とその経済的意義（2）（奄美群島）

THE TERMITE FAUNA OF THE RYUKYU ISLANDS AND ITS ECONOMIC SIGNIFICANCE (II)

(Amami-gunto)

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Introduction

In part this series on the study of termites in the Ryukyu Islands (Ikehara 1957), a report was made on the termite study conducted in Yaeyama-gunto and Okinawa-gunto. An attempt is made in this paper to list the species of termites occurring in Amami-gunto (fig. 1) and describe their distribution and economic significance.

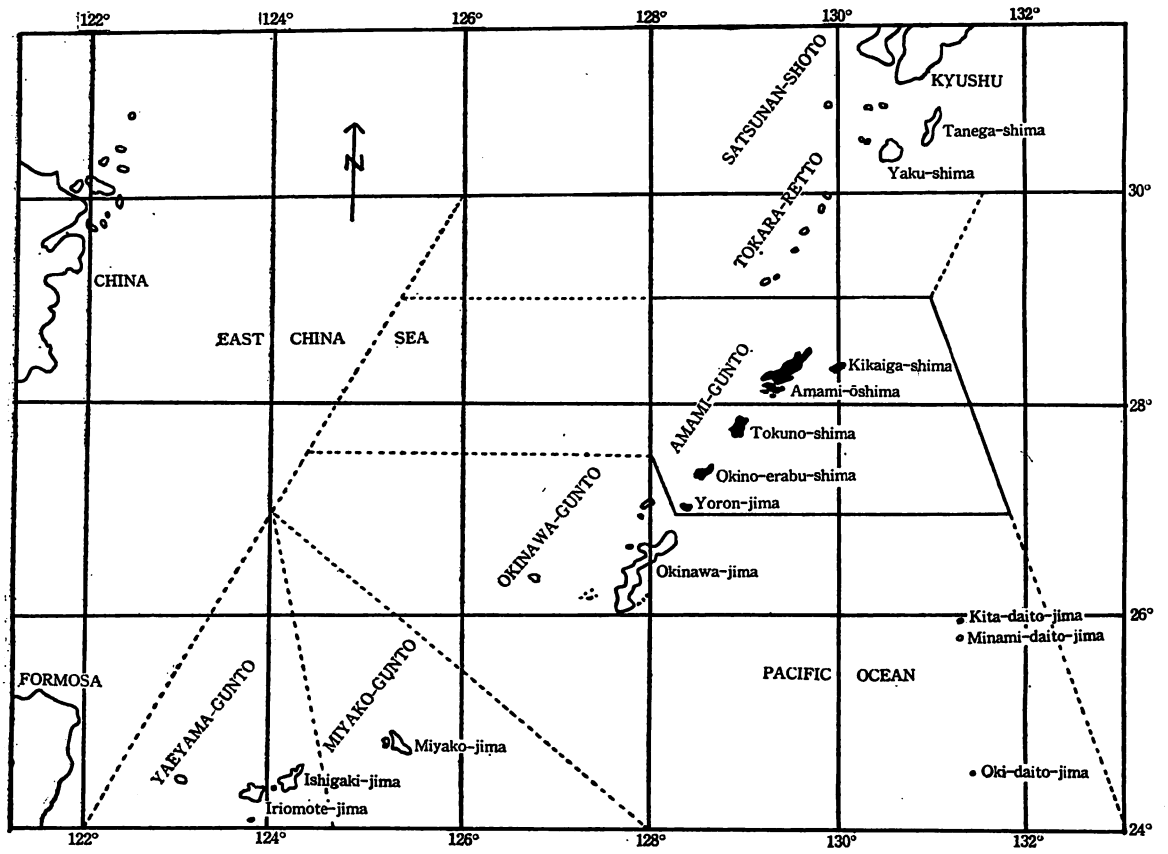

Fig. 1. Map showing Amami-gunto (solid black).

The islands of the Ryukyu chain are peaks of submerged mountains, forming three distinct longitudinal mountain series, curving convexly from Kyushu southward to Formosa. Amami-ōshima, Tokuno-shima, Okino-erabu-shima, and Yoron-jima are

part of the central series whereas Kikaiga-shima is included in the outer series. The islands of the central series are composed of palaeozoic and igneous rocks, and those of the outer series are composed of tertiary and younger rocks. Kikaiga-shima and Yoron-jima are rather flat, while the other islands are mountainous. Coral reef formations occur around most of islands in Amami-gunto, and are particularly conspicuous around Kikaiga-shima and Yoron-jima. Some geographical information about the five main islands in Amami-gunto are given in table 1.

Table 1. Geographical information about the five main islands in Amami-gunto.

