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

(The Yaeyama-gunto & the Okinawa-gunto)

Sadao Ikehara

Introduction

This is a part of the author's study on termites in the Ryukyu Islands. The Ryukyu Islands (fig. 1) consists of about 140 islands and a great number of reefs and cays scattered between Formosa and the southern end of Japan. They cover a total range of 8 degrees of longitude, 123° E. to 131°E., and over 7 degrees of latitude, 24°N., to 31°51' N., and are divided into six groups of islands, vis., Yaeyama-gunto, Miyako-gunto, Okinawa-gunto, Amami-gunto, Tokara-retto, and Satsunan-shoto.

In 1946, the Supreme Commander for the Allied Powers in Tokyo, Japan, set up the so-called 30°N. line, which divided the Ryukyu Archipelago. He called the islands lying south of that line the Ryukyu Islands. However, the Amami-gunto and the Tokara-retto in the higher latitude area are now under the control of the Japanese Government, whereas the remaining groups are controlled by the United States of America in accordance with the Japanese-American Peace Treaty of 1951. The area which is now called the Ryukyu Islands is exactly the same as what was known as Okinawa Prefecture under the Japanese Government prior to World War II.

This paper is concerned with the part of the Ryukyus under the control of the United States of America. However, the author's survey did not extend to every island in this area. The Miyako-gunto, as well as many other small islands, is not included in this paper as the survey in that area has not been completed yet. The author wishes to make the region of survey cover the whole Ryukyu Archipelago in the future.

Early traditions and records show that termites have existed in the Ryukyu Islands for many years. So far as the Ryukyus is concerned, the first available publication (Nawa, 1910) mentions one species, then identified by U. Nawa as *Coptotermes formosanus* Shiraki, which was obtained by T. Iwasaki, former Chief of the Meteorological Station in Ishigaki-jima. Comprehensive study on the termites of the Ryukyu Islands was mainly undertaken by U. Nawa. He identified the specimens sent by Iwasaki from Ishigaki-jima: *Kalotermea koshunensis* Shiraki; *Odontotermes formosanus* Shiraki; all from Ishigaki-jima. Other investigators have written on Japanese termites including the termites of the Ryukyu Islands. But we have as yet very little information regarding the termite fauna of the Ryukyu Islands and its economic significance.

The purpose of the present paper is to integrate the results of studies dealing with species, distribution, and economic significance of termites in the Ryukyu Islands.

This report is based mainly on the author's own observations from August, 1954 to July, 1955 and supplemented by those of Shiraki, Oshima, U. Nawa, Hozawa, et al. There are six common species, two rare species, and one doubtful species in the Ryukyu Islands, as follows:

- *1. *Kaloterms (Neoterms) koshunensis* Shiraki
- *2. *Kaloterms (Glyptoterms) fuscus* (Oshima)
- ?3. *Kaloterms (Glyptoterms) satsumensis* (Matsumura)
- #4. *Kaloterms (Glyptoterms) kotoensis* Oshima
- *5. *Leucoterms (Reticulitermes) speratus* (Kolbe)
- *6. *Coptoterms formosanus* Shiraki
- *7. *Odontoterms (Cycloterms) formosanus* (Shiraki)
- *8. *Euterms (Euterms) takasagoensis* Shiraki
- #9. *Capriterms (Capriterms) nitobei* (Shiraki)

Before proceeding further, the author wishes to thank Mr. Choso Goya, former President of the University of the Ryukyus, and Mr. Genshu Asato, President of the university for providing financial support which implemented this study. The author is also indebted to Professor S. Shimabukuro and Assistant Professor T. Takara (University of the Ryukyus) for their many helpful suggestions which contributed to launching the study, and to both Dr. Jack C. Elliott of Michigan State University and Dr. T. Shiraki for critical reading this paper.

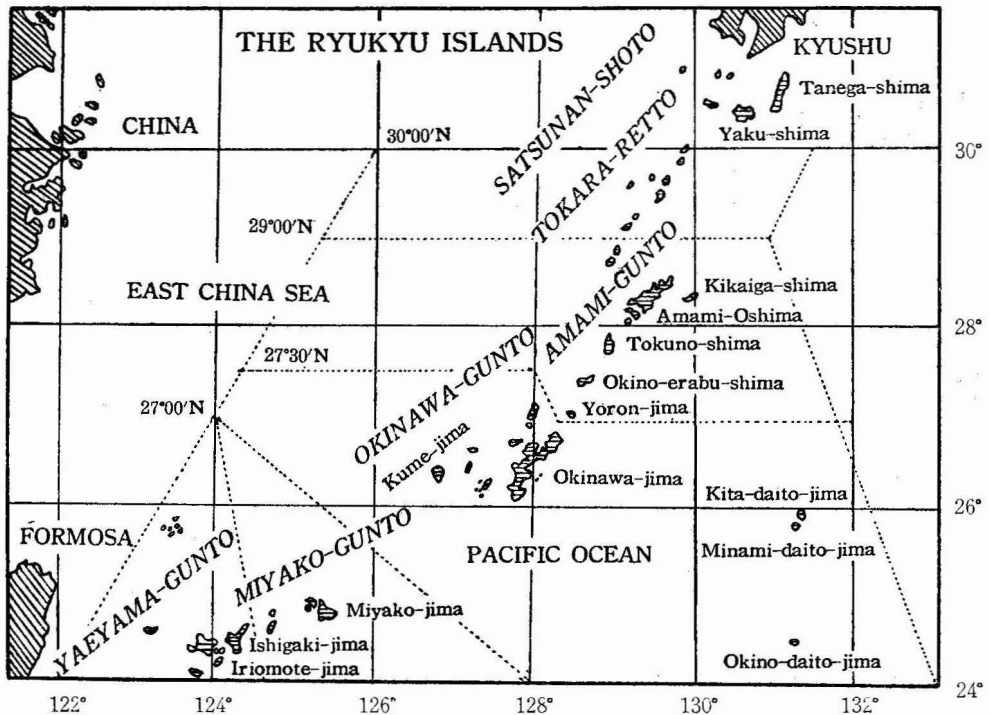


Fig. 1. A map of the Ryukyu Islands.

*.... Common species, #.... Rare species, ?.... Doubtful species.

Discussion of the Species

Order: Isoptera

Family: * *Kalotermitidae* Banks 1920

Genus: *Kalotermes* Holmgren

Subgenus: *Neotermes* Holmgren

1. *Kalotermes (Neotermes) koshunensis* Shiraki

(Fig. 2, 3)

Calotermes (Neotermes) koshunensis Holmgren, 1912, Annot. Zool. Jap., Vol. VIII, p. 114.

Calotermes (Neotermes) koshunensis Shiraki, Oshima, 1913, Philip. Journ. Sci., Sec. D, Vol. VIII, No. 4, p. 273.

Specimens examined :

U. R. Spec. No.	Caste	Locality	Collector	Date
14	N. S.	Oroku, Okinawa	Ikehara	7 Feb., '55
39	N. S.	Ibaruma, Ishigaki	Ikehara	8 Mar., '55
41	N. S.	Hirae, Ishigaki	Ikehara	11 Mar., '55
49	K. N. Q. S.	Sonai, Iriomote	Ikehara	17 Mar., '55
55	N. S.	Taketomi-jima	Ikehara	22 Mar., '55
59	A. N. S.	Nagura, Ishigaki	Ikehara	24 Mar., '55

A-Alate, K-King, N-Nymph, Q-Queen, S-Soldier.

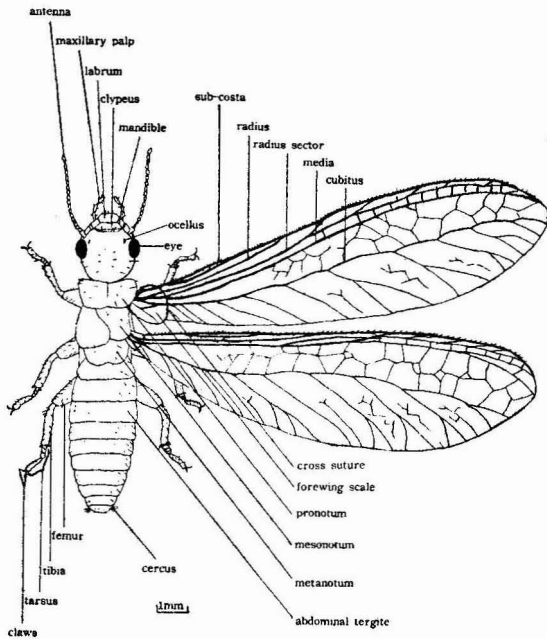


Fig. 2. Alated female of *Kalotermes koshunensis* showing structures referred to in keys.

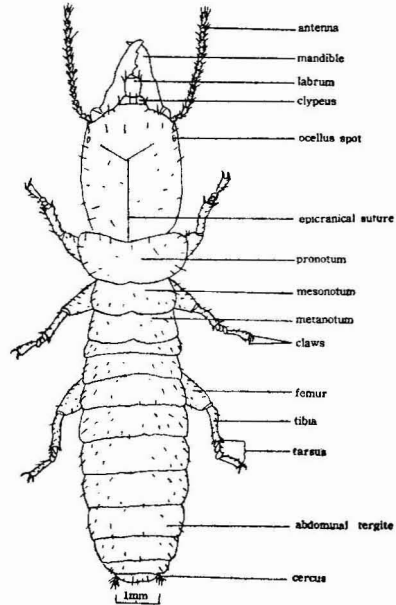


Fig. 3. Soldier of *Kalotermes koshunensis* showing structures mentioned in keys.

* In 1853 Hagen reported "*Kalotermes*" as a genus name of termite, but he changed it to "*Calotermes*" in 1858. Thus the author adopted the genus name and family name, *Kalotermes* and *Kalotermitidae* respectively.

Kaloterme koshunensis S. in the Ryukyu Islands was recorded for the first time by U. Nawa in 1911, from the specimens sent by Iwasaki in the Yaeyama-gunto. On Okinawa-jima it is a rare species, being restricted to the southern part of the island, but is one of the commonest termites in the Yaeyama-gunto. It is well known that this termite lives in an undefined nest in stumps, dead trees, etc., and its nest generally contains a small number of individuals. There is no definite permanent royal cell in the nest.

It is, apparently at present, not a species of economic importance, because it is found in dead trees, stumps, and dead branches. In the Ryukyu Islands no damage is known to be done by this termite to dwelling houses, furniture, bridges, fence poles, and other man-made structures.

Subgenus : *Glyptoterme* Holmgren

2. *Kaloterme* (*Glyptoterme*) *fuscus* (Oshima)

Glyptoterme fuscus Oshima, 1912, Dai sankai Shiroari Chosahokoku, p. 67, Pl. I, fig. 15.

Caloterme (*Glyptoterme*) *hozawae* Holmgren, 1912, Annot. Zool. Jap., Vol. VIII, Part 1, p. 118.

Caloterme (*Glyptoterme*) *fuscus* Oshima, 1913, Philip. Journ. Sci., Sec. D, Vol. VIII, No. 4, p. 274.

Specimens examined :

U. R. Spec. No.	Caste	Locality	Collector	Date
12	N. S.	Toguchi, Okinawa	Ikehara	14 Jun., '55
21	N. S.	Nakijin, Okinawa	Ikehara	19 Jun., '55
40	N. S.	Hirae, Ishigaki	Ikehara	11 Mar., '55
52	N.	Shirahama, Iriomote	Ikehara	17 Mar., '55
70	A.	Kijoka, Okinawa	Ikehara	25 Jul., '55

In 1912, U. Nawa first identified this termite in the Ryukyus, from specimens sent by Iwasaki on Ishigaki-jima. This is of wide distribution on Okinawa-jima, Iahigaki-jima, and Iriomote-jima. It lives in stumps, dead portion of trunks, fallen trees, etc., forming narrow tunnels in them instead of building a regular nest. The nest is usually found in the more protected inner, harder wood such as *Castanopsis lutchuensis*. Its relatively small colony consists of nymphs, immature nymphs, and very few soldiers.