Islands	Location	Length of shore line (km)	Area (Sq. km)	Surface formation	Maximum elevations (m)
Amami-ōshima	N. 28°23′ E. 129°30′	580	831	Palaeozoic	694
Kikaiga-shima	N. 28°20′ E. 129°57′	43	62	Caenozoic	204
Tokuno-shima	N. 27°44′ E. 128°41′	84	253	Palaeozoic	645
Okino-erabu-shima	N. 27°24′ E. 138°36′	51	93	Caenozoic	245
Yoron-jima	N. 29°91′ E. 128°26′	30	22	Caenozoic	94

Although located within the temperate zone, Amami-gunto has a subtropical marine climate with relatively high and equable temperatures throughout the year. This is due largely to the influence of the Black Current (Kuroshio), which arises in the equatorial ocean currents north of the Philippines and flows northeast through the waters surrounding the Ryukyu Islands. In the summer, the Black Current intensifies the heat and humidity of the sultry monsoon winds from the south and in the winter it warms and moistens the cold monsoon winds from the north. The result is both an increase in year-round temperature and humidity and a modification of the climate extremes which would otherwise prevail. Temperature and precipitation data for the five main islands in Amami-gunto are shown in table 2.

Table 2. Temperature and precipitation data for the five main islands in Amami-gunto.

Islands	Temperature (C)					Precipitation (mm)	
	Period	Month				Period	Average of annual total precip.
		*Feburary		*July			
		Min.	Max.	Min.	Max.		
Amami-ōshima (Nase City)	1897～1951	3.1	27.7	18.8	36.3	1897～1951	3103.8
Kikaiga-shima	1941～1951	5.5	24.3	20.0	37.4	1903～1913	1717.5
Tokuno-shima (Kametsu)	1941～1949	6.0	26.0	15.5	37.0	1903～1910	1972.7
Okino-erabu-shima (Wadomari)	1941～1951	4.1	25.5	17.7	35.7	1903～1913	1871.1
Yoron-jima						1911～1920	1678.0

*The lowest and highest temperatures during the year occur in Feburary and July respectively.

The termite fauna of Amami-gunto is not large for a subtropical region. Only five species of termites have been reported from this area. They are:

1. *Hodotermopsis japonicus* Holmgren
2. *Kalotermes* (*Glyptotermes*) *fuscus* (Oshima)
3. *Kalotermes* (*Cryptotermes*) *kotoensis* Oshima
4. *Leucotermes speratus* (Kolbe)
5. *Coptotermes formosanus* Shiraki

Acknowledgements

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Discussion of the Species

Family: Hodotermitidae Sjöstedt 1925

Genus: *Hodotermopsis* Holmgren

1. *Hodotermopsis japonicus* Holmgren

(Japanese name: Ō-shiroari)

Specimens obtained:—

U. R. Spec. No.	Caste	Locality	Collector	Date
114	S.W.N.	Urakami, Amami-ōshima	Ikehara	Mar. 9,'56
115	A.S.W.N.	Ōgachi, Amami-ōshima	Ikehara	Mar. 9,'56
129	S.W.N.	Inokawa-dake, Tokuno-shima	Ikehara	Mar. 19,'56
236	S.W.	Urakami, Amami-ōshima	Ikehara	Mar. 25,'57
250	S.W.	Koniya, Amami-ōshima	Ikehara	Apr. 2,'57

A—Alate, S—Soldier, W—Worker, N—Nymph.

This species is the largest termite occurring in the Ryukyu Islands, and was first described by Holmgren in 1912, from soldiers and workers obtained on Amami-ōshima. It is the only species of this genus thus far reported in the Ryukyus. While Holmgren's paper "Die Termiten Japans" (1912) published, this species had been reported only from Amami-ōshima. Since that time, however, this termite has also been found on Tokuno-shima, Nakano-shima, and Yaku-shima. Alates of this termite was first described from specimens obtained on Yaku-shima (Esaki 1956). I was able to collect living instars of this species in Amami-ōshima. In June of 1956, at a meeting of the Biological Institute of the Ryukyus, I described the external structure of alates which developed from these instars.

This species is commonly found in decayed trees, stumps, and dead portions of trunks (Pl. 3-B, Pl. 4-A, B). There is no record of damage by this termite to any man-made structure, such as dwelling houses, bridges, towers, etc. It seems therefore not to be a species of economic importance.