We cannot relegate this species to the group of economically insignificant termites. The author has observed six cases of attack by this species on timbers of wooden bridges on Okinawa-jima and Ishigaki-jima. A more extensive and intensive survey of the area will, no doubt, reveal a clearer picture of the damage done by this termite.

Subgenus: *Cryptoterme* Banks

3. *Kaloterme* (*Cryptoterme*) *kotoensis* Oshima

Caloterme (*Cryptoterme*) *formosae* Holmgren, 1911, Termitenstudien II, Kgl. Svensk. Vet. Akad. Handl., Bd. XLVI, No. 6, p. 55.

Caloterme kotoensis Oshima, 1912, Dai sankai Shiroari Chosahokoku, p. 56, Pl. I, figs. 3, 17, 18, Pl. II, fig. 4.

Caloterme (*Cryptoterme*) *ogasawaraensis* Oshima, 1913, Philip. Journ. Sci., Sec. D, Vol. VIII, No. 4, p. 274, text-fig. 2.

Specimens examined :

U. R. Spec. No.	Caste	Locality	Collector	Date
3	A.	Kume-jima	Ikehara	25 Jul., '54
43	N. S.	Hirae, Ishigaki	Ikehara	11 Mar., '55
51	N. S.	Sonai, Iriomote	Ikehara	17 Mar., '55
71	E. N. Q. S.	Kiyan, Okinawa	Ikehara	5 Jun., '55

E.-Egg.

Kaloterms (*Cryptoterms*) *kotoensis* is a rather common species in the Yaeyama-gunto and the southern part of Okinawa-jima. This termite lives in the dead portion of a living trunk. It receives its moisture from the living portion. The whole colony is confined in the wood, containing a small number of individuals.

The economical significance of this termite is not known yet; it may be negligible in the Ryukyu Islands.

Subgenus: *Glyptoterms* Holmgren

4. *Kaloterms* (*Glyptoterms*) *satsumensis* (Matsumura)

Termes satsumensis, Matsumura, 1907, Konchu Bunruigaku, Vol. I, p. 53, text-fig. 43.

Glyptoterms longicephalus Oshima, 1912, Dai sankai Shiroari Chosahokoku, p. 64, text-fig. 4, Pl. I, fig. 2, Pl. II, figs. 6,26.

Caloterms (*Glyptoterms*) *satsumensis* Holmgren, 1912, Annot. Zool. Jap., Vol. VIII, Part 1, p. 116.

No specimen obtained.

It is said that Iwasaki on Ishigaki-jima had obtained this termite from Ishigaki-jima in 1913 (Konchu Sekai, Vol. XVII, p. 153, Pl. VII). But most of termite investigators have been sceptical about it. In March, 1955, the author stayed for 25 days in the Yaeyama-gunto to study termites, but no specimen was obtained in spite of the author's effort. The same is true in the Okinawa-gunto. It still requires further study.

Family: Rhinotermitidae Light 1921

Genus: *Leucoterms* Silvestri

Subgenus: *Reticulitermes* Holmgren

5. *Leucoterms* (*Reticulitermes*) *speratus* (Kolbe)

(Fig. 1)

Termes speratus Kolbe, 1885, Berl. Ent. Zeitschr., Bd. XXIX, p. 147, Pl. VI.

Termes flavipes Oshima, 1908, Dobutsu. Zassi, Vol. XX, p. 515.

Leucoterms speratus Shiraki, 1909, Nippon Konchugakkai Kaiho, Tokyo, Vol. II, Part 10, p. 230.

Leucoterms flaviceps Oshima, 1914, Dai shikai Shiroari Chosahokoku, p. 1.

Leucoterms (*Reticulitermes*) *speratus* (Kolbe), Hozawa, 1915, Journ. Coll. Sci., Tokyo Imp. Univ., Vol. XXXV, Art. 7, pp. 62-83, Pl. II, figs. 11-15, text-figs. 14-18.

Specimens examined :

U. R. Spec. No.	Caste	Locality	Collector	Date
4	N. S. W.	Kume-jima	Ikehara	25 Jun., '55
6	N. W.	Yona, Okinawa	Ikehara	24 Sep., '55
11	A. N. S. W.	Baten, Okinawa	Ikehara	24 Jan., '55
13	A. N. S. W.	Oroku, Okinawa	Ikehara	7 Feb., '55
16	A. N. S. W.	Itoman, Okinawa	Ikehara	18 Feb., '55
19	A. S. W.	Iye-jima, Okinawa	Ikehara	19 Feb., '55
20	A. S. W.	Yonamine, Okinawa	Ikehara	24 Feb., '55
25	A. N. S. W.	Oku, Okinawa	Ikehara	25 Feb., '55
29	A. S. W.	Ada, Okinawa	Ikehara	25 Feb., '55
32	A. S. N.	Aha, Okinawa	Ikehara	26 Feb., '55
34	A. W.	Takae, Okinawa	Ikehara	26 Feb., '55
35	A. W.	Kawata, Okinawa	Ikehara	27 Feb., '55
50	K. Q.	Shirahama, Iriomote	Ikehara	17 Mar., '55
57	N. S. W.	Taketomi-jima	Ikehara	22 Mar., '55
62	N. S. W.	Nakagusuku, Okinawa	Ikehara	1 May, '55
64	N. S. W.	Nishihara, Okinawa	Ikehara	1 May, '55
67	N. S. W.	Onna, Okinawa	Ikehara	8 May, '55
68	N. S. W.	Katsu-dake, Okinawa	Ikehara	14 May, '55
70	N. S. W.	Taniu-dake, Okinawa	Ikehara	21 May, '55

W-Worker.