Family: Kalotermitidae Bank 1920
Genus: *Kalotermes* Holmgren
Subgenus: *Glyptotermes* Holmgren
2. *Kalotermes* (*Glyptotermes*) *fuscus* (Oshima)
(Japanese name: Katan-shiroari)

Specimens obtained:—

U. R. Spec. No.	Caste	Locality	Collector	Date
121	S.N.	Kametsu, Tokuno-shima	Ikehara	Mar., 17,'56
126	S.N.	Inokawa, Tokuno-shima	Ikehara	Mar., 18,'56
131	S.N.	Amagi, Tokuno-shima	Ikehara	Mar., 19,'56
141	S.N.	Ōgachi, Amami-ōshima	Ikehara	Mar., 27,'56
233	S.N.	Nase, Amami-ōshima	Ikehara	Mar., 24,'57
295	S.N.	Katsuura, Amami-ōshima	Ikehara	Mar., 30,'57

The wood-dwelling termite, *Kalotermes fuscus*, was first described by Oshima in 1912 under the name of *Glyptotermes fuscus* from specimens obtained in Formosa. This termite occurs on Amami-ōshima and Tokuno-shima, but there are no records of its occurrence on Okino-erabu-shima and Yoron-jima. Although I collected extensively in the later two islands, I found no specimens of this species. In the field this termite occurs in stumps, fallen trees, dead portions of liying trees, attacking only undecayed portions of wood.

Because it attacks undecayed wood it is economically important, damaging logs, fence poles, and occasionally lumber of dwelling houses which contain sufficient moisture.

Subgenus : *Cryptotermes* (Banks)
3. *Kalotermes* (*Cryptotermes*) *kotoensis* Oshima
(Japanese name: Daikoku-shiroari)

Specimens obtained : —

U. R. Spec. No.	Caste	Locality	Collector	Date
106	S.N.	Chabana, Yoron-jima	Ikehara	Mar., 11,'56
113	S.N.	Gusuku, Yoron-jima	Ikehara	Mar., 12,'56
117	S.N.	Kibiru, Okino-erabu-shima	Ikehara	Mar., 14,'56

This species was first described by Oshima in 1912 under the name of *Calotermes kotoensis*, although there had been a previous report regarding this species in Holmgren's paper in 1912. *Kalotermes kotoensis* is one of the most common and widely spread termites in Yaeyama, Miyako, and Okinawa-gunto. In Amami-gunto, however, it is rare, being restricted only to Yoron-jima and Okino-erabu-shima. This species occurs in dead portions of trunks or in dead branches of living trees surrounding building. As far as is known, the northern limit of distribution of this termite is Okino-erabu-shima.

This termite is economically unimportant in Amami-gunto, because of its rare occurrence.

Family : Rhinotermitidae Light 1912
Genus : *Leucotermes* Silvestri
Subgenus : *Reticulitermes* Holmgren
4. *Leucotermes* (*Reticulitermes*) *speratus* (Kolbe)
(Japanese name : Yamato-shiroari)

Specimens obtained : —

U. R. Spec. No.	Caste	Locality	Collector	Date
97	S.W.	Nase, Amami-ōshima	Ikehara	Mar., 9,'56
99	S.W.	Nase, Amami-ōshima	Ikehara	Mar., 9,'56
100	S.W.	Nase, Amami-ōshima	Ikehara	Mar., 9,'56
101	S.W.	Nase, Amami-ōshima	Ikehara	Mar., 9,'56
103	N.S.W.	Urakami, Amami-ōshima	Ikehara	Mar., 9,'56
107	Q.S.W.	Nama, Yoron-jima	Ikehara	Mar., 11,'56
108	A.S.W.	Rittcho, Yoron-jima	Ikehara	Mar., 12,'56
109	S.W.	Gusuku, Yoron-jima	Ikehara	Mar., 12,'56
110	S.W.	Nama, Yoron-jima	Ikehara	Mar., 12,'56
111	A.N.S.W.	Gusuku, Yoron-jima	Ikehara	Mar., 12,'56
114	A.N.S.W.	Kuniknmi, Okino-erabu-shima	Ikehara	Mar., 14,'56
119	A.N.S.W.	Nagamine, Okino-erabu-shima	Ikehara	Mar., 15,'56
120	N.S.W.	Oyama, Okino-erabu-shima	Ikehara	Mar., 15,'56
122	S.W.	Wadomari, Okino-erabu-shima	Ikehara	Mar., 17,'56
124	A.N.S.W.	Kametoku, Tokuno-shima	Ikehara	Mar., 18,'56
128	N.S.W.	Inokawa, Tokuno-shima	Ikehara	Mar., 18,'56
130	S.W.	Kametsu, Tokuno-shima	Ikehara	Mar., 19,'56
133	S.W.	Kametsu, Tokuno-shima	Ikehara	Mar., 19,'56
135	S.W.	Chinase, Amami-ōshima	Ikehara	Mar., 26,'56
137	S.W.	Sato, Amami-ōshima	Ikehara	Mar., 26,'56
138	N.S.W.	Kosuku, Amami-ōshima	Ikehara	Mar., 26,'56
139	S.W.	Akaogi, Amami-ōshima	Ikehara	Mar., 27,'56
140	S.W.	Ogachi, Amami-ōshima	Ikehara	Mar., 27,'56
142	S.W.	Akakina, Amami-ōshima	Ikehara	Mar., 27,'56
143	S.W.	Tekebu, Amami-ōshima	Ikehara	Mar., 27,'56
237	S.W.	Wan, Kikaiga-shima	Ikehara	Mar., 26,'57
239	A.N.S.W.	Nakama, Kikaiga-shima	Ikehara	Mar., 27,'57
240	S.W.	Oasado, Kikaiga-shima	Ikehara	Mar., 27,'57
241	S.W.	Aden, Kikaiga-shima	Ikehara	Mar., 27,'57
242	S.W.	Tekutsuku, Kikaiga-shima	Ikehara	Mar., 27,'57
244	N.S.W.	Shinmura, Amami-ōshima	Ikehara	Mar., 30,'57
249	N.S.W.	Katsuura, Amami-ōshima	Ikehara	Mar., 31,'57
253	A.S.W.	Koniya, Amami-ōshima	Ikehara	Apr., 2,'57
245	S.W.	Sedokaneku, Amami-ōshima	Ikehara	Apr., 2,'57