A species of damp-wood termites, *Leucotermes speratus*, is the most widely spread species found in the Ryukyu Islands. It lives not only on level lands, but also in mountain regions, and it is commonly seen in such high places as the top of Mt. Omoto-dake(1750 ft.), the highest mountain in the Yaeyama-gunto and the Okinawa-gunto. As is well known this insect requires much moisture, and the colony, in part at least, lives in damp areas, often in decayed wood.



Fig. 4. Photograph of tree severely infested with *Leucotermes speratus* at Shoshi-utaki, Okinawa.

From the stand-point of economic importance, this termite is second to *Coptotermes formosanus* S. which will be considered later. This species mainly attacks portions of dwelling-houses and their contents, bridges, fences, etc., which are placed in contact with the earth or damp masonry exerting a damp-wick capillary action. Generally speaking, the range of its work does not exceed more than 7 feet above the surface of the ground.

Genus : *Coptotermes* Wasmann

6. *Coptotermes formosanus* Shiraki

(Fig. 5)

Coptotermes formosanus Shiraki, 1909, Nippon Konchugakkai Kaiho, Tokyo, p. 239.

Termes raffrayi Matsumura, 1910, Taiwan Kansho Gaichu-hen tsuketari Ekichu-hen, Tokyo, p. 1.

Termes (Coptotermes) gestroi Oshima, 1910, Dobutsu. Z., Vol. XX, p. 376.

Coptotermes formosæ Holmgren, 1911, Term. Ceylon, Jena, p. 192.

Specimens examined :

R. U. Spec. No.	Caste	Locality	Collector	Date
5	N. S. W.	Kume-jima	Ikehara	28 Jul., '54
8	N. S. W.	Yona, Okinawa	Ikehara	23 Sep., '54
9	N. S. W.	Hentona, Okinawa	Ikehara	23 Sep., '54
10	N. S. W.	Yonabaru, Okinawa	Ikehara	24 Jan., '55
15	N. S. W.	Oroku, Okinawa	Ikehara	7 Feb., '55
17	N. S. W.	Iye-jima	Ikehara	18 Feb., '55
18	N. S. W.	Iye-jima	Ikehara	18 Feb., '55
22	N. S. W.	Yonamine, Okinawa	Ikehara	20 Feb., '55
26	N. S. W.	Ginama, Okinawa	Ikehara	23 Feb., '55
27	N. S. W.	Oku, Okinawa	Ikehara	24 Feb., '55
30	N. S. W.	Ada, Okinawa	Ikehara	25 Feb., '55
31	N. S. W.	Aha, Okinawa	Ikehara	25 Feb., '55
33	N. S. W.	Takae, Okinawa	Ikehara	26 Feb., '55
36	N. S. W.	Kawata, Okinawa	Ikehara	27 Feb., '55
37	N. S. W.	Inoda, Ishigaki	Ikehara	8 Mar., '55
58	N. S. W.	Taketomi-jima	Ikehara	22 Mer., '55
61	N. S. W.	Omoto-dake, Ishigaki	Ikehara	24 Mar., '55
63	N. S. W.	Nakagusuku, Okinawa	Ikehara	1 May, '55
65	A. N. S. W.	Shuri, Okinawa	Ikehara	3 May, '55
72	N. S. W.	Kyan, Okinawa	Ikehara	12 May, '55

This species is one of the most widely spread and harmful termites living in the Ryukyu Islands. It seems highly probable that it exists on any small island which is large enough for human habitation. Even on top of Mt. Omoto-dake (1750 ft.), Mt. Onna-dake (1250 ft.), Mt. Katsu-dake (1443 ft.), and Mt. Taniu-dake (1230 ft.), this termite is found, though it is not common there. As is well known, *Coptotermes formosanus* is found in sandy soils much more than in heavier, less porous clayey soils. Consequently, in general, the main area of its distribution is in the coastal regions and less in the mountainous regions of the Ryukyu Islands.

Coptotermes formosanus is the most economically important species, and it would no doubt exceed any other termite in the Ryukyu Islands both in damage done and difficulty of problem presented. Therefore, in all places where investigations have been made, its damage was abundant and conspicuous in dwelling houses, school-houses, furniture, etc. (fig. 3, table I).

The literature of tropical agriculture and horticulture record numerous cases of damage done by termites to cultured plants, viz., rubber trees, teas, sugar canes, etc. Such cases as those found in tropical agriculture have been also known in the Ryukyu Islands. The most interesting case of a termite attack on sugar canes of

Iye-jima is that by *Coptotermes formosanus* which occurs in buried logs used for trenches during World War II. From these logs this termite transferred into the sugar cane.

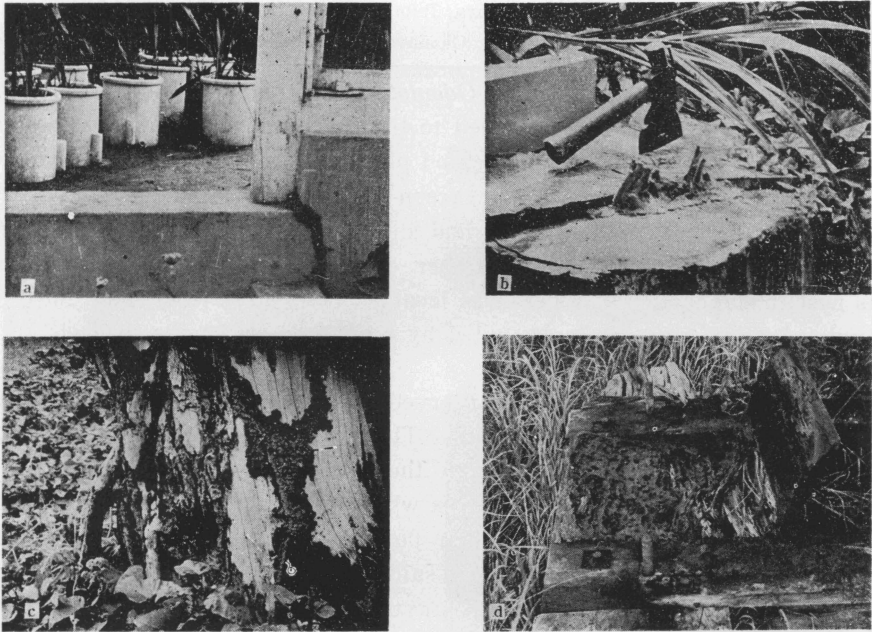


Fig. 5. Photographs showing the workings of *Coptotermes formosanus*, in the Ryukyu Islands. a. Runway from a nest in the earth, over concrete foundation to wooden frames of the green house. b, c. Stumps are infested with this termite. d. Action of this termite in the foundation-timbers of a generator left in the field.