Q—Queen.

This termite was first described by Kolbe in 1885, and named *Termes speratus.* For many years termite investigators in Japan questioned this classification and suggested that it might belong to the American species *Leucotermes flavipes.* Its nomenclature was finaly settled by Hozawa (1915) who identified it as *Leucotermes*

speratus, the only Japanese representative of this genus. Of all the termites occurring in the Ryukyu Islands this species is the most common and widely distributed. It is easily found on any island in Amami-gunto. *Leucotermes speratus* is particularly dependent upon abundant moisture, and therefore living in rotting logs, bridge pilings, dead knots in living trees, lower parts of dwelling houses, fence poles, etc.

In Amami-gunto, this termite seems to do more damage than other termites. It attacks susceptible wood in or on the ground, and never builds covered runway over wood, stones, concrete, etc.

Genus: *Coptotermes* Wasmann

5. *Coptotermes formosanus* Shiraki

(Japanese name: Ie-shiroari)

Specimens obtained:-

U. R. Spec. No.	Caste	Locality	Collector	Date
98	S.W.	Nase, Amami-ōshima	Ikehara	Mar., 9,'56
102	S.W.	Sadaikuma, Amami-ōshima	Ikehara	Mar., 9,'56
112	S.W.	Chabana. Yoron-jima	Ikehara	Mar., 13,'56
115	S.W.	Kunikami, Okino-erabu-shima	Ikehara	Mar., 14,'56
116	S.W.	Nishihara, Okino-erabu-shima	Ikehara	Mar., 14,'56
118	S.W.	Neori, Okino-erabu-shima	Ikehara	Mar., 15,'56
121	S.W.	Wadomari, Okino-erabu-shima	Ikehara	Mar., 17,'56
125	S.W.	Matsuyama, Okino-erabu-shima	Ikehara	Mar., 18,'56
126	S.W.	Oyama, Okino-erabu-shima	Ikehara	Mar., 18,'56
132	S.W.	Amagi, Tokuno-shima	Ikehara	Mar., 19,'56
134	N.S.W.	Matsubara, Tokuno-shima	Ikehara	Mar., 20,'56
136	S.W.	Urakami, Amami-ōshima	Ikehara	Mar., 26,'56
143	N.S.W.	Akebu, Amami-ōshima	Ikehara	Mar., 28,'56
234	N.S.W.	Nase, Amami-ōshima	Ikehara	Mar., 24,'57
235	S W.	Asado, Amami-ōshima	Ikehara	Mar., 24,'57
238	N.S.W.	Araki, Kikaiga-shima	Ikehara	Mar., 26,'57
243	S.W.	Ikiku, Kikaiga-shima	Ikehara	Mar., 26,'57
246	N.S.W.	Urakami, Amami-ōshima	Ikehara	Mar., 26,'57
247	S.W.	Nase, Amami-ōshima	Ikehara	Mar., 31,'57
248	S.W.	Nase, Amami-ōshima	Ikehara	Mar., 31,'57
251	S.W.	Koniya, Amami-ōshima	Ikehara	Apr., 2,'57

This termite was first described by Shiraki in 1909 from specimens obtained on Formosa, and was named *Coptotermes formosanus*. This subterranean or soil-nesting termite is of wide distribution in Amami-gunto, and although it is abundant in coastal area, it is ofen found inland.

Of the five species found in Amami-gunto, *Coptotermes formosanus* ranks second in economic significance. This termite has damaged houses and contents, telephone and electric light poles, bridges, fences, etc. on all the main islands in Amami-gunto (Pl. 1-B, Pl. 2-A). Even though this termite ranks second in economic siginificance to *Leucotermes speratus*, the damage it does is slight by comparison. Injury to cultured plants by this termite is not common in Amami-gunto, however I observed two examples of damage to living sugar-cane and one example to sweet potato in the

vicinity of Matsubara village, Tokuno-shima (Pl. 2-B).