Family: Termitidae

Genus: *Odontotermes* Holmgren

Subgenus: *Cyclotermes* Holmgren

7. *Odontotermes (Cyclotermes) formosanus* (Shiraki)

(Fig. 6)

Termes formosanus (sic) Shiraki, 1909, Nippon Konchugakkai Kaiho, Tokyo, Vol. II, Part 10, p. 234.

Termes vulgaris Shiraki, 1909, Nip. Konch. Kai., Tokyo, Vol. II, Part 10, p. 233.

Odontotermes (Cyclotermes) formosanus Holmgren, 1912, Termitenstudien III, Kgl. Svesk. Vet. Akad. Handl., Bd. XLVIII, No. 4, p. 38.

Odontotermes (Cyclotermes) formosanus (Shiraki), Hozawa, 1915, Journ. Coll Sci., Tokyo Imp. Univ., Vol. XXXV, Art. 7, pp. 105-119, Pl. III, figs. 21-23, text-figs. 26-82.

Specimens examined:

U. R. Spec. No.	Caste	Locality	Collector	Date
38	S. W.	Inoda, Ishigaki	Ikehara	8 Mar., '55
45	N. S. W.	Kainan, Ishigaki	Ikehara	12 Mar., '55
46	N. S.	Urauchi, Iriomote	Ikehara	15 Mar., '55
47	N. S.	Funaura, Iriomote	Ikehara	16 Mar., '55
67	A. N. S. W.	Shuri, Okinawa	Ikehara	18 May, '55

The typical subterranean termite, *Odontotermes formosanus*, is a common species in the Yaeyama-gunto, but it is confined to the southern part in Okinawa-jima. This termite lives in the earth and attacks wood placed in or on the earth. In the summer of 1953 when the ground work of the green-house was started on the campus of the University of the Ryukyus, the author had an opportunity to observe its nest (fig. 6b). The colony was composed of large number of individuals which constructed an ingenious nest in the earth. The nest was located about three feet below the surface of the ground. A royal cell was surrounded by many compartments in each of which a spongelike fungus bed was contained.

In May 16, 1955, the author also observed its colonizing flight on the campus of the University of the Ryukyus (fig. 6a). The swarming alates emerged in the late evening when it was raining. Although there was an electric light (40W.) at a distance of forty-three feet from the area where the winged adults were pouring out, emerging alates did not demonstrate their positive phototropism.

The damage done by this termite is said to be fairly extensive in Thailand, the Philippines, and Formosa. But in the Ryukyu Islands the damage is less as compared with that done by *Coptotermes formosanus* or *Leucotermes speratus*.

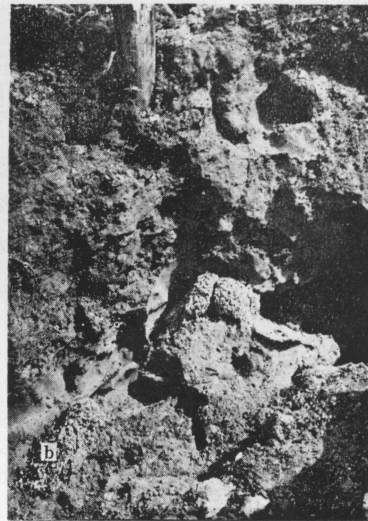


Fig. 6.a. White paper pieces show opening at the swarming of *Odontotermes formosanus*.
b. A vertical partial view of the nest of this species. Note the spongelike fungus beds in compartments.

Genus: *Eutermes* Müller

Subgenus: *Eutermes* s. st. Holmgren

8. *Eutermes (Eutermes) takasagoensis* Shiraki

(Fig. 7)

Eutermes (Eutermes) piciceps Holmgren, 1912, Termiten, III, Kgl. Svensk. Vet. Akad.

Handl., Bd. XLVIII, No. 4, p. 63.

Eutermes (Eutermes) takasagoensis Shiraki, Hozawa, 1915, Journ. Coll. Sci., Tokyo Imp. Univ., Vol. XXXV, Art. 7, pp. 120-133, Pl. VI, figs. 24-26, text-figs. 29-32.

Specimens examined:

U. R. Spec. No.	Caste	Locality	Collector	Date
42	N. S. W.	Hirae, Ishigaki	Ikehara	11 Mar., '55
44	S. Q.	Kainan, Ishigaki	Ikehara	12 Mar., '55
56	S. W.	Taketomi-jima	Ikehara	22 Mar., '55

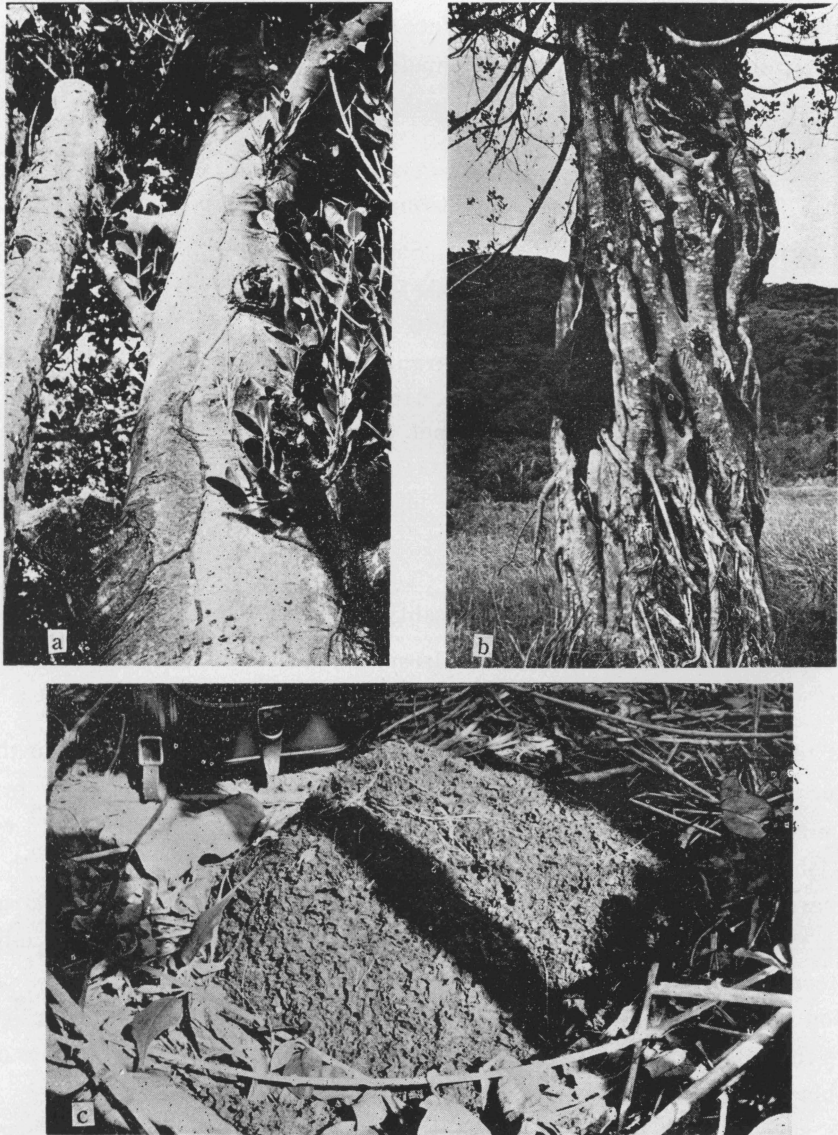


Fig. 7. Photographs of the works of *Eutermes takasagoensis* in the Yaeyama-gunto. a. Covered runways on *Garcinia spicata* Hook.f. from the nest to the earth. b. A large nest on the trunk in Iriomote-jima, 7 feet above the ground. c. A nest on a sandy-hill in Taketomi-jima, 1.5 feet in diameter.

This termite does not occur throughout the Ryukyu Islands, being restricted to the Yaeyama-gunto, where it is one of the common termites. It may be said that this termite does not like much moisture. In the Yaeyama-gunto, in fact, it occurs mainly on sandy soils or coastal regions and on hills which are well drained. It lives in forests or bushy regions where it is sunny, and attacks stumps, dead branches, dead portions of living trunks, etc.

Mostly the nest is found on a tree on which covered runways are observed from the nest to the ground (fig. 7a, b). The nest is not always located on a tree but sometimes on a stone-wall or on the surface of a sand hill where bushes grow (fig. 7c).

This termite does not damage man-made structures and there is no record of it attacking living trees or crops in the Ryukyu Islands.

Genus: *Capritermes* Wasmann

Subgenus: *Capritermes* s. st. Wasmann

9. *Capritermes (Capritermes) nitobei* (Shiraki)

Eutermes nitobei Shiraki, 1909, Nipp. Konch. K., Tokyo, Vol. II, Part 10, p. 238.

Termes (Eutermes) longicornis Oshima, 1910, Dobutsu. Z., Vol. XXII, p. 411.

Capritermes (Capritermes) watasei Holmgren, 1912, Termiten. III, Kgl. Svensk. Vet. Akad. Handl., Bd. XLVIII, No. 4, p. 116.

Capritermes sulcatus Holmgren, 1912, Annot. Zool. Jap., Vol. VIII, Part 1, p. 130.

Capritermes (Capritermes) nitobei (Shiraki), Hozawa, 1915, Journ. Coll. Sci., Tokyo Imp. Univ., Vol. XXXV, Art. 7, pp. 145-155, Pl. IV, figs. 29, 30, text-figs. 37-39.

Specimens examined:

U. R. Spec. No.	Caste	Locality	Collector	Date
48	W.	Funaura, Iriomote	Ikehara	18 Mar., '55
54	S. W.	Kabira, Ishigaki	Ikehara	20 Mar., '55

This termite is very rare in the Ryukyu Islands, and is restricted to the Yaeyama-gunto. In March, 1955, the author stayed on the Islands for 25 days in order to make a survey of the termites. During his stay he obtained 2 soldiers and 13 workers at Kabira, Ishigaki-jima. At Funaura, Iriomote-jima he obtained 7 workers of this termite, whose characters and measurements closely conform with those of *Capritermes nitobei*. Although the author has not yet collected soldiers, alates, nymphs, and other castes of this termite on Iriomote-jima, it is reasonable to assume that they occur. The discussion of this termite in the present paper mainly depends upon reports of previous investigators, because the author was able to collect this termite only twice during his entire investigation.

This species lives in or under old stumps, logs, etc. The colony is composed of a small number of individuals consisting of workers, nymphs and very few soldiers.

From the economic standpoint, this termite may be relegated to the group of economically insignificant termites in the Yaeyama-gunto.

General Discussion of Termites in the Ryukyu Islands

Here is appended a map showing the distribution of termites in the Ryukyu Islands.