Discussion and conclusion

Amami-gunto has five species of termite. The termite fauna as a whole seems to consist of three rather distinct elements (fig. 2). The first element, made up of two injuorus species, *Leucotermes speratus* and *Coptotermes formosanus*, occurs

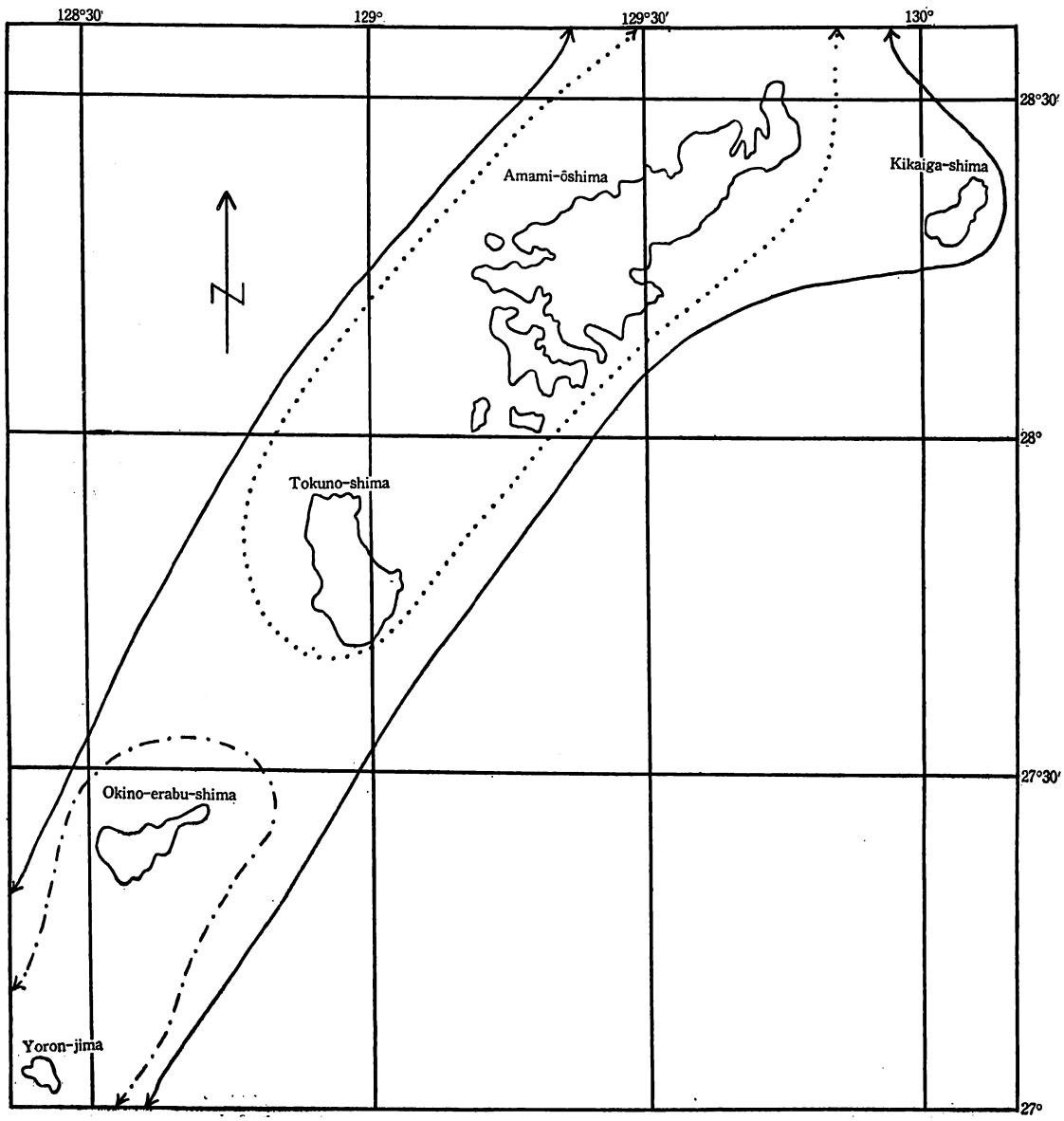


Fig. 2. Map showing three elements of termites occurring in Amami-gunto:
——— the first element; *Leucotermes speratus* and *Coptotermes formosanus*
····· the second element; *Kalotermes fuscus* and *Hodotermopsis japonicus*
—·—·— the third element; *Kalotermes kotoensis*