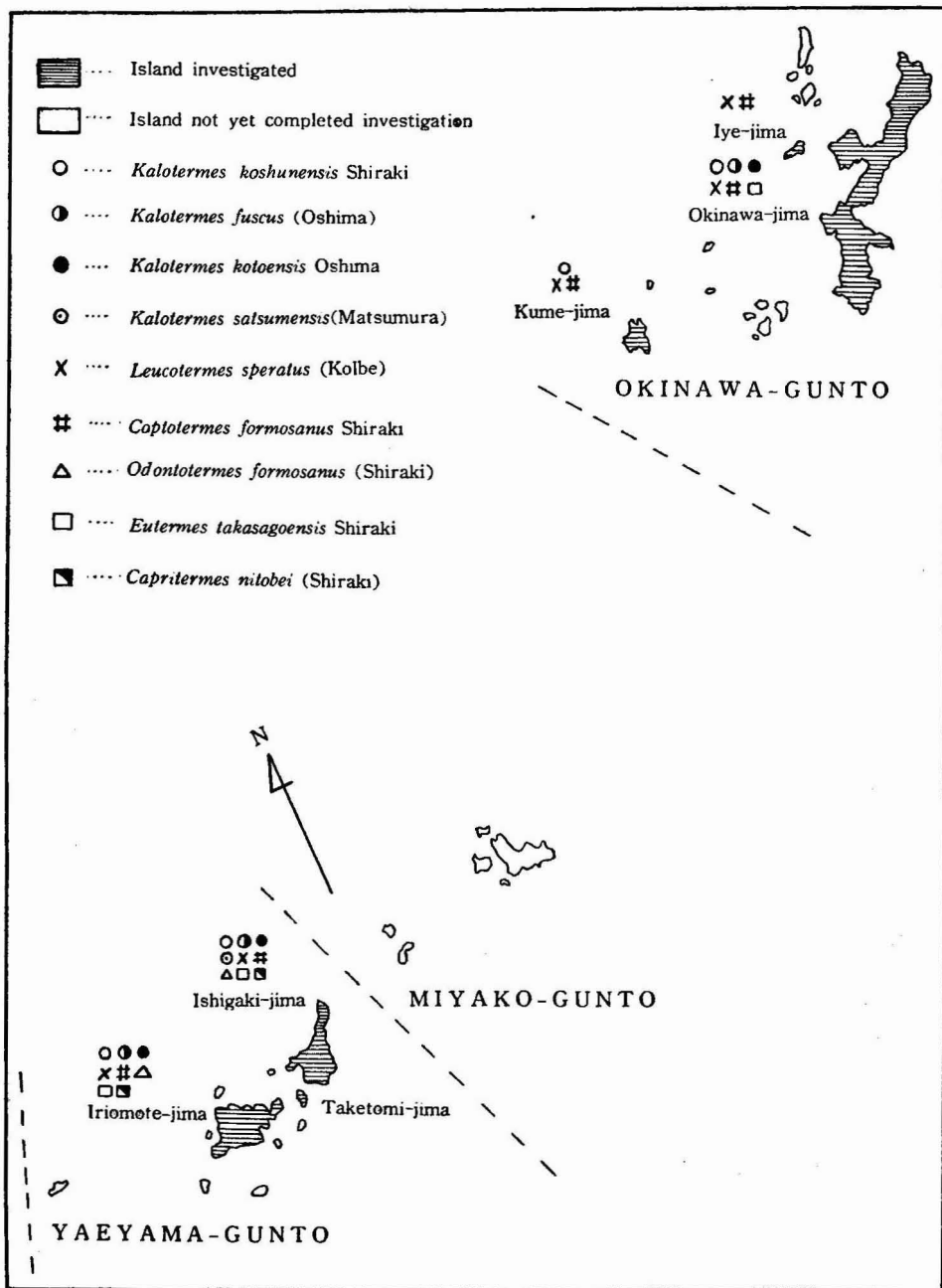


Fig. 8. A map showing the distribution of termites in the Ryukyu Islands.

In the accompanying table (table I) 964 cases of termite attacks have been classified with a view to arriving at the economic significance, though the degree of

Table 1

Classification of 964 cases of termite attacks in the Ryukyu Islands.

Species Things infested	<i>Kalotermes koshumensis</i>	<i>Kalotermes fuscus</i>	<i>Kalotermes satsumensis</i>	<i>Kalotermes kotoensis</i>	<i>Leucotermes speratus</i>	<i>Coptotermes formosanus</i>	<i>Odontotermes formosanus</i>	<i>Capritermes nitobei</i>	<i>Eutermes takasa goensis</i>	Total
Residences, School-houses, Warehouses, and their Contents										156
Wood frames	58	53	3	...	...	114
Mats	6	...	...	...	6
Books or papers	9	...	...	...	9
Shelves	3	...	...	...	3
Clothings	4	...	...	...	4
Hand looms	1	2	...	...	...	3
Tables	3	...	...	...	3
Concrete substances	3	...	...	...	3
Sweet potato	1	...	...	...	1
Others	7	3	...	...	...	10
Man-made structures in the open air										317
Bridges	6	...	...	23	9	1	...	...	39
Fence poles	1	...	...	41	22	...	...	...	64
Electric poles	19	12	...	...	...	31
Wooden stakes	34	27	...	...	...	61
Wood-mortars	1	2	...	...	...	3
Bathing tubs	1	...	...	...	1
Cartons or boxes	11	26	7	...	...	44

Species Things infested	<i>Kaloterms koshunensis</i>	<i>Kaloterms fuscus</i>	<i>Kaloterms satsumensis</i>	<i>Kaloterms kotoensis</i>	<i>Leucoterms speratus</i>	<i>Coptoterms formosanus</i>	<i>Odontoterms formosanus</i>	<i>Capriterms nitobei</i>	<i>Eutermes takosagoensis</i>	Total
Timbers .....	...	4	...	...	31	17	2	...	...	54
Coffins .....	...		...	...	4	3	1	...	...	8
Others .....	...	1	...	...	8	3	...	...	...	12
Objects in nature										472
Stumps	3	...	...	2	56	47	...	...	12	120
Logs	2	13	...	...	31	26	2	1	4	79
Fallen trees	2	6	...	...	63	39	...	1	2	113
Standing dead trees.....		2	...	...	27	43	1	...	3	76
Dead portions of living trunks	7	4	...	3	2	7	...	...	5	28
Dead branches of living trees.....	4	3	...	5	...	...	...	...	7	19
Others	1	3	...	2	16	9	2	...	4	37
Growing plants										19
Sugar cane .....	...	...	...	...	1	4	...	...	...	5
Sweet potato .....	...	...	...	...	...	2	...	...	...	2
Tea trees.....	...	...	...	...	2	...	...	...	...	2
Loquates .....	...	...	...	...	1	...	...	...	...	1
Milletts .....	...	...	...	...	...	1	...	...	...	1
Rose-trees .....	...	...	...	...	...	1	...	...	...	1
Peach-trees .....	...	...	...	...	1	2	...	...	...	3
Others .....	...	...	...	...	3	1	...	...	...	4
Total	19	43	0	12	441	391	19	2	37	964

infestation in each case has not been considered. The data used in the table have been based on the author's observation from August, 1954 to July, 1955 in the Okinawa-gunto and the Yaeyama-gunto.

According to the termite study by the author, there are five serious termite problems in the Ryukyu Islands. They are as follows:

(1) A great number of trees were cut down during World War II for the construction of trenches, and after the war for the reconstruction of dwelling houses. Also many were demolished by bombs and artillery shells. Those stumps, logs, and timbers used in trenches, or dead trees are conducive to the tremendous propagation of termites.

(2) Roofs of the dwellings which survived the war were weakened and started to leak. This condition, because of the moisture, is also conducive to termite infestation.

(3) The dwellings, which have been built since the war, are seriously damaged mainly by *Coptotermes formosanus* because of the use of unseasoned timbers and pine timbers, which are not termite resistant.

(4) In those islands where trees are scanty, such as Iye-jima, *Coptotermes formosanus* attacks sugar cane and sweet potato. In most cases the timber used for trenches serve as the base of operation for the termite.

(5) Though it has not been reported yet, the possibility of introduction of termites from Formosa, Hongkong, the Philippines, and the United States of America, is becoming greater because of the increased traffic between those countries and the Ryukyu Islands after World War II.

Key to the Species of Termites Found in the Ryukyu Islands

Alates

- 1. Small, less than 9 mm. to the tip of wings 2
- Larger, more than 10 mm. to the tip of wings 3
- 2. Media weakly chitinized, bending forward to join radius sector beyond middle ..
- *Kalotermes kotoensis* Oshima
- Media thick, unbranched, running close to radius sector .. *Kalotermes fuscus* (Oshima)
- 3. Media midway between radius sector and cubitus 4
- Media near radius sector, which have 10-14 short branches forming numerous cells
- *Kalotermes koshunensis* Shiraki
- 4. Head less than 1.05 mm. wide; eyes very slightly projecting on sides
- *Leucotermes speratus* (Kolbe)
- Head more than 1.5 mm, wide; eyes projecting on sides 5
- 5. Body more than 27 mm, long with wings; media of forewings arising from cubitus
- *Odontotermes formosanus* (Shiraki)
- Body less than 18 mm, long with wings; media of forewings not from cubitus 6
- 6. Cross suture slightly convex; wing membranes thickly covered with hairs
- *Coptotermes formosanus* Shiraki
- Cross suture straight; wing membranes with none or scanty hairs 7
- 7. Eyes very large; wings about three times as long as broad
- *Eulermes takasagoensis* Shiraki
- Eyes rather smaller; wings about four times as long as broad
- *Capritermes nitobei* (Shiraki)

Soldiers

- 1. Head short 2
- Head rectangular 4
- 2. Head black or brownish black 3
- Head yellow to yellowish brown 5
- 3. Head truncâte in front; antennae short; 4th segment shortest; pronotum much narrower than head, saddle-shaped *Eutermes formosanus* Shiraki
- Head truncate in front; antennae short; 4th segment shortest; pronotum as broad as head, anterior margin raised and broadly emarginate *Kalotermes kotoensis* Oshima
- 4. Mandibles with several coarse teeth; pronotum as wide as head 6
- Mandibles with no coarse teeth; pronotum narrower than head 7
- 5. Head with large tubular fontanel in front; mandibles with no teeth excepting base; anterior margin of pronotum wider than posterior *Coptotermes formosanus* Shiraki
- Head with no fontanel; mandibles with single coarse tooth; anterior margin of pronotum narrower than posterior *Odontotermes formosanus* (Shiraki)
- 6. Antennae with 14-16 segments, 4th segment shortest; legs short, plantula absent *Kalotermes koshunensis* Shiraki
- Antennae with 10-13 segments, 3rd segment smallest; legs slender, with plantula *Kalotermes fuscus* (Oshima)
- 7. Head yellow; mandibles normal *Leucotermes speratus* (Kolbe)
- Head yellowish brown; mandibles linear, bent *Capritermes nitobei* (Shiraki)

Summary

- 1. The total number of species occurring in the Yaeyama-gunto and the Okinawa-gunto is nine (including one doubtful species *Kalotermes satsumensis*), belonging to three families.
- 2. New records by the author concerning the distribution of termites in the Ryukyus are as follows:
 - a) *Kalotermes kotoensis*: Reported on Kume-jima.
 - b) The species occurring in Iriomote-jima, Taketomi-jima, Kume-jima, and Iye-jima are new records.
 - c) It is ascertained that the existence of *Kalotermes satsumensis* still remains problematical.
- 3. From the standpoint of economic significance, *Coptotermes formosanus* is placed first, *Leucotermes speratus*, second, *Kalotermes fuscus* and *Odontotermes formosanus* rank third, the rest are of minor importance.
- 4. The stumps, logs, dead trees which increased during and after the war are advantageous for the multiplication of termites.

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