practically over the entire Amami-gunto, and extends into Formosa on the southwest and into Japan Archipelago on the northeast. The second element, consisting of *Kalotermes fuscus* and *Hodotermopsis japonicus*, is found on Amami-ōshima and Tokuno-shima. *Hodotermopsis japonicus* appears only on the two islands mentioned as far as Amami-gunto is concerned, but it may be found in Nakano-shima and Yaku-shima, further north. *Kalotermes fuscus*, however, may be found as far as Kagoshima and as far south as Formosa. The third element consist of one rare species, *Kalotermes kotoensis*, and is confined to the southern two islands, Okino-erabu-shima and Yoron-jima, as far as Amami-gunto is concerned. This species may also be found in the southern Ryukyus and as far south as Formosa. As far as is known, the northern limit of its distribution is Okino-erabu-shima.

There is very interesting relationship between termites and fire. On 3rd, December, 1955, a large fire occurred in Nase City, Amami-ōshima, resulting in the destruction of 951 houses. Three months later upon visiting the center of the fire-raged area, I found large populations of *Leucotermes speratus* and *Coptotermes formosanus*, in charred piles, unburned lumber, and dump matting in contact with the earth. The presence of these termites bring to mind two possible hypothesis: (1) they migrated from the area adjacent to the region of the fire; (2) they are the same termites that occupied the area before the fire but survived. The first hypothesis must be ruled out because in the first place, termites could not have migrated through an area devoid of wood (wooden structures were destroyed by fire), and it is too far to migrate through underground. If even some pairs migrated to the area after the fire, three months is too short a time for them to have produced as large a population as I observed. From this situation it is clear that these two species of termites can survive fire, taking advantage of their dump-wood dwelling or soil-nesting habits.

The people in Amami-gunto are interested in protecting houses, lumber, etc. against termite attacks (Pl. 1-A, Pl. 3-A). In Amami-gunto, damage to wooden buildings over ten years old, is usually found the work of *Leucotermes speratus* and or *Coptotermes formosanus*. Injury by termites to cultured plants does not seems to be particularly important from the standpoint of economic significance, and actual damage to these particular plants is slight. Damage to sugar-cane and sweet potato may be used as examples. It is very difficult to evaluate monetarily damage done by termite, even though we can compare the economic significance of one species with that of another in a single area or in many different area. In table 3, 818 examples of termite attacks in Amami-gunto have been classified with a view to arriving at the economic significance of each species. Each example, however, does not indicate the degree of damage. The data used in the table have been based on my own investigations during March and April, 1956, and March, 1957. From the standpoint of economic significance and control, the termite situation in Amami-gunto seems to be slightly different from that in Okinawa and Yaeyama-gunto. In Amami-gunto damage by *Leucotermes speratus* seems to be greater than that of *Coptotermes formosanus*. In Okinawa and Yaeyama-gunto the opposite is true. As far as is known, *Odontotermes formosanus* does not occur in Amami-gunto, but in Okinawa and Yaeyama-gunto it causes considerable damage. *Kalotermes fuscus* is

Table 3. Classification of 818 cases of termite attacks in Amami-gunto.

Species Things attacked	*Hontotermes japonicus*	*Kalotermes fuscus*	*Kalotermes kotoensis*	*Leucotermes speratus*	*Coptotermes formosanus*	Total
Recidences, schoolhouses, Warehouses, and their contents						
Wood frames	...	...	...	61	35	96
Mats	...	...	...	...	2	2
Books or papers	...	...	...	...	5	5
Shelves	...	...	...	...	2	2
Clothings	...	...	...	...	2	2
Hand looms	...	...	...	1	1	2
Tables	...	...	...	...	1	1
Concrete substances	...	...	...	...	3	3
Sweet potato	...	...	...	...	1	1
Others	...	...	...	7	4	11
Subtotal	0	0	0	69	56	125
Man-made structures in the open air						
Bridges	...	7	...	15	4	26
Fence poles	...	3	...	35	19	57
Electric poles	...	...	...	12	4	16
Wooden stakes	...	2	...	33	23	58
Wood-mortars	...	...	...	4	1	5
Bathing tubs	...	...	...	2	...	2
Cartons or boxes	...	...	...	37	21	58
Timbers	...	3	...	24	11	38
Coffins	...	...	...	9	2	11
Others	...	2	...	8	5	15
Subtotal	0	17	0	179	90	286
Objects in nature						
Stumps	2	2	...	75	49	128
Logs	...	3	...	19	13	35
Fallen trees	...	2	...	64	26	92
Standing dead trees	...	1	...	37	31	69
Dead portions of living trunks	3	2	3	12	3	23
Dead branches of living trees	...	5	2	3	1	11
Others	...	...	...	25	13	38
Subtotal	5	15	5	235	136	396
Cultured plants						
Sugar-cane	...	...	...	...	2	2
Sweet potato	...	...	...	...	1	1
Tea trees	...	...	...	1	...	1
Loquates	...	...	...	1	...	1
Peach-trees	...	...	...	1	1	2
Others	...	...	...	3	1	4
Subtotal	0	0	0	6	5	11
Total	5	32	5	489	287	818

not economically important in Amami-gunto or Okinawa and Yaeyama-gunto, although it is slightly more important in Okinawa and Yaeyama-gunto. The remaing species are economically insignificant in Amami-gunto.

Summary

1. Five species of termites occur in Amami-gunto belonging to four different families.

2. The termite fauna of Amami-gunto is divided into three geographical elements.

3. Okino-erabu-shima marks the most northern limit of distribution of ***Kalotermes kotoensis.***

4. A survey was made of a termite infested area three months after the area was completely destroyed by fire. The results of the survey are presented.

5. From the standpoint of economic significance, ***Leucotermes speratus*** ranks first, ***Coptotermes formosanus*** second, and the remainder are of minor importance.

Literature

Economic Bureau, Government of the Ryukyus. 1956. Ryukyu no chikei chishitsu oyobi kosho [Topography, geology, and mineral deposits of the Ryukyu Islands]. Okinawa.

Esaki, T. 1934. Amami-ōshima no Gaikan (VI) [General view of Amami-ōshima (VI)]. Shokubutsu oyobi Dobutsu, Vol. II, No. 4, p. 748.

———— 1956. Notes on ***Hodotermopsis japonica*** Holmgren. Bull. Nat. Sci. Mus., Vol. III, No. 2, pp. 86–88, Pl. XIX, 7 figs.

Hanzawa, S. 1935. Topography and geology of the Ryukyu Islands. Sci. Rept. Tohoku Imp. Univ., (Geology), Vol. XVII, pp. 1–61, tab. I–XV.

Hijikuro, T. 1954. Shiroari no higai ni tsuite [On damage done by termites]. Shin Konchu, Vol. VII, No. 5, pp. 8–12.

Holmgren, H. 1911. Termitenstudien. 2. Systematik der Termiten. Die Familien ***Mastotermitidae, Protermitidae*** und ***Mesotermitidae.*** Kgl. Svensk. Vet. Handl., Bd. XLVI, No. 6, pp. 1–86, Taf. 1–6.

Ikehara, S. 1957a. The termite fauna of the Ryukyu Islands and its economic significance (I), (The Yaeyama-gunto and the Okinawa-gunto). Bull. Arts & Sci. Div. Ryukyu Univ., (Math. & Nat. Sci.), No. 1, pp. 44–61.

———— 1957b. The termite fauna of the Ryukyu Islands. Abst. Pap., 9th Pacific Sci. Congr., p. 87.

Light, S. F. 1934. A world view of termites. Termites and termite control. II ed. Univ. Calif., pp. 117–126.

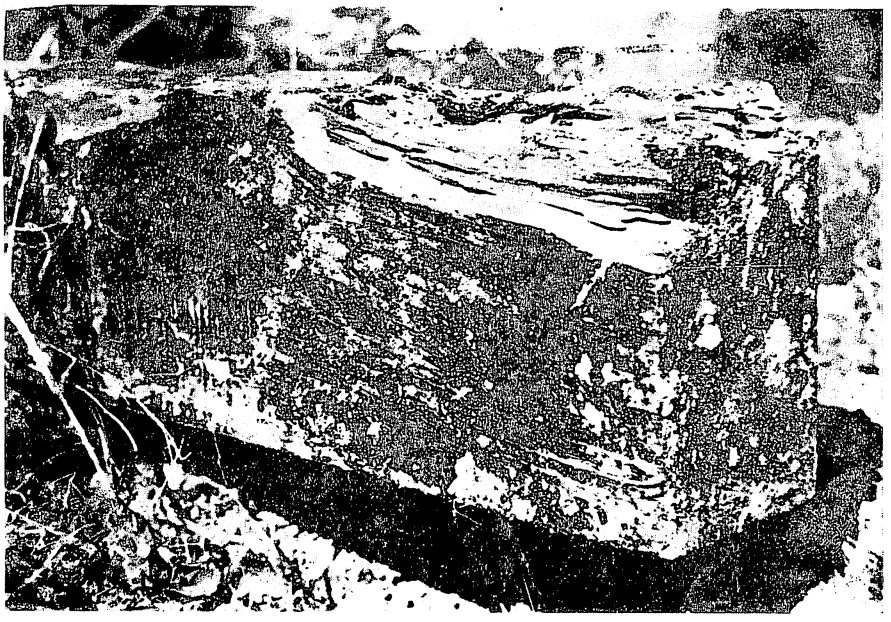
Nakane, T. 1954. Asahi shashin bukku 2 [Asahi photographic book 2]. Tokara no shima-jima [Islets of Tokara]. Tokyo.

Nase Meteorological Station. 1952. Amami-ōshima kisho 55–nenpō [55 years of meteorological report from Amami-ōshima].

Nawa, Y. 1914a. Ōshima-gun Nase no shiroari [Termites of Nase, Ōshima-gun]. Konchu Sekai, Vol. XVI, No. 199, pp. 119–120.

———— 1914b. Nase sanchu ni okeru ō-shiroari saishudan [Discourse on collection of ***Hodotermopsis japonicus*** in the mountains of Nase]. Konchu Sekai, Vol.

Plate 2



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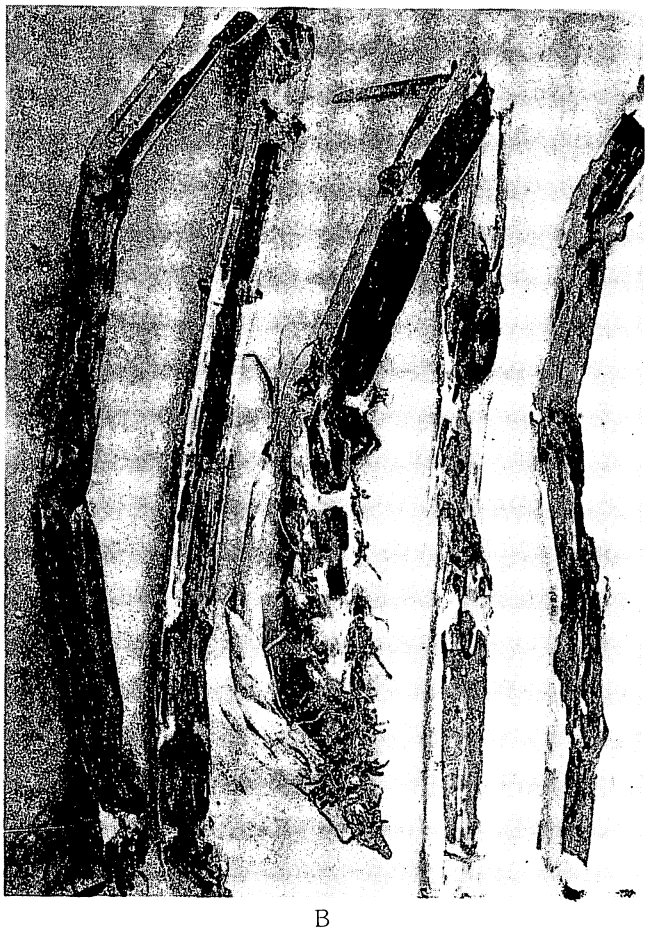
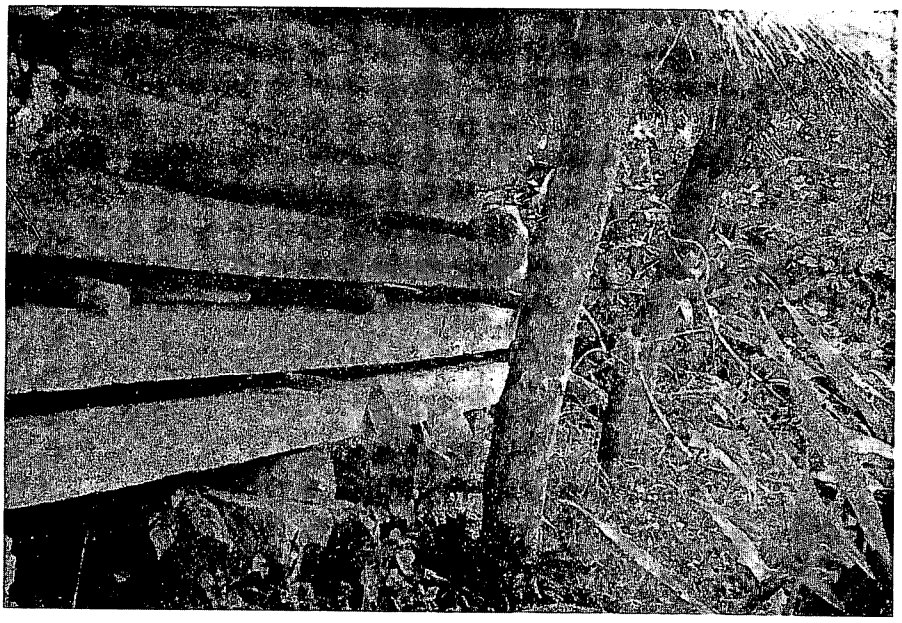


B

Plate 3



A

B

Plate 14

A

B